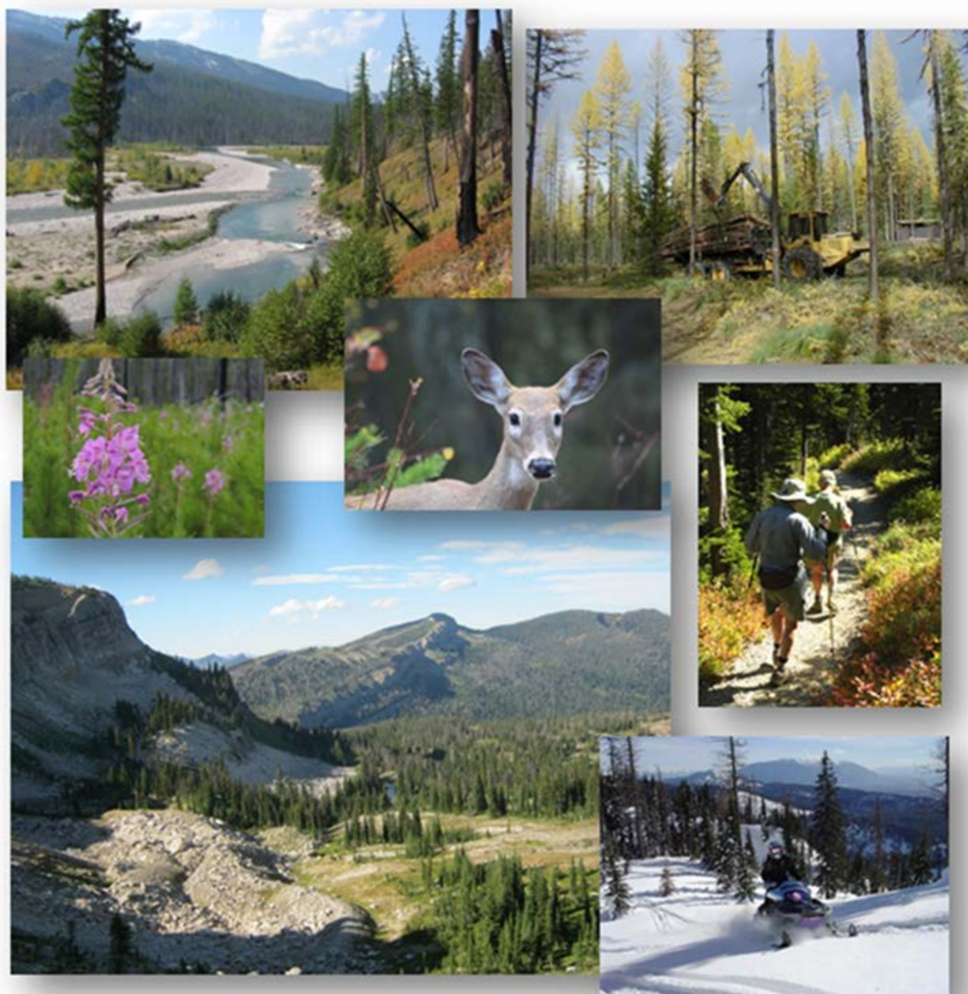
Department of Agriculture

Volume 1—Wildlife Section 3.7 of the Final Environmental Impact Statement for the Forest Plan

Flathead National Forest



Forest Service **Northern Region** **December 2017**

"… for the greatest good of the greatest number for the longest time." Gifford Pinchot, founding chief of the Forest Service, 1905

Flathead National Forest photo captions (clockwise from upper left):

- South Fork of the Flathead River, Spotted Bear Ranger District
- Forwarder working on the Paint Emery Resource Management Project, Hungry Horse–Glacier View Ranger District
- Two hikers
- Snowmobiler
- View from trail to Pentagon Cabin in the Bob Marshall Wilderness (photo by Peter Borgesen)
- Fireweed
- White-tailed deer (photo by John Littlefield)

Volume 1: Chapter 3, Wildlife section 3.7

Final Environmental Impact Statement for the Forest Plan

Flathead National Forest

Lead agency:	USDA Forest Service
Responsible official:	Chip Weber, Forest Supervisor Flathead National Forest 650 Wolfpack Way Kalispell, MT 59901 406-758-5204
For information, contact:	Joe Krueger, Forest Plan Revision Planning Team Lead Flathead National Forest 650 Wolfpack Way Kalispell, MT 59901 406-758-5243

Abstract: This is wildlife section 3.7 of chapter 3, volume 1 of the final environmental impact statement (EIS) that documents the analysis of four alternatives developed for programmatic management of the 2.4 million acres administered by the Flathead National Forest. The Forest Service has identified alternative B modified as the preferred alternative. The Flathead National Forest encompasses 2.4 million acres in Flathead, Lake, Lewis and Clark, Lincoln, Missoula, and Powell Counties, Montana.

The Forest Service is concurrently amending the forest plans of the Helena-Lewis and Clark, Kootenai, and Lolo National Forests (referred to as the “amendment forests”) to incorporate habitat management direction for the Northern Continental Divide Ecosystem (NCDE) grizzly bear population (refer to volume 3 of the final EIS for the evaluation of effects of the amendments).

Table of Contents

List of Tables

List of Figures

NOTE: The figures listed below are found in the text of the document. When figure numbers referenced in the document are preceded by 1-, e.g., figure 1-01, this indicates they are located in appendix 1 of this final EIS, and if preceded by B-, e.g., B-01, they are in appendix B of the forest plan.

Terms and Abbreviations

Term	Full name
1986 forest plan	Flathead National Forest Land and Resource Management Plan (1986)
2012 planning rule	National Forest System land management planning rule (effective 2012)
assessment	assessment of the Flathead National Forest
amendment forests	collective term for the Helena-Lewis and Clark, Kootenai, and Lolo National Forests
draft Grizzly Bear Conservation Strategy	Draft NCDE Grizzly Bear Conservation Strategy (USFWS, 2013)
the Forest	Flathead National Forest
forest plan	Flathead National Forest Revised Land Management Plan (2017 revision)
Northern Region	USDA Forest Service Northern Region (also known as Region 1)

List of Abbreviations

CFR	Code of Federal Regulations
d.b.h.	diameter at breast height
DC	desired condition (forest plan component)
DCA	demographic connectivity area
EIS	environmental impact statement
FW	forestwide (forest plan component)
GA	geographic area
GDL	Guideline (forest plan component)
GIS	geographic information system
INFISH	Inland Native Fish Strategy
MA	management area
mi	mile
mmbf	million board feet
mmcf	million cubic feet
MFWP	Montana Fish Wildlife and Parks
NCDE	Northern Continental Divide Ecosystem
NEPA	National Environmental Policy Act
NFS	National Forest System
NRLMD	Northern Rockies Lynx Management Direction
PACFISH	Pacific Fish Strategy
PCA	primary conservation area
PIBO	PACFISH/INFISH Biological Opinion
STD	standard (forest plan component)
TMDL	total maximum daily load
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service

3.7 Wildlife

3.7.1 Introduction

In 2006, a national study was completed that looked at the relationship between fish and wildlife conservation and economic prosperity in Montana. This study (sponsored by the U.S. Fish and Wildlife Service and the U.S. Census Bureau) highlighted the importance of wildlife-related activities to residents of Montana as well as those visiting the state. The percentage of Montana's population participating in wildlife-related activities (hunting, fishing, wildlife viewing) was substantially higher than that for the nation as a whole or for the Rocky Mountain region of the West. Wildlife viewing was one of the top four activities for Forest visitors in 2015, and in Montana the hunting, fishing, and wildlife-viewing economy is estimated to total over $1.2 billion in direct annual expenditures (see sections 3.10 and 3.27 for more details).

The wildlife sections of the final EIS address consequences of implementing alternative A (the 1986 forest plan, as amended) compared to three action alternatives. The forest plan must include plan components to maintain or restore (1) key characteristics associated with terrestrial and aquatic ecosystem types, (2) rare aquatic and terrestrial plant and animal communities, and (3) the diversity of native tree species similar to that existing in the plan area (36 CFR § 219.9(a)(2)). The forest plan must also address the 2012 planning rule requirements for ecosystem integrity by including management direction (plan components, including standards or guidelines) to maintain or restore the ecological integrity of terrestrial and aquatic ecosystems and watersheds in the plan area. Doing so includes plan components to maintain or restore the ecosystems' structure, function, composition, and connectivity (36 CFR § 219.9(a)(1)); Forest Service Handbook 1909.12 chap. 20 sec. 23.11-23.11d). The Flathead National Forest assessment (USDA, 2014b), the forest plan, the final EIS, and the planning record exhibits document how these requirements have been met. For a list of species known to occur on the Flathead National Forest and their association with key ecosystems and ecosystem characteristics, see appendix 6 (Coleman & Kuennen, 2013; MFWP, 2016b; MHP-MTFWP, 2013; MNHP, 2010, 2013a).

Organization of the wildlife analysis

Section 3.7.4 is organized by key ecosystems and ecosystem characteristics that provide habitat for associated animal species (see also appendix 6). Each individual section begins with an analysis of coarse-filter plan components and consequences to most species and is followed by sections on specific species. The species listed in table 45 are not federally listed by the USFWS but are included in section 3.7.4 to address public comments and to help display the effects of alternatives (USDA, 2011b). Section 3.7.5 addresses species that currently have threatened, endangered, proposed, or candidate status under the Endangered Species Act (USFWS, 2017e) and their designated critical habitat. This final EIS is also evaluating the effects of alternatives for other national forests in the Northern Continental Divide Ecosystem with respect to plan components for the grizzly bear (including cumulative consequences to the grizzly bear; see chapter 6). Plan components in the forest plan do not rely upon the particular status of a species.

Some species are species of conservation concern under the 2012 planning rule. This is a species, other than a federally listed threatened, endangered, proposed, or candidate species, that is known to occur in the plan area and for which the regional forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long term in the plan area (36 CFR § 219.9; 77 FR 21169). More information about the USDA Forest Service Northern Region (hereafter "Northern Region") species of conservation concern selection process and the rationale for selecting or not selecting species for the Flathead National Forest can be found on this Web site: http://bit.ly/NorthernRegion-SCC.

Table 45. Key wildlife species, not federally listed, included in the analysis and section containing the analysis.

Species' Common Name	Species' Scientific Name	Section
Bald eagle Beaver Black swift (2017 regional forester species of conservation concern) Boreal (Western) toad Common loon Harlequin duck Northern bog lemming	*Haliaeetus leucocephalus* *Castor canadensis* *Cypseloides niger* *Bufo boreas* *Gavia immer* *Histrionicus histrionicus* *Synaptomys borealis*	Wildlife Diversity—Aquatic, wetland, and riparian habitats
Mountain goat Peregrine falcon Townsend's big-eared bat	*Oreamnos americanus* *Falco peregrinus* *Corynorhinus townsendii*	Wildlife Diversity—Cliff, cave, scree, and rock habitats
Clark's nutcracker (2017 regional forester species of conservation concern) Elk Flammulated owl (2017 regional forester species of conservation concern) Gray wolf Marten Moose Mule deer Northern goshawk White-tailed deer	*Nucifrage Columbiana* *Cervus canadensis* *Psiloscops* [formerly *Otus*] *flammeolus* *Canis lupus* *Martes spp.* *Alces americanus* *Odocoileus hemionus* *Accipiter gentilis* *Odocoileus virginianus*	Wildlife Diversity—Coniferous forest habitats
Fisher Pileated woodpecker	*Pekania* [formerly *Martes*] *pennanti* *Drycopus pileatus*	Wildlife Diversity—Old-growth forest, very large live tree habitat, and very large dead tree habitat
Black-backed woodpecker Olive-sided flycatcher	*Picoides arcticus* *Contopus cooperi*	Wildlife Diversity—Burned forest and dead tree habitat

Table 46. Wildlife species on the Flathead National Forest that were federally listed as of August 04, 2017

Species Common Name	Species Scientific Name	Status
Grizzly bear	*Ursus arctos horribilis*	Threatened
Canada lynx	*Lynx canadensis*	Threatened; critical habitat designated
North American wolverine	*Gulo gulo luscus*	Proposed

Wildlife habitat connectivity is summarized in section 3.7.6 and is addressed throughout the wildlife sections of the final EIS. Section 3.7.7 provides a summary of key consequences to wildlife from forest plan components associated with other resource programs or management activities, section 3.7.8 addresses terrestrial invertebrates, and section 3.7.9 addresses pollinators (see section 3.2.9 for effects to aquatic species, including invertebrates).

The information in this document on species life history and habitat provides the context for key ecosystem characteristics, ecological conditions, the capability of lands on the Forest, plan components, and key indicators of the consequences of alternatives. The Forest's planning team biologist considered the many stressors that may affect species and their habitats on and off the plan area and assessed the key stressors most relevant to the Flathead National Forest. The indicators used to focus the analysis and disclose relevant environmental consequences were developed after considering key stressors, public comments, and issues identified during scoping.

Stressors can be activities that have occurred in the past; they may not be occurring presently, nor are they necessarily expected to occur in the future. Stressors may affect a species and/or its habitat if not managed or mitigated. Some activities or processes can function as both drivers and stressors of ecosystem change, depending upon their timing or magnitude. What is a driver for one species may be a stressor for another. Stressors that are not entirely within Forest Service control include those activities that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. These stressors are considered in this final EIS's sections on cumulative consequences. Changing climate is addressed in the 'Affected environment" sections of the analysis because it is ongoing and is part of the baseline condition. The analysis of consequences of alternatives also considers anticipated effects of climate changes in the future, including potential cumulative effects.

3.7.2 Regulatory framework

The following is the key set of statutory authorities that affect wildlife management on NFS lands. They are briefly identified and described below to provide context to management and the final EIS evaluation of the wildlife resource. Many other laws, regulations, executive orders, and policies not described below also guide the management of this resource.

Hellgate Treaty of 1855: The Confederated Salish and Kootenai Tribes of Montana, which includes the Kootenai, the Bitterroot Salish, and the Pend d'Oreille Salish peoples, have reserved treaty rights in the plan area under the Hellgate Treaty of 1855. These treaty rights include hunting, gathering, and grazing rights on Federal lands within the plan area.

Migratory Bird Treaty Act of 1918: Prohibits unauthorized take of migratory birds, as defined through subsequent regulations. Executive Order 13186 (66 FR 3853) and memoranda of understanding (USDA-USFWS, 2008, 2016) outline the responsibilities of Federal agencies to protect migratory birds in furtherance of the purposes of the Migratory Bird Treaty Act.

Bald and Golden Eagle Protection Act of 1940: Prohibits unauthorized take of bald and golden eagles, as defined through subsequent regulations.

Use of Off-Road Vehicles, 1972 (Executive Order 11644, as amended by Executive Order 11989): This executive order addresses the use of off-road vehicles on public lands. It requires the Forest Service to "establish polices and provide for procedures that will ensure that the use of off-road vehicles on public lands will be controlled and directed so as to protect the resources of those lands, to promote the safety of all users of those lands, and to minimize conflicts among the various uses of those lands" (section 1). The executive order directs agencies to designate the "specific areas and trails on public lands on which the use of off-road vehicles may be permitted, and areas in which the use of off-road vehicles may not be permitted" (section 3). The minimization criteria are identified in the final rule for Travel Management; Designated Routes and Areas for Motor Vehicle Use (commonly referred to as the 2005 Travel Management Rule), which implements provisions of Executive Orders 11644 and 11989 regarding off-road use of motor vehicles on Federal lands. Regulations implementing this rule are found at 36 CFR § 212. The portion of the rule pertaining to motor vehicle use is subpart B; the portion of the rule pertaining to motorized over-snow vehicle use is subpart C, which was updated in January 2015. The "minimization criteria" referenced in the 2015 circuit court opinion and district court order are in 36 CFR § 212.55(b), where specific criteria for designation of trails and areas relevant to wildlife specify that "in designating National Forest System trails and areas on National Forest System lands, the responsible official shall consider effects on the following with the objective of minimizing . . . (2) Harassment of wildlife and significant disruption of wildlife habitats." The Forest designates specific areas and trails for the use of motor vehicles (which includes off-road vehicles), which are displayed on the Forest's motor vehicle use maps as required by 36 CFR § 212 subpart B. The Forest also has completed subpart C through amendment 24 to the 1986 forest plan, and that is displayed in the motorized over-snow vehicle use map as required by 36 CFR § 212 subpart C.

Endangered Species Act of 1973, as amended: Provides requirements for Federal agencies with regard to species listed as threatened, endangered, or candidate under the act.

Sikes Act of 1974, as amended: The Sikes Act directs the Secretaries of Interior and Agriculture to cooperate with the States in developing comprehensive plans to plan, maintain, and coordinate the conservation and rehabilitation of wildlife, fish, and game, including but not limited to protection of species considered threatened or endangered pursuant to section 4 of the Endangered Species Act (16 USC 1533) or considered to be threatened, rare, or endangered by the State agency.

National Forest Management Act of 1976: This act states that the Secretary shall "promulgate regulations," under the principles of the Multiple-Use Sustained-Yield Act of 1960, to "provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives, and within the multiple-use objectives of a land management plan adopted pursuant to this section, provide, where appropriate to the degree practicable, for steps to be taken to preserve the diversity of tree species similar to that existing in the region controlled by the Plan" (Pub. L. 94-588, Sec. 5 (g)(3)(B)). The 2012 planning rule was determined to be consistent with this act (77 FR 21162).

2001 Roadless Area Conservation Rule: The 2001 Roadless Area Conservation Rule (36 CFR § 294 subpart B; 66 FR 3244-3273) includes a prohibition on road construction and road reconstruction in inventoried roadless areas and prohibits timber cutting, sale, or removal except in certain circumstances.

2012 planning rule: Relative to wildlife species, the rule directs the Forest to consider (1) habitat conditions, subject to the requirements of 36 CFR § 219.9, for at-risk species; (2) habitat conditions, subject to the requirements of § 219.9, for wildlife, fish, and plants commonly enjoyed and used by the public for hunting, fishing, trapping, gathering, observing, subsistence, and other activities in collaboration with federally recognized Tribes, Alaska Native Corporations, other Federal agencies, and State and local governments (§ 219.10 (a)(5)); (3) dominant ecological processes, disturbance regimes, and stressors such as natural succession, wildland fire, invasive species, and climate change; (4) the ability of the terrestrial and aquatic ecosystems on the plan area to adapt to change (§ 219.8)); (5) habitat/habitat connectivity; and (6) riparian areas (§ 219.10 (a)(1))

The 2012 planning rule requires that forest plans use a complementary ecosystem- and species-specific approach. The responsible official determines whether or not the plan components provide the ecological conditions necessary to contribute to the recovery of federally listed threatened and endangered species; conserve proposed and candidate species; and provide ecological conditions to maintain a viable population of each species of conservation concern within the plan area. If the responsible official determines that the ecosystem plan components are insufficient to provide such ecological conditions, then additional species-specific plan components, including standards or guidelines, must be included in the plan to provide such ecological conditions in the plan area (36 CFR § 219.9 (b)(1)). If the responsible official finds that it is beyond the authority of the Forest Service or not within the inherent capability of the plan area to maintain or restore the ecological conditions to maintain a viable population of a species of conservation concern in the plan area, then the responsible official must show that the plan includes plan components, including standards or guidelines, to maintain or restore ecological conditions within the plan area to contribute to maintaining a viable population of the species within its range.

3.7.3 Methodology and analysis process

In developing the plan components and the EIS, the Forest sought information on local wildlife populations and habitat factors (including presence, abundance, distribution, stressors, trends in habitat, and responses to management) throughout the planning process. The process included

- identification of key ecosystems and their characteristics including composition, structure, function, and connectivity. As stated in the 2012 planning rule directives, key ecosystem characteristics may be added or modified during the planning phase (Forest Service Handbook 1909.12.13);
- an assessment of possible system drivers and stressors (36 CFR § 219.6(b)(3)) and their influences on key ecosystem characteristics ((USDA, 2014b);
- an assessment of the natural range of variation for selected key ecosystem characteristics (or a suitable alternative) for establishing a context for whether ecosystems on the Forest are functioning properly (Forest Service Handbook 1909.12.14a, 1909.12.14b); and
- an assessment of the status of the ecosystem based on projected trends of key ecosystem characteristics after considering the current plan and influence of climate changes (Forest Service Handbook 1909.12.14c).

See the final EIS and appendices for documentation of the process. During the planning process, ecosystems and key ecosystem characteristic were evaluated and determinations were made regarding whether associated wildlife species needs were met by the emerging plan components, considering known locations of species and their habitats, potential habitats, and key drivers and stressors. In addition to coarse-filter plan components, species-specific plan components were then considered. The alternatives are built on the principle that by restoring and maintaining the key characteristics, conditions, and functionality of native ecological systems and managing for additional needs of key species, the Forest will be able to

- maintain or improve ecosystem diversity and integrity,
- provide for the habitat needs of diverse plant and animal species on the Forest,
- provide for ecological conditions that maintain or contribute to the persistence of native species, and
- provide for the social and economic benefits derived from observing, hunting, and trapping wildlife.

The planning team biologist obtained species information from the Montana Natural Heritage Program and also obtained the most recent list of threatened, endangered, and candidate species from the USFWS (www.fws.gov/montanafieldoffice/Endangered_Species/Listed_Species/Forests/Flathead_sp_list.pdf). To evaluate ecological sustainability, the Forest identified key ecosystems and ecosystem characteristics (see sections 3.2, 3.3, 3.5, 3.6 for more details). The public, Montana Fish, Wildlife and Parks (MFWP), and members of the Confederated Salish and Kootenai Tribes participated in the planning process (Camel-Means, 2016). The planning team biologist also coordinated with adjacent national forests (Helena-Lewis and Clark, Kootenai, Lolo) and the regional ecologist (see 77 Federal Register 21175). Many of the individuals consulted have several decades of accumulated expertise on the species and habitats of all lands in northwest Montana (see 36 CFR § 219.9 (b)(2)(ii)). The Northern Region's regional forester provided an updated list of species of conservation concern in 2017. See the Northern Region's website for information regarding the process used to identify species of conservation concern (http://bit.ly/NorthernRegion-SCC).

Spatial and temporal analysis

In general, the analysis area for indirect effects to most wildlife species is NFS lands within the Flathead National Forest (see figure 1). The cumulative effects analysis area for most species is also the Forest, but this includes all lands within the geographic area boundaries (see figure 2). Because the grizzly bear and wolverine are particularly wide-ranging species, the cumulative effects analysis area for these species is the area identified as the Northern Continental Divide Ecosystem (see figure 1-70). The cumulative analysis area for Canada lynx is critical habitat unit 3 (see figure 1-51; biological assessment figure B-14), which encompasses the area delineated by Squires and others (2013) as the occupied range of lynx in the northern Rocky Mountains. Areas selected for analysis of cumulative effects are large enough to include the consequences of activities on all lands but not large enough to obscure effects.

The anticipated life of the forest plan is about 15 years. However, because management actions have the potential to affect wildlife species and their habitats for many decades, the temporal analysis for modeled vegetation change and cumulative effects discusses changes that may occur over the next 50 years as conditions change and vegetation moves from one successional stage to another.

Information sources

A thorough review of the scientific information was completed, and the best available scientific information was used to inform the planning process and develop plan components. Key information on the population, life history, and status of animal species on the Forest was obtained from the Montana Field Guide (http://fieldguide.mt.gov) as well as other sources listed in the references section of this document. Part 219.3 of the 2012 planning rule requires the responsible official to use the best available science and, in so doing, determine what is most accurate, reliable, and relevant. For the best available scientific information, the Forest used available peer-reviewed articles and data in which reliable statistical or other scientific methods were used to establish the accuracy or uncertainty of any findings (Forest Service Handbook 1909.12 Zero Code 07.12). For best relevance, the Forest used studies conducted in western Montana or western North America in habitat conditions similar to those that occur in the plan area, if available. If these were not available, we selected articles that considered ecological processes or conditions relevant to the analysis area. The Forest attempted to avoid professional opinion or publications that have not been peer-reviewed when peer-reviewed information was available. However, in accordance with section 07.13 of the 2012 planning rule directives on sources of scientific information, scientific information that may be considered the best available scientific information may include expert opinions, panel consensuses, inventories, or observational data prepared and managed by the Forest Service, other Federal agencies, universities, national research networks, other reputable scientific organizations, and data from public and governmental participation. This information may include monitoring results, information in spatially referenced databases, data about the lands and resources of the planning unit, and various types of statistical or observational data. This final EIS provides extensive review of and references to peer-reviewed scientific literature that documents the status, habitat relationships, and responses to management activities of wildlife species and their habitats. In some cases, there is opposing, incomplete, or unavailable scientific information about a species or its habitat. This was also considered, in accordance with requirements of the National Environmental Policy Act. Data and information gaps exist, but the breadth and depth of the available scientific information are sufficient to determine the key stressors and plan components to address those key stressors.

Use of models, maps, and data

The Forest relied on a variety of databases (e.g., those from state agencies, Rocky Mountain Research Station, the agency's own internal databases) to support the development of plan components and assess the consequences of alternatives to wildlife. The Forest's map-based information is stored in a GIS database maintained by the Forest's GIS specialists.

Current technology, budgets, and the remoteness of much of the Forest may limit the ability to accurately detect or map all key ecosystem characteristics at the forestwide scale. For example, Forest Inventory and Analysis data sets are statistically accurate but were not intended to provide spatial information. As a result, Forest Inventory and Analysis data can be used to estimate the amount of old growth at a forestwide scale, but field inventories are necessary to accurately determine the location of old growth, its patch size, its connectivity, and other characteristics associated with its quality (see section 3.3 of the final EIS for more details). VMap data sets provide remotely sensed spatial information on vegetation, but the Forest's VMap database does not provide characteristics such as snag density or the density of shrubs and small trees in the understory that are important to some wildlife species. The available data is sufficient for programmatic planning and analysis of the forest plan, but more detailed information is gathered during field inventories conducted for implementation of projects.

Models were used to assess key ecosystems and key ecosystem characteristics and their natural range of variation, if available. The natural range of variation has been modeled at large scales, such as the Columbia River Basin, to smaller scales. For a discussion of the Columbia River Basin modeling, see the Forest assessment (USDA, 2014b). For the Forest's plan revision, the natural range of variation for vegetation composition, size class, canopy cover, density, pattern, patch size, and patch distribution were modeled for vegetation (see final EIS section 3.3 and appendix 2). Vegetation model outputs were then used to model habitat for key wildlife species (see final EIS appendix 3 and final EIS species sections for more details on habitat modeling).

The natural range of variation reflects the ecosystem conditions that have sustained the current complement of wildlife and plant species on the Forest and provides context for understanding the natural diversity of ecosystems and processes (such as wildfire, insects and disease, and plant succession). The natural range of variation, current condition, future trends, and effects of alternatives for vegetation were estimated using the SIMPPLE and Spectrum models, which use VMap and Forest Inventory and Analysis data sets for inputs and calibration of the models. Out of necessity, the models simplify a very complex and dynamic relationship between ecosystem processes and vegetation over time and space (see appendix 2 for more details). Ecosystem Research Group interpreted vegetation model outputs to estimate the natural range of variation and current and potential future habitat for a select set of wildlife species over the next 50 years. Although model outputs show future trends over the next 50 years, there is uncertainty regarding the timing and magnitude of trends due to the uncertainty associated with the models.

Due to the natural range of variation in the northern Rocky Mountains, fluctuations in wildlife populations and their distribution are normal. Fluctuations may occur due to changes in habitat, but fluctuations may occur even when there has not been a noticeable change in habitat. These fluctuations may be due to factors such as interspecies competition, disease, hunter or trapper harvesting, effects of weather or climate, and other factors. In addition, for migratory species a change in population may not reflect a change in local habitat conditions. Many species found on the Forest migrate and are influenced by activities or conditions that occur elsewhere in the United States or even in other countries. For example, there are 71 species of neo-tropical migratory birds on the Forest (Dan Casey, Bissell, & Batts, 2016; Kuennen, 2016; C. M. White et al., 2015). Although it is possible to assess the effects of alternatives on the key ecosystems and ecosystem characteristics they are associated with during the breeding season, activities or conditions where they winter may not be known, which may affect biologists' ability to draw conclusions about population trends or cause-and-effect relationships.

Multiple connectivity models have been created for many different species, using a variety of methods. As noted by McClure and others (2016), "Additional comparative tests are needed to better understand how relative model performance may vary across species, movement processes, and landscapes, and what this means for effective connectivity conservation" (p. 1419). Ecosystem Research Group interpreted vegetation model outputs to estimate connectivity of vegetative cover for wildlife in key connectivity areas over the next 50 years (see appendix 3 for more details). This was one of many aspects of connectivity considered in the development of plan components and analysis of effects. For more details on wildlife connectivity and use of connectivity models, see section 3.7.6 and Kuennen (2017b).

Downscaled climate models are used to predict the effects of a changing climate. For this final EIS, the Forest used a compilation of climate change effects published for the Northern Region Adaptation Partnership (Halofsky et al., in press) that summarizes climate change projections by subregions (see final EIS figure 1-05 and section 3.1.1). McKelvey and Buotte (in press) provide a summary of modeled climate change effects on wildlife in the northern Rocky Mountains.

In summary, there is uncertainty with all models, including models of the natural range of variation that occurred in the past as well as the changes predicted to occur in the future. In addition, models, maps of habitat, and numeric estimates of habitat or species populations may change over time as technology changes or as on-the-ground inventories are conducted. Inventories, models, maps and data may be updated for the implementation of projects.

Assumptions

The forest plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carry out a project or activity (including ground-disturbing actions). As a result, it does not result in direct effects to wildlife but may result in indirect or cumulative environmental consequences from managing the Forest under this programmatic framework; these consequences are assessed in this final EIS.

Before ground-disturbing actions take place, they must first be authorized in a site-specific environmental analysis. Therefore, none of the alternatives would cause unavoidable adverse impacts or an irreversible or irretrievable commitment of resources.

The forest plan's desired conditions, objectives, standards, guidelines, management area allocations, and suitability will be followed when planning or implementing new site-specific projects and activities.

Laws, regulations, and policy regulations will be followed when planning or implementing new site-specific projects and activities.

Terms and conditions and reasonable and prudent measures resulting from USFWS consultation on the programmatic framework of the forest plan will be followed when planning or implementing new site-specific projects and activities, unless modified by site-specific consultation.

Models of future conditions or consequences are probabilistic and show predicted changes given a particular set of assumptions, as discussed in detail in this final EIS.

Notable changes between the assessment, draft EIS, and final EIS

The analysis of species and their status, existing conditions, and trends contained in the assessment of the Flathead National Forest (USDA, 2014b) is updated in the "Affected environment" sections of this final EIS and in the planning record. In the Forest's assessment, the Terrestrial Ecosystem and Aquatic Ecosystem sections reported on conditions for specific wildlife species using the following three categories: (1) threatened, endangered, proposed, and candidate species; (2) potential species of conservation concern; and (3) key species of public interest. Because the planning process occurred over a time period of a few years, the status of species and use of these categories has evolved for a variety of reasons. The assessment was based upon draft planning rule directives and, since the assessment was published, the USFS has published final directives. Species of conservation concern and supporting information for their selection have been updated by the regional forester based upon the final directives (see http://bit.ly/NorthernRegion-SCC). The best available scientific information, models, and model outputs have been further evaluated and/or updated.

Because the Forest initiated its revision prior to the final planning rule directives, as set forth in Forest Service Manual 1920.3 policy paragraph 9b, the responsible official was not required to revise past steps, such as the assessment or its appendices, when the final direction of January 30, 2015, was approved by the deputy chief of the Forest Service.

Changes were made between the draft and the final EIS in order to respond to public comments, improve organization or clarity, and consider opposing science, updates in science, and/or information submitted as best available scientific information. Key changes for wildlife include:

- updating, clarifying, and reorganizing plan components and sections of text in the final EIS;
- updating existing or baseline conditions for data, such as motorized access density or acres burned by wildfires (if available);
- moving plan components for Canada lynx to appendix A of the forest plan, clarifying and expanding upon the Canada lynx critical habitat analysis, and refining forest-specific plan components and estimates of acres that may be treated using exceptions or exemptions to the vegetation standards for Canada lynx, based upon additional GIS analysis;
- clarifying plan components for the grizzly bear and expanding upon the grizzly bear analysis;
- adding section 3.7.6, which summarizes the effects of plan components on habitat connectivity (a detailed discussion of connectivity related to individual ecosystems or species is still included in sections 3.7.4 and 3.7.5);
- changing the subtitles of the native plant and animal species section of the forest plan and the wildlife plan components from "Wildlife currently designated as species of conservation concern" (plan component identifier: SCC) or "Species of interest" (SOI) to "wildlife diversity" (DIV);
- moving the wolverine analysis and its species-specific plan components to the threatened, endangered, proposed, and candidate species section (3.7.5) based upon its current status;
- consolidating elk, deer, and moose in one subsection of section 3.7.4 called "Forest ungulates";
- including bats in the new section on caves in the forest plan and clarifying that plan components for bats apply to more than one species (see wildlife diversity section 3.7.4);

- creating an addendum to appendix 3, which is on wildlife modeling, based upon updated vegetation modeling (see additional discussion under section 3.3);
- moving the tables of species, key ecosystem characteristics, and plan component cross-references to EIS appendix 6;
- modifying the original drivers and stressors table so that there is now a table addressing the climate change strategies outlined by the Northern Region Adaptation Partnership (appendix 7); and
- clarifying and expanding upon potential strategies and management approaches in appendix C of the forest plan.

3.7.4 Wildlife diversity

Diverse ecosystems on the Flathead National Forest support close to 300 species of wildlife, including mammals, amphibians, reptiles, and birds as well as about 60 known invertebrate species (see appendix 6). Within the national forests, conservation of migratory birds focuses on providing a diversity of habitat conditions at multiple spatial scales and ensuring that bird conservation is addressed when planning for land management activities. Six of the neo-tropical migratory species found on the Forest are associated with old-growth, at least 13 are associated with dead tree habitats, and 43 are associated with riparian habitats.

This section is organized by key ecosystems and ecosystem characteristics that provide habitat for associated animal species. Each individual section begins with an analysis of coarse-filter plan components and consequences to most species and is followed by sections on specific species. The following key ecosystems or ecosystem characteristics are discussed:

- aquatic, wetland, and riparian habitats
- hardwood tree habitats
- cliff, cave, scree, and rock habitats
- persistent grass/forb/shrub habitat
- high-elevation habitat
- coniferous forest habitats
- old-growth forest, very large live tree habitat, and very large dead tree habitat
- burned forest and dead tree habitats

Refer to detailed discussion of these key ecosystems or ecosystem characteristics in sections 3.2 and 3.3, including the affected environment, environmental consequences, specific indicators used for analysis, and consequences to these ecosystems from other resource programs or management direction. In addition to the indicators addressed in these sections that are referred to, additional indicators were developed or clarified after considering key stressors, public comments, and issues identified during scoping.

Aquatic, wetland, and riparian habitats

Introduction

The Forest has more abundant and diverse aquatic, riparian, and wetland habitats compared to many other national forests in Montana (see section 3.2 for more details). About 175 wildlife species on the Forest are specifically associated with aquatic, wetland, and riparian habitats for feeding, breeding, and or shelter (see appendix 6). The Confederated Salish and Kootenai Tribes expressed particular concern for wetland habitats and associated wildlife in their Climate Change Strategic Plan (CSKT, 2013). Montana Fish, Wildlife and Parks also expressed a particular concern for wetlands and associated wildlife in their State Wildlife Action Plan (MTFWP, 2015a). Montana Fish, Wildlife and Parks identified floodplain and riparian areas, wetlands, and open water as tier I community types of greatest conservation need in every ecoregion within the state because of (1) the biodiversity found in these landscapes and (2) the importance of water during the life cycles of wildlife species.

Riparian habitats provide large amounts of biomass, feeding and hiding sites, and overwintering and breeding sites that support a high diversity of plants and animals (Sanders & Edge, 1998). As noted by Knopf et al. in 1988, gravel bed river floodplains provide near-channel habitats as well as adjacent riparian forest habitats for diverse bird communities (Hauer et al., 2016). Riparian corridors "connect habitats providing additional life requisites (e.g., feeding, nesting, roosting, escape cover, etc.) as well as interaction among local populations for reproduction or other social behaviors" (USDA, 2010a, p. 1), making these areas important to many wildlife species.

Maintenance and restoration of processes that create a complex structural mosaic within riparian management zones is important. These processes include:

- flood events that change the channel, cut the channel, and leave behind the abandoned channel, creating a mosaic of cobble, gravel, and finer deposits that support a mosaic of floodplain vegetation;
- river water that flows in and out of the floodplain subsurface, providing an upwelling of cold groundwater that supports species on the surface as well as subsurface habitat for micro and macroinvertebrates and makes rivers more resilient to changes in climate;
- the presence of ponds, disconnected backwaters, and wetlands along the floodplain that provide an array of thermal conditions to support larval amphibians and help them avoid predation by fish; and
- periodic flood, fire, or other events that restore deciduous vegetation, including cottonwood trees in a variety of sizes, interspersed with shrubs. These deciduous tree and shrub communities provide key habitats for nesting, feeding, shelter, and seasonal or annual migration for highly diverse wildlife communities.

An assessment of bird biodiversity on all lands in the Flathead River Basin was completed based upon research conducted at the Landscape Biodiversity Lab at Montana State University (Mahr & Jones, 2005). The authors stated that the Flathead River Basin has higher bird richness than all but one other area within the Yellowstone to Yukon ecoregion. Examples of bird species associated with aquatic, riparian, and wetland habitats include a variety of waterfowl and shorebirds: the American redstart, bald eagle, Wilson's warbler, northern water-thrush, catbird, winter wren, great blue heron, and long-billed marsh wren. Several species of mammals, such as beaver, river otter, moose, elk, and deer, and their predators as well as numerous species of bats (such as the long-eared and long-legged myotis) forage within or above aquatic, wetland, and riparian communities.

Some aquatic wildlife species are associated with fast-moving streams (e.g., deep pools for escape from predators, downed logs or large rocks used for nesting or loafing, and high water quality that supports abundant aquatic insects for food). Downed logs are provided when trees in riparian areas fall into the stream, which are in turn affected by processes such as wildfire, insect and disease, or timber harvest. Key ecosystem characteristics for other species are associated with conditions in larger lakes (e.g., deep water for diving to avoid predators or catch fish) and shoreline conditions that provide gentle terrain and vegetation for nesting. Key ecosystem characteristics for other species are associated with conditions in wetlands (e.g., a variety of submergent, emergent, or other low-growing plants that provide cover as well as high densities of invertebrates for food).

Affected environment

On wide, low-gradient rivers (e.g., the Swan River), periodic flooding maintains a very highly convoluted pattern of meanders, sloughs, and oxbow lakes. Because this pattern is changing constantly due to periodic flooding, early-successional vegetation, including shrubs, forbs, grasses, and young hardwood trees, are maintained by natural flood processes. Beaver activity also helps to maintain nonconiferous vegetation by raising the water table.

Numerous studies have been published on the use of riparian habitats by particular species, from invertebrates (F. L. Bunnell & Houde, 2010) to amphibians (D. H. Olson & Burton, 2014) and from mammals (McKelvey & Buotte, in press; Wilk, Raphael, Nations, & Ricklefs, 2010) to birds (Lehmkuhl et al., 2007; Marcot et al., in press). However, the width of riparian areas needed by most wildlife species in the northern Rocky Mountains is unknown. Although many studies have reported on the need for "riparian buffers," studies of the results of such buffers have reported inconsistent results. Additionally, most of the studies that have been done are in places other than the northern Rocky Mountains, where wildlife species are not the same as in northwest Montana or where stand-replacing wildfire is not a dominant factor in the natural range of variation. In a literature review considering appropriate widths for riparian management zones, Lee and others (2004) surveyed management prescriptions next to waterbodies in both Canada and the United States. They found that although prescriptions for buffer widths varied by waterbody type such as wetlands, intermittent streams, and fish-bearing streams, they were generally wide enough to protect many of the important riparian processes that support aquatic biota. However, the buffers were generally less than the widths that are recommended to protect terrestrial fauna.

Marczak et al. (2010) found that where the total width of a stream buffer was less than 164 feet, responses by different species were more variable compared to untreated riparian areas. They also found that species did not respond similarly to riparian treatments. Some edge-related species increased in abundance or diversity, some interior-associated species declined, and for some species, presence and abundance remained unchanged. They concluded that increases in protections in some locations should be balanced with riparian areas that allow partial resource extraction in other locations (Marczak et al., 2010; Reeves, Pickard, & Johnson, 2016; Spies et al., 2007).

To maintain the entire breeding bird community associated with forested riparian habitats in the Pacific Northwest, Pearson and Manuwal (2001) recommend a minimum buffer of 150 feet along each side of second- and third-order streams. They stated that habitat features such as deciduous trees and berry-producing shrubs appear to be important and should be maintained within forested riparian areas. Wenger (1999) recommended a distance of 300 feet for most wildlife, acknowledging that the distance might be difficult to implement in all management applications. Semlitsch and Bodie (2003) suggested that upland terrestrial vegetation might need to be combined with the protections that come with riparian management zones for some sensitive terrestrial species. Braithwaite and Mallik (2012) recommended producing a wider edge structure when harvesting green trees or salvaging dead trees to better emulate the natural disturbance of wildfire (see Kuennen, 2017c for more details).

Wetlands with diverse vegetation typically contain a range of microhabitats which supports high species diversity. It is important to maintain the structure, function, and diversity of wetland pools, their spatial arrangement and connectivity, and the surrounding terrestrial habitat for pool-breeding amphibians. Terrestrial habitat supports adult populations and enables them to move as habitat conditions change. Forest canopy conditions over ephemeral pools can have strong effects on amphibian species composition because many species are found in cool, shaded pools and some are specialized breeders (e.g., wood frog, long-toed salamander, tiger salamander). Studies by Semlitsch and others (2009) demonstrate that the egg-laying and aquatic larval life stages are sometimes affected positively by clearcutting, whereas effects on juvenile and adult terrestrial stages are mostly negative. Partial-harvest treatments produced both positive and weaker negative responses compared to clearcut treatments. Mitigating the detrimental effects of canopy removal, higher surface temperature, and loss of soil-litter moisture in terrestrial habitats surrounding breeding ponds is important for maintaining amphibian populations in managed forested landscapes. Seasonal or temporary pools are considered a distinctive type of wetland that is usually devoid of fish and, as a result, allows the safe development of young amphibian and insect species unable to withstand competition or predation by fish. Maintaining disturbance processes is important to balance the loss of seasonal pools through succession. Without disturbance processes, amphibian species that favor early-successional habitats (chorus frogs, toads, tiger salamanders) would decline or disappear, favoring species only associated with later successional stages (Skelly, Werner, & Cortwright, 1999, table 7.1). Local populations are adapted to natural variability in pool flooding and drying due to events such as drought.

On the Forest, many upland riparian areas are dominated by coniferous forests, although early-successional plants are maintained by high water tables in some areas. On streams with a higher gradient, early-successional stages including shrubs, forbs, grasses, and young hardwood trees have historically been promoted by wildfire, insects, and disease. Early-successional openings in riparian areas are required by some wildlife species; late-successional stages and forest cover are required by some wildlife species, and others require a mosaic of different successional stages.

For additional discussion of the best available science related to riparian areas, see section 3.2.6, the introduction to the “Environmental consequences” section for aquatic resources. Also refer to section 3.2.5 in the aquatics section of the final EIS for additional information on affected environment for riparian areas and wetlands.

This section assesses effects to most species associated with aquatic, riparian, and wetland ecosystems. Following the general discussion, six species are discussed as examples in order to help display differences in the effects of the alternatives. The six species are the black swift, harlequin duck, beaver, northern bog lemming, boreal (western) toad, and bald eagle.

Key stressors

Land management

Land management actions on all lands, including vegetation, fire and fuels management, roads, energy and minerals, livestock grazing, invasive species, and recreation, can affect species associated with these habitats. Activities on other land ownerships or controlled by other management agencies that may affect aquatic, wetland, and riparian wildlife habitats include water diversion, flood control, stream channel manipulation, hydropower management, farming, construction of housing subdivisions, and commercial development (see section of 3.2 for more details).

Changing climate

Climate models show that future changes in climate are anticipated to decrease runoff, groundwater infiltration, and availability of wetland habitats. Water temperatures are likely to increase with increasing summer air temperature and decreased late summer stream flows. In the central Rocky Mountains, snowpack, rate of spring warming, and spring precipitation are the primary drivers of spring runoff severity (I. T. Stewart, Cayan, & Dettinger, 2004). Changes in the timing or amount of runoff have occurred in the past and are likely to occur in the future. Effects on aquatic, wetland, and riparian species are likely to be variable. The ability of most species to adapt to higher variability or more prolonged periods of variability cannot be predicted with certainty.

Key indicator for analysis of most wildlife associated with aquatic, wetland, and riparian habitats

The following indicator is important for the wide variety of wildlife species associated with aquatic, wetland, and riparian habitats:

- Diversity of successional stages in riparian areas

Also refer to indicators and effects addressed in sections 3.2.3 through 3.2.13, and 3.3.1 through 3.3.11.

Environmental consequences

Effects common to all alternatives

Riparian areas with special management direction are called riparian habitat conservation areas under alternative A and riparian management zones under alternatives B modified, C, and D (see figures 1-07, 1-08) Differences in their delineation are discussed in the following sections. Under all alternatives, plan components for aquatic ecosystems help to provide high-quality habitat benefiting wildlife associated with aquatic, wetland, and riparian habitats (see section 3.2 of the final EIS and the Aquatic Species, Watersheds, Riparian Management Zones, and Soils sections of the forest plan for more details). All alternatives would promote connectivity in riparian habitat conservation areas/riparian management zones to varying degrees. For wildlife, the differences in alternatives are primarily related to riparian habitat conservation area/riparian management zone widths and plan components that affect riparian habitat diversity (Kuennen, 2017c).

Alternative A

The Inland Native Fish Strategy (INFISH) (USDA, 1995c), as it was amended to the Flathead National Forest plan in 1995, is unchanged from its original wording in alternative A. INFISH reduces the risk to watersheds and riparian and aquatic resources by improving riparian zone protections. INFISH has standards and guidelines for timber, roads, grazing, recreation, minerals, and fire management that have improved water quality and stream habitat on the forest (see section 3.2.8 for more details). Under alternative A, riparian habitat conservation areas (see figure 1-08) are established and are areas where riparian-dependent resources receive primary emphasis. Riparian habitat conservation areas for fish-bearing streams are generally a minimum 300 feet slope distance on each side, whereas for permanently flowing non-fish-bearing streams the riparian habitat conservation area are generally a minimum 150 feet slope distance for each side. Seasonally flowing or intermittent streams, wetlands less than 1 acre, landslides, and landslide-prone areas in priority watersheds for bull trout are generally a minimum100 feet slope distance, and, if not in a priority watershed, are generally a minimum 50 feet slope distance. For ponds, lakes, reservoirs and wetlands greater than 1 acre, riparian habitat conservation area widths are generally a minimum 150 feet. There is an estimated 313,922 total acres of mapped riparian habitat conservation areas on the Forest, which is approximately 13 percent of NFS lands on the Forest (see figure 1-08). Riparian habitat conservation areas are not suitable for timber production, but timber harvest is allowable if consistent with forest plan direction.

Plan direction associated with the INFISH amendment benefits many, but not all, wildlife species associated with aquatic, riparian, and wetland habitats. Under alternative A, plan standards direct the USFS to minimize the disturbance of riparian ground cover and vegetation in riparian habitat conservation areas. Because of this emphasis, riparian habitat conservation areas have been treated as buffers in many areas of the Forest. The lack of timber harvest and prescribed fire in some riparian habitat conservation areas has reduced the habitat for species associated with riparian shrubs, deciduous trees, grasses, and forbs but has benefited species associated with later successional stages. Wildlife connectivity and habitat for forest-interior species are supported by the emphasis on forest cover. For more details, see individual species sections below.

Alternatives B modified, C, and D

Forestwide standard FW-STD-RMZ-01 would establish riparian management zones (see figure 1-07), which are the same for all action alternatives (B modified, C, and D). Compared to alternative A, riparian management zone widths would be different for category 3 (seasonally flowing streams, intermittent streams, and lands identified as potentially unstable or landslide prone) and category 4 (ponds, lakes, reservoirs, and wetlands). Under alternatives B modified, C, and D, seasonally flowing or intermittent streams (not just streams in priority watersheds for bull trout), landslides, and landslide-prone areas would have a minimum riparian management zone width of 100 feet slope distance on each side of the stream or edge of the landslide-prone terrain. Under alternatives B modified, C, and D, FW-STD-RMZ-01 would increase the minimum riparian management zone width to 300 feet slope distance (with qualifiers, to be identified in the field at the project level) for ponds, lakes, reservoirs, and wetlands *greater than* 0.5 acre and for all sizes of Howellia ponds and for fens and peatlands. For ponds, lakes, reservoirs, and wetlands *less than* 0.5 acre (except for Howellia ponds and fens and peatlands), the minimum riparian management zone width would be 100 feet slope distance (with qualifiers), similar to alternative A. Based on these definitions, there are an estimated 410,863 acres of mapped riparian management zones on Forest lands, comprising approximately 17 percent of the NFS lands on the Forest (see figure 1-07). This is an increase of an estimated 96,941 acres forestwide compared to the area within riparian habitat conservation areas on NFS lands in the existing 1986 forest plan. This expansion is the result of increasing the size and distance of riparian management zone areas around wetlands, lakes, ponds, landslide-prone areas, and some intermittent streams. Riparian management zones are not suitable for timber production under any of the action alternatives, but timber harvest is allowable to contribute to desired conditions, as consistent with standards and guidelines.

Desired conditions FW-DC-RMZ-01 through 06 provide ecological conditions for diverse vegetation structure, composition, pattern, and connectivity, consistent with natural disturbance regimes and processes. Desired conditions for riparian areas contribute to maintaining vegetation conditions at the stand and landscape scale that are resilient and resistant to potential future stressors or threats (see section 3.3 and appendix 7 of the final EIS). Standards and guidelines for riparian management zones help to achieve or maintain desired conditions and address timber, roads, grazing, recreation, minerals, and fire management in order to maintain or restore water quality and stream and wetland habitat on the Forest (see sections 3.2.10 and 3.2.11 for more details). The standards and guidelines for riparian management zones benefit wildlife and habitat diversity because they emphasize a wider riparian management zone for wetlands, successional stage diversity, retention of downed trees, retention of live trees, and snags. Additionally, standards and guidelines benefit wildlife because they state that vegetation management activities must comply with streamside management zone law and because the use of chemicals that may affect aquatic food chains is restricted.

Riparian management zones on the Forest are abundant and interconnected (see figure 1-07). Some standards and guidelines would apply to the entire riparian management zone and others would apply only to the inner riparian management zone, as defined in FW-STD-RMZ-01. Forestwide standards FW-STD-RMZ-02 through 05 and forestwide guidelines FW-GDL-RMZ-01 through 13 apply to the entire riparian management zone of their respective category. Standard FW-STD-RMZ-05 states that within 300 feet of peatlands, fens, and bogs (i.e., the entire riparian management zone), ground-disturbing vegetation treatments shall only occur to restore or enhance riparian-associated resources. Because fens and peatlands are types of wetlands that have a unique hydrology, chemistry, and plant and animal communities, this standard provides the needed protection.

Standard FW-STD-RMZ-06 applies to the inner management zone for all categories except peatlands, fens, and bogs. This standard states that vegetation management shall only occur in the *inner* riparian management zone in order to restore or enhance aquatic and riparian-associated resources. Exceptions may occur as long as aquatic and riparian-associated resources are maintained. The exceptions are for (1) nonmechanical treatments, e.g., prescribed fire, sapling thinning, or hand fuels reduction treatments; (2) mechanical fuel-reduction treatments in the wildland-urban interface within 300 feet of private property boundaries; and (3) treatments that address human safety hazards adjacent to infrastructure or within administrative or developed recreation sites. This standard provides protection to the portion of the riparian management zones that most influences the condition of the water features and preserve the functional attributes for riparian and aquatic resources and water quality.

Forestwide guideline FW-GDL-RMZ-09, which applies to the entire riparian management zone defined in FW-STD-RMZ-01, provides for habitat connectivity by stating that the distance to cover for created openings should not exceed 350 feet. Guideline FW-RMZ-12-15 benefits wildlife habitat connectivity by limiting new landings and roads and retaining understory vegetation.

In summary, under alternatives B modified, C, and D, aquatic ecosystem plan components would meet the needs of most species associated with aquatic, riparian, and wetland habitats. Refer to sections 3.2.10 and 3.2.11 in the aquatics sections of the final EIS for a detailed discussion on the effects of the alternatives on riparian areas and wetlands.

Summary of modeled alternative consequences

To look at riparian habitat diversity, Ecosystem Research Group modeled consequences of alternatives, differentiating between low-gradient riparian habitats along rivers and streams that are maintained by flooding vs. those in upland areas that are controlled by bedrock and affected primarily by forest succession, fire suppression, wildfire, insects and disease, and vegetation management activities. Ecosystem Research Group modeled the amount of early-successional habitat in upland riparian habitat conservation areas based on a warmer and drier climate over the next five decades.

The natural range of variation was modeled going back about 1,000 years, and the effects of the alternatives were projected for the next 50 years, incorporating anticipated changes in climate, using the fire suppression logic of the model. Disturbances, such as fire or insect activities, have historically had major influences on vegetation conditions within riparian areas, just as they have on the conditions of vegetation across the entire Forest. For further information, refer to section 3.2.5 in the aquatics section and to section 3.3.1 in the vegetation section of the final EIS for discussion of ecosystem processes and disturbances forestwide and in riparian areas. Some disturbances are severe enough to convert forest stands to an early-successional stage of development, creating openings for a period of time that are dominated by grasses, forbs, shrubs, and seedling trees (conifers and hardwoods). Based upon vegetation modeling, the natural range of variation for early-successional openings in riparian habitat areas used for modeling ranges from about 2.4 to 8 percent (8,000-33,000 acres) of the total acres of NFS lands, with variation due to processes such as wildfire, insects, and disease. Current levels are estimated to be near the middle of the range (about 24,000 acres) (see appendix 3).The model predicts all alternatives would stay within the minimum and maximum natural range of variation over the five-decade time period. Acres of riparian habitat in an early-successional stage would decline the most (from about 24,000 acres to about 10,000 acres) from current levels under alternative A over the five-decade period. Under alternative A, the quantity of habitat for riparian wildlife species associated with dense shrubs, grasses, forbs, and young hardwood trees would decrease, but it would increase for species associated with coniferous forest in later successional stages. Under alternative C, the amount of early-successional forest would increase above current levels by the end of decade 5. Alternative C has more management area 1b (recommended wilderness) and lower levels of fire suppression. Alternative C would provide the most habitat for wildlife species associated with riparian areas in the early-successional stage but the least habitat for species associated with coniferous forest in later successional stages. Under alternatives B modified and D, levels would fluctuate but would remain near current levels by the end of decade 5. (The results of vegetation modeling for alternative B modified are similar to the results for alternative B; see appendices 2 and 3 for more details.)

Cumulative effects

This section summarizes the activities and effects that are common to most wildlife species associated with aquatic, wetland, and riparian habitats. See also the individual cumulative effects section specific to aquatic species in section 3.2.12 and the species discussions in sections 3.7.4 and 3.7.5.

Historically, much of the private land in the valley bottom of the Flathead Valley was cleared for grazing and farming, reducing native riparian vegetation but maintaining open space used by wildlife. Private land in the Flathead Valley then became more valuable for residential and commercial development, resulting in less open space and less wildlife habitat for many species, especially on the shores of large lakes and streams. This reduces the connectivity in and between riparian areas and upland areas. Developments may also increase human disturbance or loss of wildlife due to vehicle collision as animals move from aquatic and riparian habitats to upland areas.

Many land managers now work together to protect and restore the high quality of the aquatic, wetland, and riparian habitats of the Flathead River Basin. Numerous acquisitions and conservation easements have been completed along lakes, rivers, and streams by groups and individuals such as MFWP, F. H. Stoltze Land & Lumber Company, and The Nature Conservancy, including the Montana Legacy Project, under which lands formerly owned by Plum Creek Timber Company in the Swan Valley were conveyed to the Forest. All of these provide for conservation of wildlife habitat. Montana Fish, Wildlife and Parks is continuing to actively pursue conservation easements on private lands to limit the loss of riparian habitats (G. Bissell, MFWP, personal communication to R. Kuennen, 2014).

In the future, loss of habitat associated with human developments on some private lands is likely to continue and may increase as the human population in the Flathead Valley grows. Newlon and Burns (2010), with the Montana Natural Heritage Program , completed an analysis of wetlands in the Flathead Valley using remote sensing and photo interpretation techniques. Their study area encompassed private lands and former Plum Creek Timber Company lands as well as lands managed by the Montana Department of Natural Resources and Conservation, MFWP, the Flathead National Forest, and USFWS. About 24,255 acres of wetland and riparian habitats were mapped on private lands and about 8,129 acres were mapped on public lands (including wildlife refuges managed by USFWS). The authors' preliminary analysis showed relatively little overall change in wetland area between 1981 and 2005, but they found changes in wetland functional capacity and land cover types around wetlands. These changes included relatively large areas of forest and grassland/shrub cover types that had been converted to agricultural and/or urban land cover types on private lands.

Laws governing the protection of lakes, streams, and wetlands apply to all land ownerships. In addition, the Flathead County Growth Policy (adopted March 19, 2007) includes lake and lakeshore protection regulations as an implementation tool. These are designed to promote public health and safety, maintain water quality, and preserve public waterbodies and natural resources available to the citizens of Flathead County. County policy P10.5 protects wetlands and riparian areas. County policy P5.5 restricts industrial uses that cannot be mitigated near incompatible uses such as residences and schools and environmentally sensitive areas such as wetlands, floodplains, riparian areas, and areas of shallow groundwater. County policy P19.4 recognizes riparian buffers for their recreational value and their ability to protect the quality of water along major streams and rivers in the county, which enhances recreational opportunities, protects the quality of water (e.g., by reducing erosion, surface runoff containing pesticides or fertilizers, and streambank depredation or defoliation), and protects the natural aesthetics of waterways. Portions of the Swan Valley geographic area are in Missoula County, where a May 2016 growth policy includes direction to prioritize and provide protection strategies for key resources and resource-rich areas and/or demonstrate that the plan does not unduly compromise critical natural resources or natural functions. For example, guidance for rural residential cluster development benefits riparian habitats by discouraging development on lands that have been identified as conservation resource lands and stating that development should be located far enough away from areas of riparian habitat and community types to protect the resource, thus benefiting wildlife.

State streamside management zone law and policy benefits wildlife on all lands. Many landowners implement best management practices and other watershed conservation practices. Lands managed by the Montana Department of Natural Resources and Conservation (e.g., Swan State Forest, Coal Creek State Forest, and Stillwater State Forest) are addressed by that agency’s Habitat Conservation Plan. On Montana Department of Natural Resources and Conservation lands, riparian habitats are protected during riparian timber harvest by the establishment of a riparian buffer equal to the 100-year site index tree height along Class 1 streams (MTDNRC, 2011). Streamside management zones on private timber lands are managed to protect water quality and reduce cumulative effects on streams, but the width of these areas is smaller and some activities do not have as many restrictions as on NFS lands.

The Confederated Salish and Kootenai Tribes developed a comprehensive wetlands conservation plan for the Flathead Reservation, adjacent to the Forest, adopted by the tribal council in 1999. The interim and long-terms goals of the plan are a synthesis of tribal goals for wetlands and riparian lands articulated in prior plans, strategies, ordinances, consent decrees, environmental standards, and best management practices, including shoreline protection, aquatic and wetlands conservation, noxious weed management, water quality standards, Kerr Dam mitigation and management, lower Flathead River corridor management, non-point source assessments, and watershed plans.

Timber harvest does not occur in riparian areas in Glacier National Park, but trees may be removed to provide for human safety. Glacier National Park’s general management plan (1999) addresses aquatic habitats. Research projects, as well as restoration projects, are ongoing. Cumulatively, vegetation management on NFS, State, Tribal, Glacier National Park, and some private lands contributes to aquatic, wetland, and riparian habitats and their connectivity.

Historically, wildfires were instrumental in creating dense riparian shrub and deciduous tree communities, but the development of river valleys and adjacent private uplands has placed a high level of emphasis on fire suppression (see section 3.8 for more details). As more people inhabit areas in and adjacent to riparian areas, there may be more clearing of fuels for fire protection on private or State lands. Drought, disease, insects, and/or wildfires may continue to have effects on riparian wildlife habitat on all lands.

Mining is expected to continue to be a minor land use on Forest lands, and the potential for mining on State and private lands is also expected to be low to moderate (see section 3.23 for more details).

In the West, impoundments have interrupted the natural flood cycle of rivers to the detriment of cottonwood/shrub communities in some areas. The only large impoundment affecting Forest lands is the Hungry Horse Dam and Reservoir, completed in 1953, which provides hydropower and flood control. The Hungry Horse Dam inundated a segment of the South Fork of the Flathead River and flooded an estimated 6,867 acres of riparian/wetland wildlife habitats, according to MFWP. Montana Fish, Wildlife and Parks has a mitigation program for this loss of habitat that is beneficial for wildlife (see USDA, 2014b for more details).

Introduction of aquatic invasive species or contaminants in waterbodies resulting from recreational, agricultural, or industrial activities may have negative impacts on species associated with aquatic, wetland, and/or riparian habitats. The potential for introduction of disease and aquatic nuisance species exists on all lands within the cumulative effects analysis area, often as an indirect result of water-based recreation. Many management agencies have increased inspections and public education efforts in recent years in order to reduce these risks.

In summary, proposed management direction on the Forest, in the context of all lands of the larger landscape, contribute to the quality of aquatic, wetland, and riparian habitats (see section 3.2 for more details). This would be accomplished by providing plan components to protect water quality and quantity; establishing aquatic sites, wetlands, and riparian management zones; applying best management practices; providing connectivity; providing for diversity of vegetation structure, species, and forest densities; protecting habitats from development; providing for natural flood and groundwater infiltration processes; and restoring areas impacted by invasive species or other past management. Although the Forest does not have authority over all the stressors, the ecological conditions of aquatic, wetland, and riparian communities and the processes that maintain them would be provided on NFS lands. Coarse-filter plan components provide for biodiversity and ecological conditions that support the long-term persistence of the majority of species associated with these habitats. Aquatic, wetland, and riparian habitat is distributed across all Forest geographic areas.

Black swift (species of conservation concern)

Affected environment

The black swift is identified as a species of conservation concern by the regional forester (see http://bit.ly/NorthernRegion-SCC). This species is a neotropical migratory bird that winters in Central and South America. During the breeding season, black swift distribution is most widespread in British Columbia and western Alberta, with spotty distribution in western states from Alaska to southern California and east to Colorado. The black swift is present on the Forest only during the breeding season.

Aquatic ecosystems, including rock cliffs near waterfalls, provide key habitat for black swifts in Montana (J. S. Marks, Hendricks, & Casey, 2016). A total of almost 50 sites in Montana were surveyed by MFWP in 2015. As of 2015, there was a total of seven known nest sites in northwest Montana outside Glacier National Park on national forest or Confederated Salish and Kootenai Tribes lands (C. Hammond, personal communication, 2015; C. Hammond, 2016) and six known nest sites in Glacier National Park (Glacier National Park, 2013). On the Forest, there is one known nesting site, which is at Lower Holland Falls in the Swan Valley geographic area (A. Anderson & Turnock, 2012).

Many potential nest sites in northwest Montana have not been surveyed (C. Hammond, personal communication, 2016). Swifts are hard to detect because of their fast erratic flight and little to no vocalization. This makes point counts and other standard bird monitoring techniques ineffective (Daniel Casey, 2004). In addition, monitoring breeding sites is generally difficult because of dangerous access and the cryptic nature of colony sites (Daniel Casey, 2004; Marin, 1997). Colonies typically consist of only one or two nests, making observation of many breeding swifts logistically challenging (Hirshman, Gunn, & Levad, 2007). Colonies are also difficult to document because adult birds visit the nest only infrequently (A. Anderson & Turnock, 2012).

The closest study of black swifts is in Glacier National Park, adjacent to the Forest, where the species had fairly high nest failure rates, with no evidence of renesting after nest failure (Hunter & Baldwin, 1962, 1972). Adults show strong nest site fidelity, using the same nest for a decade or more (Levad, Potter, Shultz, Gunn, & Doerr, 2008). The black swift has a low reproductive rate and is relatively long lived, and the survival of adults is likely the most important factor in regulating black swift population growth (Wiggins, 2004). The black swift is unique among swifts in that they incubate only one egg per clutch (Hirshman et al., 2007). There is no population estimate, trend, or density available for Montana.

Black swifts nest on ledges or in shallow caves on steep rock faces behind tall waterfalls (Hirshman et al., 2007)—a very limited and specialized habitat. Known nesting locations have high topographic relief, inaccessibility to predators, unobstructed flyways to and from the nest, and darkness for most of the day (Hunter & Baldwin, 1962). Increasing stream flow, number of potential nest platforms, amount of available moss, shading of potential nest niches, topographic relief of surrounding terrain, and ease of aerial access to potential nest niches contributed to a higher probability that the site would be occupied by black swifts (Levad et al., 2008). Most characteristics of black swift nesting habitat are a function of inherent geologic and topographic conditions and are not affected by NFS management. On the Forest, the 100-foot waterfall that provides known nesting habitat has abundant waterflow, which is dependent upon high-elevation snowmelt from lands that are in wilderness and inventoried roadless areas, so waterflow would not be affected by human activities.

Marks and Casey surveyed waterfalls for black swift nests in 2004 (Hendricks, 2005; J. Marks & Casey, 2005), visiting 32 potential nesting sites on the Flathead National Forest and adjacent areas of western Montana. They listed nine potential nesting waterfalls on the Forest (Dan Casey, 2004) (using the criterion that waterfalls had to be at least 20 feet tall), in all geographic areas except the North Fork geographic area or the Hungry Horse geographic area (Hendricks, 2005). All identified potential black swift nest sites on the Forest are in Class 1 watersheds. Class 1 watersheds are those that exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition (see also section 3.2).

Black swifts forage on flying insects over wide areas in the mountains and descend to valleys to feed over rivers, lakes, and meadows, sometimes long distances from the nest (Marin, 1997), and most observations on the Forest are of feeding birds. Feeding habitat is distributed across the Forest along the North Fork and Middle Fork of the Flathead River adjacent to Glacier National Park as well as in the main Flathead Valley, Swan Valley, and Stillwater Valley (Kuennen, 2013c). The nesting locations of these birds are unknown, but based upon the number of black swift feeding observations, there are likely black swift colonies in Montana that are as yet unidentified (A. Anderson & Turnock, 2012).

Key stressors

Human disturbance

Black swifts generally nest in inaccessible areas where human disturbance is low. There have been no studies of the effects of human recreational activities on black swifts. Incidental observations at a swift nesting colony in a cave in southern California and at Box Canyon Falls in Colorado (Wiggins, 2004) suggest that humans occasionally disturb black swift nesting attempts. However, both of these situations were somewhat unusual in that the nests were readily accessible to human visitors.

Changing climate

There is currently little direct information on the factors affecting black swift populations, but the main threat is hypothesized to be the lack of late summer water runoff, which affects the suitability of nest and colony sites and may decrease local food supplies in some areas (Wiggins, 2004).

Key indicators for analysis

The following species-specific indicator applies to black swifts:

- Provide key ecosystem characteristics for black swift nesting habitat and reduce the risk of disturbance near active nesting colonies.

In addition, refer to the effects of alternatives described under section 3.7.4, subsection "Aquatic, wetland, and riparian habitats," and sections 3.2.3 through 3.2.13.

Environmental consequences

Effects common to all alternatives

Under all the alternatives, management area allocations would support ecological conditions for nesting by black swifts at the known nesting site on the Forest. Alternatives differ with respect to management areas on lands adjacent to the known nest site, but these differences are expected to have minor effects because both management areas have a very low potential for human activities that could cause disturbance to nesting black swifts. In alternatives B modified and C, the nest area is in an inventoried roadless area with a management area 1b allocation (recommended wilderness). Under alternatives A and D, the management allocation is management area 5a (nonmotorized year-round). All of these management areas have a low risk of disturbance due to most human activities.

Under all alternatives, riparian habitat conservation area or riparian management zone direction supports most key ecosystem characteristics for black swifts. Plan components provide protection for riparian habitat within 300 feet of perennial streams that flow into the nine waterfalls listed as having the potential to provide black swift nesting habitat. This management direction also supports ecological conditions that provide feeding habitat.

Alternative A

The 1986 forest plan does not specifically address human disturbance of black swift nesting colonies.

Alternatives B modified, C, and D

Guideline FW-GDL-WL-DIV-05 reduces the risk of human disturbance because it specifies that new projects or authorizations of activities known to disturb black swifts should not occur within 500 feet of active black swift nest sites from April 15 to August 15 unless project design features mitigate new disturbance to nesting black swifts. The type of design features would vary depending upon site-specific characteristics and the nature of the activity and so would be assessed at the project level. Forestwide desired conditions FW-DC-WTR-07 through 14 and FW-DC-CWN-01 support ecological conditions that provide for wildlife biodiversity and habitat integrity at the watershed scale, benefiting feeding habitat and potential nesting habitat for black swifts.

The 2012 planning rule requires the Forest to determine whether the plan components provide the ecological conditions necessary to maintain or restore a viable population of a species of conservation concern in the planning area (36 CFR 219.9(b)(1)). Key ecosystem characteristics for the black swift are cliffs with shading and cover provided by waterfalls suitable for nesting colonies. Black swifts forage on flying insects and descend to valleys to feed over rivers, lakes, and meadows, sometimes traveling long distances from the nest.

It is likely beyond the authority of the Forest Service or not within the capability of the plan area to maintain long-term persistence of the black swift in the plan area. However, the forest plan has plan components, including standards and guidelines, to maintain, improve, and restore ecological conditions within the plan area to contribute to maintaining a viable population of the species within its range, considering that

- this species migrates to and winters in the tropics, demographically operating at a larger scale than the plan area;
- this species persists in the plan area even though the geologic and topographic conditions that create rock cliff, waterfall nesting sites are limited in number and distribution, thus limiting the ecological capacity of the Forest to provide nesting habitat;
- nine potential nesting waterfalls have been identified on the Forest, but occupancy by nesting birds has not been documented;
- the known nesting site on the Forest is in an area to be allocated as recommended wilderness (management area 1a), where natural processes will prevail and threats are few;
- the known nesting site on the Forest has high waterflow throughout the nesting season and is close to 100 feet tall, so suitable conditions are likely to be present in the future;
- most observations of feeding black swifts are on sections of the Flathead River between Glacier National Park and the Forest, where the majority of nesting birds are known to occur;
- plan components contribute to high water quality and quantity in the plan area; and
- threats or stressors that can be influenced by management are low because the known nesting site is generally difficult to access. A species-specific plan component would limit the risk of nest site disturbance, and black swifts are not known to be sensitive to human disturbance while feeding.

Although the Forest does not have authority over all the stressors that may affect black swifts, the forest plan includes plan components that would maintain, improve, and restore the ecological conditions of key nesting and foraging habitats.

Cumulative effects

Waterfalls providing potential nesting habitat occur on NFS lands as well as Confederated Salish and Kootenai Tribes lands and Glacier National Park lands adjacent to the Forest. There are no known waterfalls suitable for nesting on State or private lands.

A nonmotorized recreation trail has accessed the base of Holland Falls in the Swan Valley below the known nest for decades. According to Anderson and Turnock, it is probable that the colony has been there for some time and gone unnoticed by casual visitors (A. Anderson & Turnock, 2012). Despite the existence of the trail, the black swift nesting colony has not abandoned this nesting site; therefore, black swifts appear to be tolerant of existing use and the pattern of recreationists moving along the trail. The rock at Holland Falls is fractured and not suitable for rock climbing (J. Dunham, Swan Lake Ranger District Recreation Specialist, personal communication, 2016).

There are several potential nest sites and one known nest site on Confederated Salish and Kootenai Tribes lands (adjacent to the Forest) in the Mission Mountains Tribal Wilderness. In Glacier National Park and the Mission Mountains Tribal Wilderness, many waterfalls are difficult to access, so risks of disturbance to nesting black swifts are very low. In a 2012 survey of previously known nesting sites in Montana, one previously occupied site was believed to be unoccupied. One colony at Haystack Creek in Glacier National Park is monitored frequently and has supported three active nests in the past. In 2013 only two nests were active, and in 2014 only one nest was active (L. J. Bate, 2015). Whether this is due to natural changes in waterflow or human disturbance is unknown. Continued monitoring is needed to determine whether this change in active nesting is a long-term trend or whether it represents a normal level of variation.

There is no information on the natural range of variation for black swift nesting habitat in Montana, so the risk of consequences from changing future climate is uncertain. Droughts undoubtedly affect habitat on a periodic basis, but nesting birds have persisted. In the future, the potential combination of less snowpack and earlier spring snowmelt could cause lower late-summer flows. Changes in climate could cause some waterfalls to dry up before black swift young have fledged from the nest. Data from four snow telemetry (SNOTEL) sites on the Forest present a flat to slightly decreasing trend in the April 1 peak snowpack from 1983-2012 (see USDA, 2014b, figure 14). The four sites show varying trends in total water year precipitation, with the high-elevation site (Noisy Basin at 6,040 feet) exhibiting an upward trend whereas the three sites at lower elevations (4,350 to 5,035 feet) appear flat to downward (see USDA, 2014b, section 3.2.10 for more details). Past actions on the Forest have maintained Class 1 watershed condition for all areas with waterfalls believed to be suitable for nesting, and this condition is likely to be maintained in the future.

Harlequin duck

Affected environment

The breeding season range of the Pacific population of harlequin ducks occurs across most of Alaska and British Columbia as well as portions of the Yukon, Washington, Oregon, Idaho, Colorado, and Montana. Aquatic ecosystems, including fast-moving streams, provide key breeding habitat for harlequin ducks in Montana (J. S. Marks et al., 2016). Montana is at the eastern edge of the range of the Pacific population, which extends south to northwest Wyoming. Harlequin ducks are small sea ducks that spend most of the year in near-shore sea environments but move inland to fast-moving streams to breed. They form lifelong pair bonds on the coastal wintering grounds, and then the pairs migrate to the stream where the female was born (Hansen, 2014a).

During the breeding season, harlequin ducks use clear, low-gradient, fast-moving mountain streams with abundant aquatic insects. Females are known to lay eggs in a wide variety of microsites including cliffs, under downed logs in burned areas, on instream logjams, or on streambanks with thick shrub and/or tree cover (L. Bate, 2014a; Cassirer & Groves, 1994). Key habitat characteristics are high water quality, a complex stream structure (including fast water to support aquatic prey, deep pools for escape, and rocks or large downed logs for loafing), as well as dense vegetative or log cover on the shoreline to reduce disturbance and protect birds for from avian predators during incubation (L. Bate, 2015). Cover also provides stream shading that promotes cool water temperatures and associated higher oxygen levels important to the aquatic invertebrates that harlequins feed upon. On the west side of the Continental Divide, calm backwaters along rivers or beaver ponds may be important for brood rearing (L. Bate, 2015; Kuchel, 1977). Harlequin broods may move downstream from the fast-moving streams where they are born to larger streams and rivers as the summer season progresses (Cassirer & Groves, 1994; Kuchel, 1977), and they are often easier to observe at this time. A strong stream selection factor in Montana appears to be stream reaches with at least two loafing sites per 33 feet (Kuchel, 1977).

About 25 percent of known breeding harlequins in northwest Montana nest along a 10-mile reach of McDonald Creek in Glacier National Park (Reichel & Genter, 1996), adjacent to the Forest. There is little to no information about harlequins in Montana prior to the late 1980s, and the currently available information is not sufficient to detect a population trend (C. Hammond, 2016). In 1996, Reichel estimated that the statewide population of harlequin ducks in Montana ranged from 150-200 pairs. There has been no subsequent population estimate, and the population trend in Montana is unknown. The Glacier National Park population appears to be stable, but the population trend in other parts of Montana is unknown. In some areas of the West, harlequin duck populations appear to be in decline (C. Hammond, 2016). In 2014, the Montana Natural Heritage Program and other cooperators carried out a systematic survey of harlequin ducks on streams in Montana where they have been known to breed historically. This effort detected a total of 31 broods with 126 chicks on 17 of the 49 streams that were surveyed (B. Maxell, 2014).

On the Forest, harlequin duck brood monitoring data for nine streams with historical evidence of broods suggests relative stability. From 1990-2017, nine streams have had verified broods in about 69 percent of the survey years. Trail Creek and Spotted Bear River are the two streams that have been most consistently monitored and have also consistently produced young. Other streams have not been monitored as frequently, but about 78 percent of streams had verified brood production in at least 50 percent (proportionally) of all years monitored. Only two streams have not had verified brood detections since 2010, but these are in remote wilderness areas and have been surveyed only once or twice since then, which is not likely sufficient to conclude a loss of breeding areas. Across all nine streams and the 27-year monitoring period, broods have been detected in 69 percent of survey years (Hansen, 2014b; Staab, 2017).

Historically, harlequin duck nesting was known to occur in five of the seven Forest geographic areas (Reichel & Genter, 1996). Numerous broods have been consistently detected in Trail Creek in the North Fork geographic area and in Spotted Bear River in the South Fork geographic area. Other geographic areas have not been surveyed as consistently, but broods have also been observed in the Middle Fork and Hungry Horse geographic areas. There are no records of harlequin ducks nesting in the Salish Mountains or Swan Valley geographic areas, and these geographic areas are not believed to contain potential nesting habitat. Nesting stream reaches are more reliably detected than the nest sites themselves. Nest sites are often difficult to locate because of very dense trees, shrubs, and downed logs that occur near nest sites on the Forest.

Like many other sea ducks, male harlequins depart the breeding grounds immediately after females begin incubation, so females do not frequently renest in the event of a nest failure (Lisa J. Bate, 2013). Relative to many other species of ducks, harlequins occur at very low population densities on their breeding grounds and exhibit high breeding site fidelity, low reproductive rates, and delayed reproduction (Wiggins, 2005), and thus they may be susceptible to local extirpations (NatureServe, 2015c). Bond and others (2009) estimated survival probability for 144 adult female harlequin ducks at four breeding areas in western North America. They found that survival was lowest during incubation, with the highest number of mortalities attributed to predation. Adult survival likely drives population dynamics. If a nesting pair is lost, the habitat may not be occupied by another pair in that or subsequent seasons.

Because harlequins are on their nesting streams early in the season, nesting success may be affected by changes in waterflow. In Glacier National Park, breeding pairs inhabit Upper McDonald Creek from late April through mid-June, and females with broods are on the creek during July, August, and early September. Late spring high waterflows in 2014 may have caused reduced detectability or failed reproduction on some streams where breeding had been observed in the past (L. Bate, personal communication, 2014) (L. Bate, 2014a, 2014b, 2015). In Montana, nesting has not been monitored long enough or consistently enough in some areas to know whether climatic variation causes harlequins to move or causes nest failure, and, if so, how many years of nest failure they may be able to tolerate before a female will no longer return to a stream reach (Hansen, 2014b).

There are somewhat conflicting scientific findings regarding the effects of instream recreation and road-related disturbance on harlequin ducks. Although harlequins are generally tolerant of people, they may be sensitive to particular types of disturbance at certain times of year. Hansen's analysis in Glacier National Park (Hansen, 2014a) showed that harlequin ducks did not avoid high-quality habitats adjacent to roads and other sites with high recreational use. But harlequin ducks have been observed avoiding boats (e.g., rafts, packrafts, kayaks) in breeding stream reaches during incubation and the first four weeks after hatching (Clarkson, 1992; Kuchel, 1977; Reichel & Genter, 1996).

In all monitored watershed subbasins on the Forest that have known harlequin duck nesting, the overall watershed condition is high, indicating that habitat diversity and quality for harlequin ducks on the Forest is high at the watershed scale. According to PIBO data monitoring, there is an improved trend in aquatic habitat in reference and managed watersheds (C. N. Kendall, 2014). Habitat conditions such as large wood, pool fines, percent pools, and residual pool depth have trended upwards since sampling began in 2001 (see section 3.2 for more details). Some stream reaches that appear to provide suitable habitat characteristics in terms of stream characteristics and water quality are not known to be used by harlequin ducks, but only two breeding streams have been consistently surveyed and harlequin ducks can be very difficult to detect while on the nest.

Key stressors

Land management

Some activities can reduce the quantity or quality of nesting habitat by removing vegetation that provides cover for nesting or avoiding predation. Activities that produce sediment can affect the aquatic organisms that harlequins feed upon. Activities on all lands where harlequin ducks nest may affect instream and streamside conditions on breeding stream reaches and may risk disturbance or displacement of harlequin ducks.

Recreation

Recreational floating, boating, and fishing may disturb or displace nesting harlequin ducks in their nesting stream reaches on all lands, but anecdotal observations suggest broods may be more tolerant of people once they move to larger rivers. They often remain on loafing rocks as floaters drift by but dive underwater if approached. The Forest Service does not have authority over some types of stream-related recreation.

Changing climate

The effects of changing climate on water flows could have a negative impact harlequin duck habitat. Changing water levels could make nesting and foraging habitat unsuitable at key times when they historically would have been suitable. There is no information on the natural range of variation for harlequin duck nesting habitat.

Forest insects and disease are expected to increase with climate change and may be beneficial by creating downed woody material, which provides nesting cover and instream nesting or loafing sites. However, large, stand-replacing fires (also expected to increase with the changing climate) may be detrimental by causing temporary increases in runoff or by temporarily removing dense shrub and tree cover along stream banks (see section 3.2.10 for more details).

Competition and predation

Numerous theories have been proposed as to why Upper McDonald Creek has such a high density of nesting harlequin ducks. One is that natural fish barriers low in the watershed limit fish density and fish size. Some species of fish may prey on harlequin ducks or compete with them for food resources. Strong correlations have been shown between harlequin duck density and fishless stream reaches (Hansen, 2014a). During incubation, females and their eggs are highly susceptible to predation by avian predators as well as marten, mink, red squirrel, and wolf (Hansen, 2014a). Predation by species such as bald eagles may also affect harlequins on their wintering grounds.

Hunting

Harlequin ducks are classified as waterfowl in Montana and can be legally hunted. However, most harlequins have left Montana by the time the waterfowl hunting season in Montana begins (C. Hammond personal communication, 2014). Hunting may occur in wintering areas.

Other causes of mortality on Pacific Ocean wintering grounds

Oil spills and other toxic pollutants on the ocean wintering grounds of harlequin ducks can kill large numbers of harlequins (Reichel & Genter, 1996). Immediate bird mortality from the *Exxon Valdez* oil spill was high; more than 1,000 harlequin ducks were estimated to have died as a direct result of the spill (Esler et al., 2002). It took the harlequin population about 25 years to recover from the *Exxon Valdez* oil spill (C. Hammond, 2016).

Habitat Inundation

Construction of dams can flood the fast-moving streams used by harlequin ducks during the breeding season.

Key indicators for analysis

Cassirer and others (1996) prepared a conservation assessment and strategy that addresses the status and conservation of harlequin ducks in the Rocky Mountains of Idaho, Montana, and Wyoming based on inventory, monitoring, and research data collected in the Rocky Mountains. Wiggins prepared a conservation assessment for the Rocky Mountain region in Colorado (Wiggins, 2005). These authors emphasize measures to sustain harlequin duck populations and an adaptive approach for maintaining riparian and instream harlequin duck habitat. Guidelines include maintaining streamside vegetation for nesting cover, maintaining instream flows and water quality, and reducing or not increasing human disturbance. The authors also identify areas where additional information is needed regarding basic ecology and management for harlequin duck conservation.

The following species-specific indicator applies to harlequin ducks:

- Provide key ecosystem characteristics of potential nesting stream reaches and reduce the risk of human disturbance of harlequin ducks on known nesting stream reaches

In addition, refer to effects of alternatives described in section 3.7.4, subsection “Aquatic, wetland, and riparian habitat” and sections 3.2.3 through 3.2.13, which address instream flows and water quality.

Environmental consequences

Effects common to all alternatives

All alternatives have plan components to maintain or restore high water quality, which would provide for the aquatic insects harlequin ducks feed upon.

Alternative A

The 1986 forest plan does not specifically address human disturbance on harlequin duck nesting stream reaches.

Alternatives B modified, C, and D

Species-specific desired condition FW-DC-WL DIV-01 supports ecological conditions that provide nesting sites for harlequin ducks, aquatic insects for feeding, and low levels of human disturbance during key time periods. Forestwide standards FW-STD-RMZ-01 and 06 protect harlequin duck nest sites because they are generally within the inner riparian management zone of permanently flowing streams, where cover would be protected.

Harlequin ducks may be disturbed by activities such as road building, trail use, camping, fishing, boating, timber harvest, prescribed burning, or thinning near their nest sites. The action alternatives have plan components to reduce the risk of human disturbance on nesting stream reaches during key time periods. Guideline FW-GDL-WL-05 specifies that new projects or authorizations for activities known to disturb harlequin ducks should not occur along active nesting stream reaches from April 15 to August 15 unless project design features mitigate new disturbance to nesting harlequin ducks. The type of design features and distance would vary depending upon site-specific characteristics and nature of the activity and so would be assessed at the project level. Plan components for the Forest are consistent with the recommendations of Wiggins (2005) and Cassirer and others (1996), as applicable to NFS lands.

Cumulative effects

In the past, the construction of Hungry Horse Dam may have affected harlequin ducks on the Forest by flooding nesting stream reaches, but the magnitude of this effect is unknown. Existing designation of rivers as wild and scenic or future designation of eligible rivers into the National Wild and Scenic River System would prevent impoundments in the future, benefiting harlequin ducks. Natural stream barriers may help reduce competition between harlequin ducks and some fish species, but this is still speculative.

Under all action alternatives, several streams, including the two known nesting streams with the most abundant, consistent production of harlequin ducks, are listed as eligible wild and scenic rivers (see appendix 5). Wild and scenic river designation into the National Wild and Scenic River System could indirectly increase the level of human disturbance on harlequin nesting stream reaches by making these streams more widely known, increasing the risk of disturbance and lowering nesting success (especially if the stream reaches are near boaters or floaters). However, this designation could be beneficial to harlequin ducks by protecting the stream’s outstandingly remarkable values, including the habitat characteristics that are associated with harlequin duck nesting habitat. The harlequin duck would be protected under forest plan components regardless of the stream’s wild and scenic river eligibility (Forest Service Handbook 1909.12 chap. 80 secs. 83.1 and 84.3).

Streams with the potential to provide harlequin duck nesting occur in adjacent national forests and Glacier National Park, where management supports their habitat. Recreation is likely to increase in the future on all land ownerships due to human population growth. Some studies indicate that harlequin ducks may be sensitive to some types of human disturbance until after the first four weeks after hatching. Rafting and kayaking have been banned on Upper McDonald Creek in Glacier National Park since the early 1990s. Montana Fish, Wildlife and Parks has closed fishing in Trail Creek (a consistent nesting stream), Whale Creek, Red Meadow Creek, Coal Creek, and Big Creek, which may indirectly reduce disturbance on potential and known nesting stream reaches. The larger rivers on the Forest where harlequins are known to rear their broods (e.g., the North and South Forks of the Flathead River) are wild and scenic rivers where outstandingly remarkable values must be maintained (USDA, 2013b). River outfitter and guide service days on the larger rivers are limited by permits subject to an environmental analysis that includes effects on wildlife.

Maintaining dense cover on nesting stream reaches helps to reduce the risk of human disturbance and predation. Stand-replacing wildfires may temporarily reduce cover on all land ownerships, but cover may increase in 10-20 years following fire as shrubs regrow and standing trees become downed wood.

In Glacier National Park, adjacent to the Forest, there is natural variability in amount and timing of stream flows, and harlequin duck nesting success is also known to be variable. Future changes in climate may magnify this effect on all lands. There has likely always been stream flow variability, but the intensity and timing of future climate effects on harlequin ducks are uncertain. Hansen (2014a) speculated that climate changes will likely enhance the prevalence of severe streamflow factors that limit harlequin reproductive success. Peak runoff is expected to occur earlier in the spring, potentially reducing the foraging efficiency of females preparing to lay eggs and delaying egg laying until nest sites become available. In addition, the timing of spikes in streamflow may cause flooding of established nests. The potential combination of earlier spring snowmelt, less snowpack (at least at lower elevations), and lower late-summer flows associated with more frequent or extreme summer drought could reduce water quality and quantity in the late nesting season. This could also affect harlequins because backwaters important for brood rearing may be dried up by August, although known brood-rearing streams on the Forest are on the larger rivers (e.g., the North and South Forks of the Flathead River), where this effect is less likely. Climate changes could also have negative effects on the aquatic insects that harlequin ducks feed upon since these insects require cold water with high levels of oxygen (Hansen, 2014a). Multiple agencies monitor stream conditions and harlequin ducks, contributing to the Forest’s ability to manage adaptively.

The effects of hunting and environmental contamination on the Pacific Coast waters where harlequin ducks winter are uncertain, but this is being studied.

Northern bog lemming

Affected environment

Northern bog lemming population, life history, habitat, and distribution

The northern bog lemming is known to occur in much of Canada, Alaska, and northwest Montana, with a Montana range that extends east to the Rocky Mountain Front and south through the Lost Trail Pass to the Continental Divide (Reichel & Corn, 1997). The total number of known bog lemming sites in Montana was listed as 18 in 1997 (Reichel & Corn, 1997). There are currently 22 locations where northern bog lemmings have been documented (Kuennen, 2013f; Turnock & Anderson, 2012). The majority of sites are in Glacier National Park, with additional sites on six national forests in northwest Montana (including two national forests adjacent to the Flathead National Forest). Northern bog lemmings are a mouse-sized small mammal with a high reproductive rate. The population, distribution, and trend of bog lemmings is unknown because they are very difficult to detect, even with a trapping effort, and many potential sites have not had a trapping effort (Turnock & Anderson, 2012).

Bog lemmings are found in diverse wetland and riparian habitats, but large mats of sphagnum moss (associated with peatlands) have been found to be the best indicator that northern bog lemmings are present (Reichel & Beckstrom, 1994), and these are the most likely sites to find new populations (Reichel & Corn, 1997). Known bog lemming habitat patches across Montana range from 1-340 acres in size and from 3,340 feet in elevation at McDonald Creek in Glacier National Park to 6,520 feet at Maybee Meadows on the Beaverhead-Deerlodge National Forest. In low-gradient landscapes, beavers may increase potential bog lemming habitat by creating ponds that go through succession to become dominated by sedges and peat (Chadde et al., 1998).

Although key characteristics of habitat for bog lemmings in Montana are associated with bogs, peatlands, and a subset of peatlands known as fens, they have been detected in at least nine other habitat types, including riparian habitats with Engelmann spruce, subalpine fir, birch, willow, sedge (*Carex* spp.), spike rush (*Eleocharis* spp.), or combinations of the above. Wetlands that may contain peat total about 700 acres in about 290 different sites on the Forest, ranging in size from < 1 to 84 acres. They occur in all geographic areas, with the highest number of acres in the South Fork geographic area (including wilderness) and the lowest number of acres in the Middle Fork geographic area. Very few of the peatlands have ever had bog lemming surveys. There are numerous other riparian habitats with spruce, subalpine fir, birch, willow, sedge (*Carex* spp.), spike rush (*Eleocharis* spp.), or combinations of the above on the Forest that have never had bog lemming surveys (Reichel & Corn, 1997; Turnock & Anderson, 2012). Bog lemmings have been confirmed by trapping at two sites on the Forest, one in the Bowen Creek area of the Salish Mountains geographic area and one in the Lindbergh Lake area of the Swan Valley geographic area. Northern bog lemming observations have also been reported at the Sanko Creek Fen in the Salish Mountains geographic area and in the Meadow Creek Fen in the Swan Valley geographic area, but these observations have not been confirmed. New, non-invasive sampling techniques such as eDNA are being tested that may make it easier to detect bog lemmings in the future.

Key stressors

Land management

Activities that can affect fens and peatlands on all lands include nearby activities that change peatland hydrology (such as clearcutting, cattle grazing, or road building). Clearcutting and stand-replacing wildfire in areas next to peatlands may increase populations of species that compete with northern bog lemmings, at least temporarily (MNHP-MTFWP, 2015a).

Changing climate

The effects of changing climate on peatlands are unknown, but climate has varied widely over the past 1,000 years during which current peatlands were forming. Peatlands have a high water-holding capacity, which helps their resilience in periods of drought (Chadde et al., 1998).

Modification of wetlands, including peatland mining, dredging, or filling

Peatlands are classified as wetlands, so on all lands these activities require permits under the authority of other agencies (e.g., U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, Montana Department of Fish, Wildlife and Parks).

Key indicators for analysis

The following species-specific indicator applies to northern bog lemmings:

- Support key ecosystem characteristics of peatlands

In addition refer to the effects of alternatives described in section 3.7.4., subsection “Aquatic, wetland, and riparian habitats.”

Environmental consequences

Effects common to all alternatives

Key ecosystem characteristics described in the "Affected environment" section would be provided for by plan components for watersheds, peatlands and fens, and riparian areas (see also subsection "Aquatic, wetland, and riparian habitats," sections 3.2.3 through 3.2.13, section 3.2.10 and section 3.5). Under all alternatives, vegetation management and road access requirements would help to reduce the risks to northern bog lemming habitat that could occur due to changes in the hydrology of peatlands and other wetlands.

Alternative A

Under alternative A, riparian habitat conservation areas are defined as areas where riparian-dependent resources receive primary emphasis (see figure 1-08). Riparian habitat conservation areas for wetlands less than 1 acre have an interim riparian habitat conservation area width that is generally 100 feet slope distance and, if not in a priority watershed, the width is generally 50 feet. For wetlands greater than 1 acre, the riparian habitat conservation area width is generally 150feet. The 1986 forest plan has standards and guidelines that promote northern bog lemming habitat in riparian habitat conservation areas. Although livestock grazing may affect peatlands in some areas, it is not widespread across the Forest; localized impacts to potential bog lemming habitat may occur unless peatland areas are fenced, as would be specified in a site-specific allotment management plan.

Alternatives B modified, C, and D

Desired conditions, standards, guidelines, and suitability related to northern bog lemming habitat do not differ between alternatives B modified, C, and D; therefore, the effects would be the same. Forestwide standard FW-STD-RMZ-01 would establish riparian management zones (see figure-1-07). Under the action alternatives (B modified, C, and D), riparian management zone widths would be greater around peatlands, fens, and bogs than under alternative A. Standard FW-STD-RMZ-01 would increase the riparian management zone width to 300 feet slope distance (with qualifiers) for all sizes of howellia ponds and fens or peatlands, with standards and guidelines that apply to the entire area. This increased distance for fens and peatlands, the primary habitat of bog lemmings, is beneficial for this species. In addition to consequences discussed in section 3.7.4., subsection "Aquatic, wetland, and riparian habitats," desired condition FW-DC-WL DIV-01 addresses bog lemming habitat and its connectivity. Plan components for riparian management zones and bog lemmings incorporate conservation recommendations in the statewide action plan published by MFWP (MFWP, 2015b).

Compared to the no-action alternative, the action alternatives designate eight more peatlands and fens as management area 3b (see figures 1-01 through 1-04), where peatland protections would be even more extensive. MA3b-Special area-SUIT-01 and 02 state that special areas are not suitable for timber production or commercial use of non-timber forest products. Vegetation management activities (such as prescribed fire) may be allowed if specifically designed to maintain the values and desired conditions associated with the special area. MA3b-Special area-SUIT-03 states that special areas are not suitable for construction of new wheeled motorized trails and areas or associated structures. Existing trails that access these areas are suitable (see also section 3.5).

Cumulative effects

In the past, peatland hydrology may have been affected on all lands by cattle grazing, adjacent road building, dredging, filling, timber harvest, or fire suppression, but regulations for wetlands (e.g., by U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, Montana Department of Fish, Wildlife and Parks, Montana Department of Natural Resources and Conservation) now protect wetlands on all lands.

How the natural range of variation in the past has affected peatlands and fens is unknown. Fire suppression may increase cover, but it can also increase the risk of high-severity fires near peatland habitat, especially if summers become hotter and drier in the future. Small peatlands may occur in naturally small and isolated patches, making them vulnerable to extended periods without water due to changes in groundwater. Larger peatlands with deeper water are not as vulnerable. Peat accumulates very slowly, typically increasing at a rate of 8-11 inches over a period of 1,000 years. Constant high water levels lead to accumulation of organic matter, which is usually greater than 15 inches deep. As summarized by Gage and Cooper (2013),

> Stable hydrologic regimes are necessary for peat accumulation, and a water table decline will, over time, result in peat oxidization. Because fens vary widely in geomorphic setting and hydrologic functioning, and few long-term hydrologic data are available for different fen types, it is difficult to generalize about the likely response of fens to past climatic fluctuations. The HRV [historical range of variation] for key climatic factors important to fen hydrologic regimes and carbon accumulation dynamics such as the amount and seasonality of precipitation, timing of spring snowmelt, and temperature is broad and includes extended periods of both wet and cool conditions and extended dry periods. (p. 159)

Existing peatlands are believed to have been formed over a period of about 1,000 years, with extended dry periods and other climatic fluctuations in the past, and they have persisted. It is likely that they will persist in the future.

Common loon

Affected environment

The breeding range of the common loon is distributed across most of Canada and Alaska. Northwest Montana is at the southern edge of the common loon breeding range, and the Montana population migrates primarily to the West Coast for winter. Common loons are vulnerable to predation and to chemical contamination of their coastal wintering habitat (e.g., oil spills, lead or mercury contamination) (Evers, 2014).

Northwest Montana has a 10-year average summer count of 230 individuals at most, including about 60-70 territorial pairs, 50-60 non-breeding “single” adults, and about 35-55 chicks. The number of territorial pairs in Montana has increased by 44 percent from 2006-2014, and chick production has also increased (Byrd, Kneeland, Persico, & Evers, 2015). Hammond and others suggest that Montana’s population may be stable (C. A. M. Hammond, Mitchell, & Bissell, 2012; MT-CLWG, 2013).

Three of Montana’s four areas of highest loon-breeding densities are within the Forest analysis area (this also includes other land ownerships). On the Forest, there are about 25 known breeding pairs on nesting lakes distributed across the Hungry Horse, Middle Fork, North Fork, Salish Mountains, and Swan Valley geographic areas (Kuennen, 2013i; Kuennen, 2013a). About half of the lakes with breeding pairs have shoreline on NFS lands. In addition to the approximately 50 lakes with known or potential nesting habitat, many more lakes are used by loons for feeding within the Forest.

Availability of nesting lakes in a complex with additional feeding habitat is a key ecosystem characteristic. Common loons nest and feed on lakes of suitable size and elevation. In northwest Montana, the highest common loon nest success was observed on lakes greater than 13 but less than 60 acres in size (C. A. M. Hammond, 2009). In northwest Montana, lakes less than 5,000 feet in elevation generally have a long enough ice-free season to accommodate loon nesting (C. A. M. Hammond, 2009). Not only are lake-scale habitat factors important to loon management, but landscape-scale factors are important as well, especially complexes of lakes that provide for feeding near nesting lakes. Hammond and others (2012) expressed a need to protect occupied territories and prioritize conservation efforts for lake complexes that have high numbers of territorial pairs. These territories are likely to remain occupied over time and to provide the population growth necessary for the occupancy of surrounding unoccupied habitat.

Nest success may decrease when loons are exposed to disturbance, based on work by Kelly in 1992 and Vermeer in 1973 (C. A. M. Hammond et al., 2012), but some loons appear to tolerate disturbance, according to a 1982 report by Titus and VanDruff (C. A. M. Hammond et al., 2012). In 1981, Christenson reported that because loons may spend more time off their shoreline nests if disturbed, their eggs are more vulnerable to predators (C. A. M. Hammond et al., 2012). In addition, Vermeer reported in 1973 that recruitment may decline over time as loons are less likely to return to territories experiencing excessive disturbance and therefore must either compete for territories occupied by other pairs or establish new ones on unoccupied lakes (C. A. M. Hammond et al., 2012).

High lead and/or mercury levels in feeding lakes or lake sediments can negatively affect loons (Savoy, 2004). Chemicals used to kill undesirable fish species may indirectly affect loons by reducing food availability, at least in the short term. Chemicals in State waterbodies are monitored by agencies other than the Forest Service.

Key stressors

Land management

On all lands, stressors include disturbance near lake shorelines with loon nesting resulting from recreational use, disturbance from vegetation management or road construction, or loss of protective vegetation (at the nest site or between sources of shoreline disturbance and nursery areas).

Water-based recreation on nesting lakes

People approaching too close to loon nests in boats, in float tubes, or on paddleboards can flush nesting loons from the nest for prolonged periods of time, leading to loss of eggs due to cooling or predation. Boat wakes can flood and flush eggs from nests. The Forest Service does not have authority over recreational use on lakes or on other land ownerships. The State regulates recreational activities such as fishing, boating, and wake limits on recreational lakes.

Changing climate and weather

Evers (2014) hypothesized that potential climate changes can affect loons by (1) changes in air and water temperature that can affect the production, abundance, and distribution of aquatic organisms that provide food for the common loon, either directly or indirectly; (2) prolonged drought that could alter the depth of water, flow of water, and water-borne nutrients in a lake; and (3) changes in water chemistry. The historical range of variation for these factors is unknown, but common loons nest on large lakes, which tend to be relatively stable in changing climatic conditions.

Key indicator for analysis

The following species-specific indicator applies to common loons:

- Key ecosystem characteristics of loon territorial nesting lakes, including minimizing the risk of human disturbance to nesting loons

In addition, refer to effects of alternatives described in section 3.7.4., subsection "Aquatic, wetland and riparian habitats" and sections 3.2.3 through 3.2.13.

Environmental consequences

Effects common to all alternatives

Plan components would support key ecosystem characteristics described in the "Affected environment" section. Hammond et al. (2012) stated that Montana's loon population was in a state of equilibrium and that management for stable or growing loon populations could be achieved using long-term monitoring and protection of loons on occupied territorial nesting lakes and nearby feeding lakes. The Forest has been helping to protect nesting loons for decades and would continue to do so under the plan direction for all alternatives.

Alternative A

Riparian habitat conservation area management direction provides for most key ecosystem characteristics for common loons because it provides protection for riparian habitat areas within 150 feet of lakes where loons nest and feed. However, riparian habitat conservation area direction does not address human disturbance at loon nesting lakes.

Alternatives B modified, C, and D

Key ecosystem characteristics described in the "Affected environment" section would be supported by the implementation of the coarse-filter plan components for watersheds and riparian management zones included in all action alternatives that would reduce the risk of cover loss and manage road access near nesting lakes, described in section 3.2.10. In addition, species-specific plan components included in all action alternatives would reduce the risk of human disturbance to nesting loons. Desired conditions FW-DC-WL DIV-01 and 02 and guideline FW-GDL-WL DIV-05 would reduce the disturbance of loons at code A territorial nesting lakes (those with current or recent nesting) (C. A. M. Hammond, 2009, appendix A or subsequent MFWP updates). Objective FW-OBJ-WL DIV-01 specifies that the Forest Service would install structures such as floating signs or nesting platforms to promote successful common loon reproduction on three to ten lakes annually, as needed.

Cumulative effects

Past disturbance is thought to have depressed loon populations. Common loon populations on the Forest and adjacent lands managed by other landowners have rebounded from the lows of the 1980s due to more than three decades of coordinated effort by multiple agencies, private organizations, and private landowners. These efforts have included educating recreationists about the sensitivity of loons to disturbance while loons are nesting and raising young chicks, the negative effects of contaminants such as lead, and the importance of maintaining diverse, abundant populations of fish in nesting lakes. Efforts have also included placing floating signs around active nests and/or placing floating nesting platforms on lakes with high levels of water fluctuation or strong boat wakes. In the future, given expected increases in the number of recreational users and the development of private shorelines, these efforts are anticipated to continue. Campgrounds and boat ramps that facilitate access to lakes can indirectly contribute to human disturbance of nesting loons on some lakes. Grizzly bear standard FW-STD-REC-01 limits increases in the number and capacity of developed recreation sites in the recovery zone/primary conservation area, which could also reduce the risk of disturbance of nesting loons on some lakes in the future.

Habitats preferred by the common loon in northwest Montana are also expected to continue to change as a result of human land uses on all lands, particularly in the developed valley bottoms where many nesting lakes are located. Private land development on shorelines and increasing recreational use on some lakes may limit nesting habitat or increase disturbance. Lakes tend to be popular recreation destinations, so on lakes with mixed ownerships, disturbance to nesting loons by people who approach too close is likely. Some lakes that have nesting loons are adjacent to private lands, and most disturbances are likely to come from private lands and residences. Continued coordination and mitigation of these effects will be necessary.

The effects of environmental contaminants (e.g., mercury) on loons associated with the Pacific Coast environment where loons winter is being monitored (Byrd et al., 2015).

Some climate change predictions include more frequent storms and greater fluctuations in water levels (see the climate discussion in USDA, 2014b). Because loons have difficulty walking on land, their nests are often very close to lake or island shorelines. Increasing water levels, more frequent storms, or more wave action may destroy nests during the time period when adults are incubating. Some, but not all, loons may renest. Because the probability of these risks actually occurring is based upon a variety of factors (e.g., lake-basin configuration), the level of risk is not currently known, but loon nesting success is monitored by multiple partners, which will help support adaptive management.

Beaver

Affected environment

Beavers are distributed across most of North America and are year-round residents across Montana. Beavers are considered to be ecological engineers that create habitat for many other species, so they play an important role in helping to sustain biodiversity. Beavers use much of the woody vegetation they cut in building dams and lodges. Beavers eat a variety of shrubs and hardwood trees, including willows, mountain alder, aspen, and cottonwood, which they cache near shore for winter food. They also eat herbaceous vegetation during summer.

The number of beaver dams on NFS lands is unknown, but they are widespread across the Flathead Valley (Newlon & Burns, 2010). Beaver prefer to build dams on small- to medium-sized, low-gradient streams (< 6 percent slope) that flow through unconfined valleys and generally populate the lowest-gradient (slope < 1-2 percent) sites first (Pollock, Lewallen, Woodruff, Jordan, & Castro, 2015). Beaver also build dams on lakes, wetlands, culverts, or just about any place where additional water can be retained. They generally avoid constrained valleys with high-gradient streams but will colonize this less-preferred habitat if their population densities are high. Water impoundments built by beavers elevate the water table and expand the saturated surface area of riparian zones; they can also convert upland plant communities into wetland plant communities or expand the area of wetlands. Beaver ponds can also trap sediment and increase productivity of streams by increasing the availability of organic nutrients (Pollock et al., 2015) and by allowing sunlight to reach more water surface for photosynthesis. Because beaver impoundments can slow the flow of a stream, they hold the water within the stream reach for longer periods and can increase base flows as well as warming the temperature. Warmer temperatures are beneficial to some species but detrimental to others.

Key stressors

Human activities

Beaver dams have been removed when they create conflicts with human infrastructure or cold-water fish species, but this tends to be a short-term solution as new beavers will often reoccupy a site within one or two years. Alternative methods can be used to reduce the impacts of dams without removing them (Pollock et al., 2015). When beavers threaten infrastructure on private lands, they are often trapped and removed. Montana Fish, Wildlife and Parks regulates trapping.

Changing climate

A changing climate is not believed to be a substantial stressor for beavers in northwest Montana; instead, beavers may increase habitat resilience to changes in climate.

Key indicator for analysis

The Forest can provide habitat for beavers by providing for biodiversity, which includes the deciduous trees and shrubs they feed upon and use for dam building. The following species-specific indicator applies to beavers:

- Habitat to facilitate construction of and reduce the risk of loss of beaver dams

In addition, refer to the effects of alternatives described under section 3.2 and section 3.7.4., subsection “Aquatic, wetland and riparian habitats” and “Hardwood tree habitats.”

Environmental consequences

Effects common to all alternatives

Under all alternatives, plan components for riparian habitat conservation areas or riparian management zones would support key ecosystem characteristics for beavers and the wetland habitats they create for many other animal and plant species.

Alternative A

Alternative A does not have plan components that support the presence of beaver dams.

Alternatives B modified, C, and D

Plan components for aquatic, wetland, and riparian ecosystems and key ecosystem characteristics would improve habitat diversity for beavers and for the other species associated with the wetlands created by beaver dams. In addition, species-specific desired condition FW-DC-WTR-14 would promote the ecological role of beaver. When managing beaver dams that are threatening infrastructure or impairing bull trout spawning, guideline FW-GDL-WTR-04 limits activities to those preferred techniques that sustain beavers.

Cumulative effects

Private landowners are likely to continue to remove beaver dams and/or trap beavers if they flood roads or property. Beaver pelt prices determine their popularity for recreational trapping, and MFWP regulates trapping to sustain beaver populations. Glacier National Park, encompassing about a million acres adjacent to the Forest, is closed to trapping. Beavers play a role in creating wetlands in Glacier National Park and the Flathead Indian Reservation adjacent to the Forest.

Maintaining beaver across the landscape may help the resilience of aquatic ecosystems in the face of anticipated future climates, benefiting many other aquatic, wetland, and riparian wildlife species in the future. Water storage from beaver impoundments may support the sustainability of wetlands and riparian habitats by capturing runoff for slow release downstream. As water storage in the form of glaciers and snow decreases, surface and groundwater storage behind beaver dams may provide a buffer for base flows (Beechie et al., 2013).

Larger and higher-severity wildfires associated with changing climate may initially reduce availability of food and dam-building materials for beavers, impairing their ability to survive the first few winters after fire. Within a few years, shrubs and deciduous trees would regenerate in burned areas and increase forage and building materials for dams.

Boreal (western) toad

Affected environment

The range of the boreal toad extends from Alaska south to Mexico, across the western United States and across western Montana. Maxell (2000) conducted a systematic survey of standing waterbodies in 40 randomly chosen 6th hydrological unit code watersheds across western Montana. Boreal toads were found in 27 percent of the watersheds (Kuennen, 2013a), with breeding documented in 21 percent. At sites where toads were observed, only small numbers of adults and relatively small numbers of eggs or larvae were observed. In Glacier National Park, adjacent to the Forest, surveys conducted in 1999-2000 detected breeding boreal toads in 5 percent of the watersheds surveyed. Maxell's conclusion was that toads were recovering since a decline in the 1980s or were continuing to decline because populations were small, isolated, and/or subject to one or more factors impacting populations separately or synergistically, as had been known to occur in Colorado, Utah, Wyoming, and New Mexico (B. A. Maxell, 2000). However, a subsequent study of boreal toads in Glacier National Park found that they dramatically increased in numbers after fires in 2001 and 2003.

Similarly, there were extensive wildfires in the North Fork, South Fork, Swan Valley, and Hungry Horse geographic areas of the Forest in 2003. Extensive monitoring has occurred on the Forest during 15 years of annual citizen-science Herpetology Days surveys. Across the Flathead National Forest, juvenile or adult boreal toads have been observed in 35 of the National Hydrologic Dataset subwatersheds. In the last 10 years or so, the Montana Natural Heritage Program database has 62 records of this species on the Forest, including an estimated 58,000 juveniles and immature toads from about 27 sites. Boreal toads may be in decline in the more arid grazing lands east of the Continental Divide and their breeding ponds on the Forest (as well as their populations) may fluctuate, but 15 years of monitoring on the Forest does not provide evidence of a decline.

Boreal toads are prolific breeders and are highly mobile. They breed in a wide variety of aquatic habitats, ranging from low-elevation beaver ponds, reservoirs, streams, marshes, lakeshores, potholes, wet meadows, ditches and marshes to high-elevation ponds, fens, and tarns at or near treeline. They exhibit a preference for shallow, warm areas with mud or silt bottoms (B. A. Maxell, 2000). Breeding sites used by toads can experience a high level of fluctuation in water levels from year to year due to drought and natural variation in groundwater and runoff levels, as well as through changes in water yield and water temperature caused by tree harvest and wildfires. Small breeding ponds created by seeps may dry out in some years before metamorphosis occurs, killing tadpoles and rendering reproduction entirely unsuccessful at that site for the year (B. A. Maxell, 2000). After breeding, adult toads disperse into surrounding terrestrial habitats. Toads can remain away from surface water for relatively long periods of time. Although they inhabit a variety of both wet and dry upland habitats, adult boreal toads are largely terrestrial and may move more than a mile away from water after the breeding season is finished (MNHP-MTFWP, 2015e).

Juveniles are often present in wetlands adjacent to breeding sites and may overwinter along the borders of sites where they were born (Nussbaum, Brodie, & Storm, 1983). Adult and juvenile western toads dig burrows in loose soil, use the burrows of small mammals, or occupy shallow shelters under logs or rocks. At least some toads overwinter in terrestrial burrows or cavities where conditions prevent freezing (MNHP-MTFWP, 2015e).

On the Forest, boreal toad habitat was modeled based upon riparian landtypes. On NFS lands of the Forest, there are at least 23,000 acres of modeled boreal toad breeding habitat, not including lands in the Bob Marshall and Great Bear Wilderness Areas (USDA, 2014b, 2017). Although small wetlands and small waterbodies on the Flathead may go through large fluctuations in water levels from year to year, monitoring has shown that they appear to reoccupy sites during years when water levels become suitable. Boreal toads are distributed across abundant aquatic, wetland, and riparian habitats in all Forest geographic areas and do not appear to be experiencing low numbers, isolated populations, or declines observed in some other areas. Based upon findings by Guscio et al. (2008) in areas adjacent to the Forest, increases in wildfires on the Forest in recent decades have improved habitat for boreal (western) toads.

According to Guscio (2008), toads that bred in the Robert burn in the spring of 2003 were found exclusively in burned habitats during the summer months, and toads used high-severity burn areas much more than expected. Severely burned areas were more open, but toads could use burned areas without great risk of increased water loss as long as they had cover provided by downed logs, etc. They also found that boreal toads shifted their use away from severely burned habitats to moderately burned areas later in the summer because partially burned areas had more groundcover and canopy cover and likely retained more soil moisture (Guscio et al., 2008). In an Oregon study, Bull found that boreal toads used sites with tree harvest or prescribed burn activities in proportion to their availability and were not avoided by boreal toads (Bull, 2006). Areas with no trees, or with tree seedlings, were used more than expected based on availability, whereas older stands were used less. Timber harvest and wildfire can affect boreal toads by changing vegetative cover, which can indirectly affect the water level and temperature in breeding sites. Since boreal toads prefer warm water, this is generally not a negative factor for the cold waters of the Forest.

Boreal toads may congregate around roads in the late evening and early morning.(B. A. Maxell, 2000). They may be run over by motor vehicles when they move from breeding habitats to non-breeding habitats, especially on highways and other high-speed roads that are traveled at night.

Cattle grazing may be a stressor for boreal toads, but this is a very minor factor on the Forest because it is predominantly a forested environment, whereas habitat east of the Continental Divide in Montana is predominantly a grassland environment. Since 1986, more than half of the cattle allotments on the Forest have been vacated and closed. As of 2014, the Flathead National Forest had nine active grazing allotments in two geographic areas: Swan Valley and Salish Mountains (see section 3.24 for more details).

Certain chemicals in the water or sprayed within about 330 feet of waterbodies can be lethal to toads during certain stages of the toad life cycle (B. A. Maxell, 2000). The Forest has mapped aerial retardant avoidance areas and also limits the use of herbicides and pesticides within about 330 feet of waterbodies unless their use is necessary to control invasive species.

Die-offs of boreal toads in the southern Rockies have been associated with chytrid fungus (*Batrachochytrium dendrobatidis*) infections (Garner et al., 2006). Limb deformities in toads have been linked directly to trematode infections by *Ribeiroia ondatrae* (Johnson et al., 2002). Chytrid fungus is present in a variety of amphibians in Montana, and deformities in toads have been observed in some areas (B. A. Maxell, Hokit, Miller, & Werner, 2004).

Key stressors

Invasive species

Chytrid fungus is not known to be present on the Forest, nor have any deformities been observed. The invasion of breeding sites by non-native bullfrogs, which feed on boreal toad eggs and tadpoles, has occurred at one location in the Salish Mountains geographic area (MNHP, 2013b). On all lands, invasion of small, shallow breeding ponds by Reed canary grass (*Phalaris arundinacea*) can cause breeding ponds to dry out, and this has occurred in portions of the Swan Valley and Salish Mountains geographic areas.

Changing climate

Increased incidence of drought associated with a changing climate could have a negative effect on boreal (western) toads if it repeatedly causes breeding ponds to dry up before immature toads are able to survive out of water. Because the Forest has widespread, diverse waterbodies of a wide range of sizes that are used by boreal toads for breeding, the impacts of changing climate conditions on boreal toads are expected to be relatively low. Increases in wildfires are expected to have a neutral or positive effect.

Key indicator for analysis

The following species-specific indicator applies to the boreal toad:

- Key ecosystem characteristics of boreal toad habitat, including minimizing the risk of aquatic invasive species in ponds and wetlands used for breeding

In addition, refer to the effects of alternatives described under section 3.2 and section 3.7.4, subsection "Aquatic, wetland and riparian habitats," and sections 3.2.4, 3.2.9 and 3.6.

Environmental consequences

Effects common to all action alternatives

Under all alternatives, plan components for riparian habitat conservation areas or riparian management zones would provide for key ecosystem characteristics for boreal toads.

Alternative A

Riparian habitat conservation area management direction provides for most key ecosystem characteristic for boreal toads because it provides protection for riparian habitat within 150 feet of ponds, lakes, and wetlands greater than an acre in size and within 50-100 feet of wetlands less than an acre in size where boreal toads breed. Riparian habitat conservation area management direction also limits new roads in riparian habitat conservation areas. Alternative A does not have specific management direction to address aquatic invasive species in ponds, but the Forest works cooperatively with other agencies to prevent and treat invasion.

Alternatives B modified, C, and D

Under alternatives B modified, C, and D, standard FW-STD-RMZ-01 provides for key ecosystem characteristics for boreal toads because the riparian management zone around wetlands greater than 0.5 acre would be increased to a distance of 300 feet. Plan components for the boreal toad incorporate conservation recommendations in the statewide action plan published by MFWP (2015b). In addition, standards for snags and downed wood (see section 3.3.7) would provide habitat for boreal toads in upland habitats. Standards FW-STD-IFS-01 through 05 and guideline FW-GDL-IFS-02 would indirectly reduce the risk of mortality of boreal toads as they move from aquatic to upland habitats.

Plan components for invasive species and roads included in all the action alternatives would reduce the risk of spread of aquatic invasive species as well as the risk of mortality due to roads. Desired condition FW-DC-WTR-12 states that aquatic ecosystems are free of invasive species such as zebra mussels, New Zealand mud snails, quagga mussels, and Eurasian milfoil. Non-native plant and amphibian species are not expanding into waterbodies that support native amphibian breeding sites (e.g., non-native bullfrogs, Chytrid fungus, yellow flag iris, or reed canary grass). Desired conditions FW-DC-NNIP-01 through 04 and guidelines FW-GDL-WTR-06 through 08 also would benefit boreal toads by reducing the risk of aquatic species invasion. Objective FW-OBJ-NNIP-01 would provide direction to treat 12,000 to 16,000 acres over the expected 15-year life of the plan to contain or reduce non-native invasive plant density, infestation area, and/or occurrence. Some of these acres would restore sites that provide boreal toad habitat.

Cumulative effects

Boreal (western) toads are cumulatively affected by activities occurring in waters where they breed as well as activities on land. Monitoring has shown that the invasive plant reed canary grass occupies some boreal toad breeding sites in areas of intermingled public and private lands, such as the Swan Valley and Salish Mountains. In recent years the Forest has implemented projects to reduce the invasion of reed canary grass in wetlands of the Swan Valley geographic area.

On all lands, livestock grazing in shallow breeding ponds may remove emergent vegetation used by larvae, and trampling by livestock may crush tadpoles. However, livestock grazing is a very minor activity on most of the Forest and boreal toad breeding sites are widely distributed, so livestock grazing has minor effects on the Forest.

Although diseases and parasites are not known to be a factor on the Forest, die-offs of boreal toads have occurred in the southern Rockies and may occur in the northern Rockies (including the Forest) in the future. These die-offs have been associated with chytrid fungus (*Batrachochytrium dendrobatidis*) infections. Other pathogens that may affect boreal toads include the fungus *Saprolegnia ferax* and the trematode *Ribeiroia ondatrae* (Johnson et al., 2002). Pathogens may be spread by the actions of others.

Past timber harvests have created open habitats that are favored by boreal toads, provided that downed woody material was retained in the harvest units. Downed woody material retained on NFS and State lands benefits boreal toads by providing cover. An increase in wildfire and the use of prescribed fire in recent decades has been beneficial to the boreal toad for the same reasons.

Roadside ditch breeding sites are vulnerable to seasonal dry-up and impacts from activities such as road grading and maintenance. This impact is most likely to occur on private lands. On NFS lands, the magnitude of this effect is difficult to quantify, but it appears to be relatively small because traffic levels on most NFS roads are low during the toad breeding season and most NFS roads do not have high-speed use, reducing the risk of mortality (USDA, 2017).

Bald eagle

Affected environment

Population, life history, habitat, and distribution

The bald eagle is distributed across most of North America, including across Montana. The bald eagle was removed from the Federal list of threatened and endangered species in 2007, but it continues to be protected by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Bald eagle population biology, ecology, habitat, and relationships identified by research are described in the Pacific Bald Eagle Recovery Plan (USFWS, 1986) and the Montana Bald Eagle Management Plan (MBEWG, 2010; USDI-BR, 1994). Formal surveys for nesting bald eagles, including those on the Forest, are conducted by MFWP in cooperation with the USFS and other State, Federal, and volunteer partners.

The Pacific Bald Eagle Recovery Plan identified bald eagle management zones. Portions of Idaho, Washington, and Montana (including the Forest) are in the Upper Columbia Basin zone #7 (USDI-BR, 1994). In 2010, 180 of the 242 known nests in Montana’s zone 7 were checked, revealing 77 percent nesting success with 190 eaglets produced. The population continues to increase, and nesting birds are starting to occupy areas that were previously considered to be marginal habitat at best (MBEWG, 2010).

There has been a steady increase in the number of statewide bald eagle territories, from less than 100 in 1989 to over 600 in 2010. Nesting bald eagles are territorial (limiting their nesting density), but they are well distributed in suitable habitat across the Forest. There are 10-13 known active nest territories on or immediately adjacent to NFS lands on the Forest (USDA, 2014b).

In Montana, bald eagles nest in very large trees (typically greater than 30 inches d.b.h.) in forests with an uneven canopy structure and in direct line of sight of a large river or lake that is generally less than 1 mile away. On the Forest, nests have been located in western larch, ponderosa pine, Engelmann spruce, and black cottonwood trees.

Bald eagles generally feed near large rivers and lakes, where they prey on fish, waterfowl, and small mammals, steal food from other predators, and scavenge carrion. During the breeding season, important foraging habitat is usually less than 10 miles from the nest. Some eagles stay in the general vicinity of the nesting area during winter, but others may migrate hundreds of miles to wintering grounds. During the winter, roost trees are used by bald eagles for shelter.

Key stressors

Land management

On all lands, wildfire, along with timber harvest and other types of vegetation manipulation, can affect nesting habitat by removing nest trees, roost or perch trees, or nest screening cover. Prolonged loud activities (e.g., blasting or gravel crushing) or recreational use in which people stop and remain under a nest site may disturb nesting bald eagles. On non-Forest land ownerships, commercial or residential development near lakes and large rivers may result in loss of nesting habitat or disturbance to nesting bald eagles. Direct mortality from collisions with power lines or along high-speed highways may occur when bald eagles scavenge roadside carrion.

Chemical contaminants

In the past, one of the greatest threats to bald eagles in the United States was the high level of persistent organochlorine pesticides (such as DDT) occurring in the environment. Because bald eagles are at the top of the food chain, DDT affected their successful reproduction by causing egg-shell thinning. DDT was subsequently banned in the United States, and bald eagle populations grew at exponential rates following the ban. Lead poisoning is still known to occur when bald eagles ingest lead from lead shot, bullet fragments, or sinkers buried in their food.

Changing climate

An increase in stand-replacing wildfires could result in the loss of nest trees, especially if the trees are located in very dense stands and/or there are ladder fuels present to carry fire into the crowns of the nest trees. Bald eagles use large lakes and rivers as well as terrestrial habitats and so are not believed to be sensitive to climate change effects on their widely varied food sources. This is because they can move long distances to find food.

Key indicator for analysis

The following indicator applies to the bald eagle:

- Key ecosystem characteristics for the bald eagle, including very large trees and snags for nesting and roosting within 0.5 mile of large rivers and lakes, and to reduce the risk of human disturbance to eagles at active nest sites

In addition, refer to the indicators and effects of alternatives described section 3.2.10, section 3.7.4, “Aquatic, wetland, and riparian habitats,” and sections 3.3.6 and 3.3.7.

Environmental consequences

Alternative A

The 1986 forest plan provides direction to apply the guidelines and recommendations contained in the Pacific Bald Eagle Recovery Plan, as updated in 2010 (MBEWG, 2010), during site-specific analysis. Implementation of the following management direction has contributed to a recovered bald eagle population and would continue to do so under alternative A:

- Prohibit cutting of snags for firewood within 300 feet of any river, lake, or reservoir.
- Prohibit disturbance-causing activities such as road construction, logging and seismic exploration using explosives within ½ mile of active bald eagle nests during the nesting period February 1 through August 1.

Alternatives B modified, C, and D

Compared to alternative A, the action alternatives place more emphasis on management to promote very large tree presence in the valley areas where many bald eagles nest by retaining individual trees and by actively managing forest stands to make them more resilient to expected future stressors (see section 3.3 for more details).

Key ecosystem characteristics described in the “Affected environment” section would be supported by the implementation of plan components for watersheds and riparian management zones as well as vegetation structure, which are included in all the action alternatives. In addition, species-specific plan components included in all the action alternatives would promote the retention of existing and future nest/roost trees and reduce the risk of human disturbances known to disrupt nesting. Desired condition FW-DC-WL DIV-01, standard FW-STD-TE&V-03, and guideline FW-GDL-TE&V-10 would provide emphasis on the retention of key trees used by bald eagles for nesting. Guideline FW-GDL-WL DIV-02 states, “To reduce the risk of disturbance to nesting bald eagles in active nesting territories (as identified in the MFWP bald eagle nesting territory database), visual buffers within ¼ mile surrounding active and alternate bald eagle nest sites should not be removed, but may be enhanced.” Guideline FW-GDL-WL DIV-05 would benefit bald eagles by limiting disturbance from activities known to disrupt nesting bald eagles within 0.25 miles of known, active nest sites from February 1 to August 15. This guideline would allow for site-specific implementation to reduce the risk of disturbance from the time nest-building and incubation begins until young bald eagles have fledged and left the nest area. These guidelines are consistent with the recommendations of the Montana Bald Eagle Management Guidelines (MBEWG, 2010; USDI-BR, 1994) (see also appendix C).

Cumulative effects

The Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act protect bald eagles on all lands. Habitats preferred by the bald eagle in northwest Montana are expected to continue to change as a result of human land uses on all lands, particularly in the developed valley bottoms where many nesting lakes and rivers are located. On all ownerships, fuels reduction within the wildland-urban interface could help to protect bald eagle nesting and roosting habitat, provided suitable trees are retained. Private land development on shorelines and increasing recreational use on some lakes may limit nesting habitat or increase disturbance. Continued coordination and mitigation of these effects by multiple agencies will likely continue to be necessary, although many bald eagles appear to be more tolerant of humans than was once thought.

Although DDT has been banned in the United States, bald eagles continue to be killed by other environmental contaminants (e.g., lead shot or poisons used to kill ground squirrels). This has been a documented source of bald eagle mortality on private lands in recent decades, as has collision with vehicles when bald eagles feed on road-killed animals. Changes in regulations now allow people to remove road-killed big game animals, reducing this risk. These factors cause mortality of individual birds but do not currently appear to be impacting the population as a whole.

Direct mortality due to the poaching of bald eagles was a source of mortality in the past but has been greatly reduced in recent decades as a result of public education efforts about the important role of bald eagles and other birds of prey.

Hardwood tree habitats

Introduction

Hardwood trees occur in riparian as well as upland areas. In the mountainous West, hardwood tree communities are disturbance dependent. Although hardwood trees usually make up less than 10 percent of forest cover in western forests, they are highly preferred as nesting and foraging sites for birds, insectivorous mammals, and amphibians and as a preferred substrate for many invertebrates (Fred L. Bunnell, Wind, & Wells, 2002).

In seven of nine Pacific Northwest studies compiled by Bunnell and others (2002), upland hardwood communities had significantly greater bird species richness than upland conifer communities (especially those forest communities containing quaking aspen or cottonwood trees).

On the Forest, hardwood tree communities are composed of black cottonwood, aspen, paper birch, and water birch. Examples of key ecosystem characteristics for many species associated with this habitat include soft, decayed, or hollow trunks and a branching structure that provides nesting sites. Paper birch is known for loose bark that provides shelter as well as sap and catkins that provide food. Examples of species associated with hardwood forests are the veery, great blue heron, several sapsuckers, downy woodpeckers, pileated woodpeckers, and black-capped, boreal, and chestnut-backed chickadees (Kuennen, 2013d). In addition, several bat species preferentially roost in hardwood trees, including the little brown bat and the silver-haired bat. Mammals such as the fisher, black bear, flying squirrel, and red squirrel are known to nest, den, or rest in very large cottonwood trees where available (Fred L. Bunnell et al., 2002).

Great blue herons usually nest in colonies containing a few to several hundred pairs, building bulky stick nests high in the multiple branches of the largest cottonwood trees available. Most Montana nesting colonies are in very large trees sustained by periodic flooding along major river floodplains and lakes. The veery is a small neotropical migratory bird that nests in moist, low-elevation hardwood forests with a dense shrub understory. They nest in trees, shrubs, or on the ground and do not require trees of large size (Daniel Casey, 2000). In Montana, veeries are often associated with willow thickets and cottonwood stands along streams and lakes in valleys as well as in lower mountain elevations, including the Flathead region (Kuennen, 2013o; MBDC, 2012). The veery prefers disturbed forest, probably because hardwood trees and denser understory conditions are not found in undisturbed forests (Moskoff, 1995 (revised 2005)). On wide, low-gradient rivers (e.g., the Swan River), periodic flooding maintains a highly convoluted pattern of meanders, sloughs, and oxbow lakes. Because this pattern is changing constantly due to periodic flooding, cottonwoods and shrubs are the predominant vegetation; conifers are more patchy because they only become established in the intervals between flooding events. Beaver activity also helps to maintain cottonwood/shrub communities and complements the effects of flooding.

This section assesses effects to most species associated with hardwood tree habitats.

Affected environment

According to Forest Inventory and Analysis data, the hardwood tree dominance type covers an estimated 1.3 percent of the Forest (about 31,000 acres). These are areas where black cottonwood, aspen, or paper birch are the dominant species, though there may be conifer trees present as well. Though they do not dominate, hardwood trees are present on other areas of the Forest as well, usually as a minor component of conifer-dominated forests. Aspen is present on an estimated 0.9 percent; paper birch is present on an estimated 1.4 percent; and black cottonwood is present on an estimated 2.0 percent of the Forest, according to Forest Inventory and Analysis data (see section 3.3.3).

Nearly 70 percent of the hardwood tree dominance type is located in the valley bottoms of the Swan Valley geographic area and the far north and far south ends of the North Fork geographic area. Hardwoods are often associated with the wet meadows and ponds that occur in these areas. The acreage of habitat suitable for the growth of very large cottonwood trees for nesting is naturally very limited on the Forest, ranging from about 270 acres in the Salish Mountains geographic area to about 5,700 acres in the Swan geographic area, mostly on other land ownerships, with a small portion on Forest lands (see USDA, 2014b for more details). Some upland areas are also capable of growing hardwood trees. On the Forest, aspen and paper birch occur in upland areas and are not as dependent upon seasonal flood flows as cottonwood is. Increases in wildfire in some geographic areas (e.g., the North Fork, South Fork, and Hungry Horse geographic areas) since 2003 have increased hardwood tree dominance and presence in upland areas in recent decades. To sustain hardwood tree communities, Bunnell and others (2002) recommend encouraging upland patches of hardwoods, avoiding the conversion of riparian areas to conifer communities, and controlling domestic grazing in riparian areas.

Key stressors

Land management: On all lands, vegetation management activities such as timber harvest, thinning, prescribed fire use, fire suppression, and livestock grazing can affect the quantity and quality of hardwood tree habitats. Private land development in the valleys can affect the availability of hardwood tree habitats.

Flooding: Regulation of flood flows by Hungry Horse Dam can affect the regeneration of riparian cottonwood groves on the lower South Fork and main stem of the Flathead River.

Key indicator for analysis of most wildlife species associated with hardwood trees

The following indicator is important for the wide variety of wildlife species associated with hardwood tree habitats:

- Hardwood tree dominance type and presence

In addition, refer to effects of alternatives in sections 3.2 and 3.3.

Environmental consequences

Summary of modeled alternative consequences

Trends over time in the non-coniferous vegetation types (hardwood and grass/shrub plant communities) are difficult to portray through modeling. Persistent non-forested plant communities are relatively rare types on the Forest and are naturally fragmented in nature, and there is no specific direction in the Spectrum model (see appendix 2) to sustain these non-coniferous vegetation types. Therefore, model results, although helpful, should be supplemented with other information for discerning the trend and amounts of these communities over time. Since hardwood trees are largely associated with early-successional forest conditions, modeling of forest successional stages (i.e., forest size classes), disturbance processes, and their effects on non-coniferous vegetation can provide insight and information for the assessment of trends in hardwood species over time.

Because deciduous trees and shrubs along low-gradient streams are maintained by periodic flooding, Ecosystem Research Group modeled upland riparian deciduous communities that are maintained by other disturbance factors such as fires, insects, and disease on the Forest. Their query was designed to assess the availability of habitats that provide shrubs and deciduous trees within riparian habitat conservation areas/riparian management zones. For the current condition, a GIS layer including the locations of all VMap areas with cover types dominated by shrubs and deciduous trees was used. For purposes of modeling future vegetation treatments, areas that are mapped as riparian habitat conservation areas/riparian management zones are not suitable for timber production. Future habitat was modeled as forest openings containing riparian shrubs and hardwood trees, primarily resulting from moderate- or high-severity wildfires and insects and disease within 20 years following the disturbance.

The model predicts that under all alternatives, upland riparian deciduous communities would stay within the minimum and maximum range of the natural range of variation over the five-decade future time period. Acres of riparian habitat in an early-successional condition would decline slightly during the first two decades, followed by an increase in habitat that returns to near current levels for alternatives B and D. Results of vegetation modeling for alternative B modified are similar to the results for alternative B (see appendix 2).

According to this model, under alternative A, upland riparian deciduous communities would stay well below current levels, probably because wildfires are suppressed in the model and there is no modeling of prescribed burning. Under alternative C, these communities would slightly exceed current levels by decade 5, likely because this alternative includes the most prescribed burning to meet desired conditions. Since upland riparian areas generally produce substantially higher levels of shrubs after a reduction in canopy closure, it might not matter much whether that loss in canopy occurs from fire, insects, disease, or vegetation management. Consequently, it is likely that habitat for riparian species associated with shrub and hardwood habitats would stay at or above current levels, assuming that the modeled increases in natural disturbances are highly probable by the end of decade 5. More frequent fire might favor longer-term (more persistent) presence of these vegetation types, if conifer regeneration is delayed.

Alternative A

Amendment 21 includes the forestwide objective (#6-Veg) to encourage cottonwood, birch, aspen, western red cedar, and western larch as stand components in areas where these species are best adapted. Direction includes implementing management activities to achieve this objective through actions such as planting, thinning, and prescribed fire where consistent with watershed, fisheries, and other riparian objectives and standards. Although the no-action alternative provides some direction to maintain hardwood trees, it does not have specific objectives to increase hardwoods. As a result, other management objectives have often received greater management consideration. The Forest has grazing allotments in two geographic areas, the Salish Mountains and Swan Valley geographic areas. Protection of riparian hardwood communities is implemented through some allotment management plans. This alternative has no restrictions on future grazing allotments.

Alternatives B modified, C, and D

All action alternatives would contribute towards maintaining or improving nesting, denning, roosting, and foraging habitat for species associated with hardwood trees on NFS lands. This is due to plan components that recognize the importance of hardwood trees in providing biodiversity, and desired conditions to maintain or increase hardwood trees on suitable sites. Under the action alternatives, hardwood trees would be addressed by desired condition FW-DC-TE&V-09, which was informed by the model analysis of the natural range of variation and the anticipated influences of future disturbances, particularly fire (see appendix 2). The current conditions of hardwood dominance type and presence of hardwood trees are estimated to be within but at the lower end of the desired range. Maintaining or trending upward in amount of area in hardwood dominance type or in amount of area where hardwood species are present is the desired condition.

A simulation model was used to estimate natural range of variation for certain key vegetation characteristics and to project vegetation conditions into the future (see appendix 2, SIMPPLLE model description). Model results suggest a downward trend in the hardwood dominance type over the next five decades when assessed forestwide. However, the model indicates that fire will continue to be a dominant feature of the landscape, and the model shows the amount of early-successional forest (seedling/sapling size class) trending upward over time forestwide. This suggests that there may be more potential for hardwood species to maintain or increase their presence on the landscape than might be indicated by the model due to the abundance of disturbances that create the early-successional forest openings favored by hardwood species.

Standard FW-STD-GR-05 and guideline GA-SV-GDL-04 would limit cattle grazing allotments and numbers on NFS lands, decreasing the risk that hardwood tree habitats would be impacted by cattle grazing.

The forest plan includes vegetation management objective FW-OBJ-TE&V-03. This objective would promote treatments (e.g., timber harvest, planned ignitions, thinning, planting) to increase hardwoods on 500 to 5,000 acres. This is especially important in areas where hardwoods are not regenerated by flooding and where conifer competition reduces hardwoods (see also section 3.3.4).

Hardwood species are often associated with water features, and the desired conditions for riparian management zones recognize and promote the presence of hardwoods. FW-DC-RMZ-04 and 05 provide for diversity of vegetation composition and structure within riparian management zones, acknowledging that early-successional forest structures supporting riparian-associated grasses, forbs, shrubs, and deciduous trees (cottonwood, birch and aspen) are an important part of this diversity.

Cumulative effects

This section summarizes activities and effects that are common to most species associated with hardwood tree habitats.

In the past, hardwood trees in upland areas in many western forests were considered to be competitors with the higher-value coniferous trees, so they were not maintained or promoted. Fire suppression in some areas has reduced hardwood tree presence. In recent years, paper birch has become more valuable for firewood and is likely to continue to be a popular firewood tree in the future. Very large cottonwood trees may have been removed due to private land development or changes in water flow due to impoundments, such as Hungry Horse Reservoir, but there are no records of how many trees or groves have been lost.

There are hardwood trees with dense shrubs on State or other Federal lands along the major river floodplains of the Forest, including groves of large cottonwoods along the Forest’s boundary adjacent to the south and west sides of Glacier National Park and in the wildlife refuge at the south end of Swan Lake. Cottonwood groves in these two areas would be protected unless they are killed by wildfire. In the future, an increase in high-severity wildfires may kill very large cottonwood trees. Additional streams have been listed as eligible for wild and scenic river designation under all alternatives, so their outstandingly remarkable values would be maintained. Designation of rivers as wild and scenic in the

National Wild and Scenic River System would prevent impoundments in the future, benefiting hardwood tree habitats.

In the future, riparian areas on private lands of the Flathead Valley are likely to continue to be developed, resulting in loss of hardwood tree habitat or increases in other nest predator species associated with human developments.

In summary, proposed management direction on the Forest, in the context of all lands of the larger landscape, contribute to hardwood tree habitats. This would be accomplished by plan components to maintain or increase hardwood trees on suitable sites. Although the Forest does not have authority over all the stressors, the ecological conditions of hardwood tree communities and the processes that maintain them would be provided on NFS lands. Coarse-filter plan components provide for biodiversity and the ecological conditions that support the long-term persistence of the majority of species associated with these habitats. Hardwood tree habitats are distributed across all Forest geographic areas.

Cliff, cave, scree, and rock habitats

Introduction

Cliff, cave, scree, and rock habitats are widespread on the Forest (see forest plan figures B-03-09; note these habitats are included in the “non-forest” potential vegetation type, but they also occur as microsites throughout the forest within other vegetation types.). These habitats are inherently stable for long periods of time because they are changed primarily by geologic forces. About a dozen vertebrate species and about a dozen invertebrates known to occur on the Forest are associated with these habitats on the Forest (see appendix 6). Population surveys of bats are difficult to conduct because of the difficulty in finding and accessing many caves, the nocturnal behavior of bats, their large home ranges, and the difficulty of species identification (Hendricks & Maxell, 2005).

Examples of key ecosystem characteristics include cliffs used for nesting by many bird species; caves and crevices used for roosting and hibernating by many bat species; and rock outcrops or boulder and talus accumulations used by some mammals for hibernation, shelter from the weather, or to escape from predators. Examples of species associated with cliff, cave, scree, and rock habitats include the mountain goat, white-throated swift, turkey vulture, northern alligator lizard, Cordilleran flycatcher, peregrine falcon, hoary marmot, pika, bushy-tailed woodrat, cliff or violet-green swallow, and a variety of bat species. These species are found across the Forest but may have spotty distribution because their primary habitats have naturally spotty distribution. Cliff, cave, scree, and rock habitats make up 2 percent or less of the Flathead ecosystems.

Some species associated with boulders and talus habitats, such as the pika and hoary marmot, are restricted to alpine and subalpine habitats (Kuennen, 2013d, 2013g). Pikas tend to make short-distance movements to gather vegetation next to talus slopes, which they store in rock crevices, whereas marmots travel farther to feed in meadows (MNHP-MTFWP, 2015c). These two species are not known to be sensitive to human disturbance and are observed most frequently in the Flathead’s wilderness areas, where there are virtually no human activities that affect their habitat. There is no inventory of talus slopes and boulders on the Forest.

Caves provide the primary habitat for roosting and hibernating of most bat species in the Northern Region (B. A. Maxell, 2015; NEPA, 2013). Temperature, access by predators, and proximity to foraging habitat and water are some of the factors influencing habitat selection by bats. Caves are extensively used by bats for roosting; bats roost in clusters in microsites within caves of a suitable temperature. The size, configuration, and complexity of a cave influences the microclimate by affecting airflow, air temperature, and humidity. Particular caves may not be equally suitable for the different types of roosting during all times of the year (Rancourt, Rule, & O'Connell, 2005). Old mines, buildings, and bridges are also used by bats. Twelve species of bats have been detected by acoustic surveys on the Forest (A. Shovlain, USFS wildlife biologist, personal communication, 2011). These are all eight *Myotis* species known to occur in Montana plus the big brown bat, the silver-haired bat, the hoary bat, and the Townsend's big-eared bat.

The following section assesses effects to most of the species associated with cliff, cave, scree, and rock habitats on the Forest. Following the general discussion, three species are discussed as examples in order to help display differences in effects of the alternatives. The three species are the Townsend's big-eared bat, mountain goat, and peregrine falcon.

Affected environment

There are a large number of caves on Forest lands, with a wide variety of lengths and depths. Very few of the caves have been inventoried to determine species presence or absence, and the number that have environmental conditions that could support hibernating bats or maternity roosts is unknown. The highest number of caves on the Forest is in the South Fork and Middle Fork geographic areas, where about 163 caves and relatively large rock crevices have been identified within the Bob Marshall Wilderness (Ballensky, 2011). The majority of caves in the Bob Marshall Wilderness have little or no use by people due to their remoteness and the difficulty of accessing them, so they provide a high level of security from disturbance for roosting and wintering bats. Cliffs occur across the Forest at all elevations. For example, cliffs are located near water at Tally Lake and Tally Lake Gorge, along the Flathead River between Columbia Falls and Hungry Horse, and along the South Fork of the Flathead River south of Hungry Horse Reservoir and west of Flathead Lake. Accumulations of boulders and talus occur across the Forest in areas where there are steep slopes.

Key stressors

Blasting, crushing, or removal of rock

On all lands, these activities can result in habitat loss but can also create manmade environments used by some species (see the discussion of saleable minerals in section 3.23 for more details).

Human disturbance of cliff, cave, scree, and rock habitats

Closure of caves to reduce vandalism can make habitat inaccessible to bats if there are no other entry points. Humans can cause disturbance to nesting birds or roosting bats in key habitats.

Changing climate

Species such as the hoary marmot and pika may be susceptible to summer heat stress associated with summer warming. In the northern Rocky Mountains, the temperature tolerance limits of pika are not likely to be reached in the near future (McKelvey & Buotte, in press). Specific microhabitat features such as local moisture sources, the physical structure of talus fields, and northerly aspects may help to buffer the effects of climate changes (Millar & Westfall, 2010).

Disease

White-nose syndrome is a disease that kills large numbers of some species of bats. As of 2016, this disease has been documented in Washington as well as the central states such as Missouri (Heffernan, 2015). In other States, white-nosed syndrome has been documented in two of the bat species known to occur on the Forest, the big brown bat and the little brown bat (B. A. Maxell, 2015). Caving equipment or clothing can spread disease from cave to cave if decontamination measures are not used. Bats can fly long distances across many land ownerships.

Key indicator for most wildlife species associated with cliff, cave, scree, and rock habitats

The following indicator is important for the wide variety of wildlife species associated with cliff, cave, scree, and rock habitats:

- Presence and ecological conditions of cliff, cave, scree, and rock habitats

Environmental consequences

Effects common to all alternatives

Under all the alternatives, ecosystem plan components would meet the needs of most species associated with cliff, cave, scree, and rock habitats (e.g., scree and boulders). These habitats are created by geologic and topographic forces that are very stable.

Alternative A

There is no management direction specific to cliff and rock habitats, but there is management direction for specific species (such as peregrine falcons) associated with this habitat, as detailed in sections of this final EIS on specific species).

Alternatives B modified, C, and D

Desired conditions FW-DC-CAVES-01 through 06 and guidelines FW-GDL-CAVES-01 through 03 for cave and karst features promote ecological conditions to support bats and other animal species that use these habitats. Although the majority of caves on the Forest are not accessible to humans for much of the year, one cave that is very accessible has been vandalized in the past, requiring installation of a protective door. This cave system has multiple chambers that are accessible to bats. Plan components that specify the use of bat-friendly gates, if needed, would help to make caves accessible to bats while protecting the cave resource. The desired condition to educate cavers about the risk of spreading disease (FW-DC-CAVES-06) would also help to protect bats. Guideline FW-GDL-WL DIV-03 states that if old buildings or bridges known to be used as bat roosts are removed, measures should be used to mitigate the loss of bat habitat (e.g., the Forest could install a bat house or roost structure or remove the building or bridge during a time period when bats are not using it, if feasible). Most gravel pits on the Forest are in areas where glacial till deposits occur, so caves, talus, and boulder areas are not impacted by gravel extraction. Guideline FW-GDL-E&M-06 states that available resources at existing gravel pits should be used before constructing new pits.

Cumulative effects

This section summarizes activities and effects that are common to most species associated with cliff, cave, scree, and rock habitats.

Blasting of cliffs or rock may occur in the future in relation to activities such as widening of highways, but most cliffs are on State or NFS lands or within Glacier National Park (adjacent to the Forest) and the value of cliffs in providing habitat for bats and other cave-associated species is recognized, so the risk of cliff habitat loss is very low. There have been very few past impacts to high-elevation talus and boulder habitats on the Forest because they are generally within wilderness and inventoried roadless areas (see figure 1-73). High-elevation talus and boulder areas are also protected in the Mission Mountains Tribal Wilderness of the Confederated Salish and Kootenai Tribes and in Glacier National Park.

Caving and rock-climbing are popular recreational activities in some areas and may increase in the future, but these activities require specialized training and/or equipment and they are not likely to increase as rapidly as other types of recreation. Recreational cave and mine exploration on all land ownerships can lead to an increased rate of the spread of diseases such as white-nose syndrome. There is a decontamination protocol in place for cavers on NFS lands, which should aid in slowing the spread on NFS lands, but diseases may continue to be spread elsewhere. Because both people and bats may carry diseases and travel long distances, disease can be spread across a wide area. Disease control requires a cooperative effort. Multiple agencies are monitoring bats, which will help support adaptive management of bats.

In summary, the proposed management direction on the Forest, in the context of all lands of the larger landscape, contributes to cliff, cave, scree, and rock habitats. This would be accomplished by plan components designed to protect caves and to keep caves accessible to wildlife if they are closed to prevent vandalism. Although the Forest's ecological capacity to provide cliff, cave, scree, and rock habitats is limited by geologic and topographic factors and the Forest does not have authority over all the stressors, the ecological conditions for cliff, cave, scree, and rock communities and the processes that maintain them would be provided on NFS lands. Coarse-filter plan components would provide for biodiversity and the ecological conditions that support the long-term persistence of the majority of species associated with these habitats. Cliff, cave, scree, and rock habitats are distributed across all Forest geographic areas.

Townsend's big-eared bat

Affected environment

The Townsend's big-eared bat is distributed across the western United States, southwestern Canada, and Central America. Overall, the recent population trend is not well known, but the species appears to be declining in abundance in some portions of the range and to be stable or increasing in others (Gruver & Keinath, 2006; NatureServe, 2015a). In Montana, this species has been documented across all but the northern tier of the state (MNHP-MTFWP, 2015d), but the population and trend is unknown (B. A. Maxell, 2015). Intensive population surveys of bats are difficult to conduct because of the nocturnal behavior of bats, their large home ranges, and the difficulty of species identification while a bat is in flight. Recent acoustic surveys of bats have provided additional information on occurrence. However, "Townsend's big-eared bats are unusually difficult to survey for because they are quite effective at avoiding mist-nets and are difficult to detect acoustically because they use low-intensity calls" (Hendricks & Maxell, 2005).

This bat uses caves, cave-like structures, and mines for wintering, giving birth, and roosting. The Forest has very few old mines. Caves in a complex with diverse aquatic and riparian habitats for feeding are key ecosystem characteristics. A key component of habitat for the Townsend's big-eared bat is roosting habitat, including maternity roosts where bats give birth and raise their young, hibernacula where bats spend the winter, day roosts where bats rest during the day, and night roosts where bats congregate at night when they are actively feeding. Winter and summer roost sites may be limited based on temperature and airflow requirements. Females form maternity colonies during the spring and summer that are typically composed of 20 to 180 females. According to the Montana Natural Heritage Program, most caves and mines in Montana appear to be too cool in summer for use as maternity roosts. In Montana, daytime roosts may include snags and old buildings (Genter & Jurist, 1995).

The Townsend's big-eared bat inhabits Montana on a year-round basis and occurs at low density due to the geologically limited availability of caves used for hibernating and roosting habitat. Cave and mine availability may limit dispersal. Adults appear to have high fidelity to roost sites (B. A. Maxell, 2015). On the Forest, this bat has been observed in three caves—two winter hibernating sites (BHSCC, 2013, 2014; Kuennen, 2013h; Kuennen, 2013q; B. A. Maxell, 2015; MNHP, 2013c; Whittle, Hanauska-Brown, Brown, & Bodenhamer, 2015) and two day/night roosts (B. A. Maxell, 2015). There are no known maternity roosts on the Forest. Many of the caves on the Forest have not been inventoried for the presence of bats, but the Forest is currently gathering valuable information from volunteers. Statewide, there are three known maternity roosts (two in caves, one in a mine) and 39 winter hibernating sites (B. A. Maxell, 2015).

White-nose syndrome is a disease that kills large numbers of some species of bats. The Townsend's big-eared bat is identified as a vector for white-nose syndrome but is not identified as being susceptible to mortality (B. Maxell et al., 2015). A primary cause of population decline in some areas has been listed as human disturbance of caves (Pierson et al., 1999). Disturbance by humans is believed to play a role in the short-term dynamics of local populations, but in some cases what has been interpreted as site abandonment may be normal movement patterns (Sherwin, Montgomery, & Lundy, 2013). The response of Townsend's big-eared bats to human activities is largely undocumented in Montana. The maternity colony at Lewis and Clark Caverns has persisted for over a century, even though it is exposed daily to tour groups (MNHP-MTFWP, 2015d).

The foraging behavior of this bat has not been reported or studied in Montana. Foraging and drinking habitat located near roosts and/or connected by vegetated patches or corridors may be needed to support colonies. The average travel distance from caves of Townsend's big-eared bats is about 2 miles (Gruver & Keinath, 2006; NatureServe, 2015a). In California, the mean center of feeding activity was 2 miles from caves for females and 0.8 miles for males (Fellers & Pierson, 2002). Townsend's big-eared bats feed on various nocturnal flying insects near the foliage of trees and shrubs, especially near beaver pond complexes, meadows, and streams.

Key stressors

Land management

Closure of caves or mines used as winter hibernation sites or maternity roosts can reduce or eliminate key habitat or change the airflow and temperature throughout a cave. Riparian management can affect feeding and day-roosting habitat. Most caves are on public lands, but old buildings or bridges used as roosts may be found on other land ownerships. The Forest has one old mine as well as old buildings on NFS lands.

Human disturbance at maternity roosts or in winter hibernacula

The levels of human use of caves in the plan area are not known, but many cave entrances on the Forest are plugged by snow during winter when this bat is known to use caves on the Forest. Many are in remote wilderness locations where they are difficult to access on a year-round basis. Only one cave closure has been necessary on the Forest to protect cave resources.

Changing climate

Climate influences food availability, timing of hibernation, timing and duration of seasonal migrations, frequency and duration of torpor, rate of energy expenditure, and reproduction and juvenile development in bats. Changes in climate or in the frequency, magnitude, or severity of disturbances such as fire and insect outbreaks have been hypothesized to have an impact on this and other bats but are not currently well understood (Sherwin et al., 2013).

Key indicator for analysis

The following species-specific indicator applies:

- Presence of key ecosystem characteristics for bats, including the Townsend's big-eared bat

In addition, refer to the indicators and effects of alternatives on caves and on feeding and roosting habitat described section 3.7.4, subsections “Aquatic, wetland, and riparian habitat associations” and “Old-growth forest, very large live tree habitat, and very large dead tree habitat.”

Environmental consequences

Effects common to all alternatives

Plan components prevent the net loss of roosting habitat by protecting caves used for hibernating and/or roosting and snags that may be used for day roosts. Plan components provide for diversity and connectivity of the aquatic, wetland, and riparian sites used for feeding. The levels of human use of caves in the plan area are not known, but many cave entrances on the Forest are plugged by snow during winter, so threats to hibernacula are low. Because many caves on the Forest are in a very large wilderness area, they are also difficult to access in other seasons.

Alternative A

The 1986 forest plan does not have management direction specific to Townsend’s big-eared bats but does provide direction for management of caves. The current forest plan states that the Forest will “preserve and protect caves for their unique environmental, biological, geological, hydrological, archaeological, paleontological, cultural and recreational values.” This management direction helps to prevent some disturbances to caves that have the potential to threaten this bat species. However, the management direction does not specifically address human disturbance or the spread of disease.

Alternatives B modified, C, and D

Townsend’s big-eared bat habitat is inherently limited by the geologic conditions that create caves with suitable temperatures to be used as maternity roosts or hibernacula, thus limiting the ecological capacity of the Forest to provide habitat. Most caves on the Forest are in wilderness management areas (management area 1a), where caves are difficult to access and management direction is protective of caves. Where caves are accessible to people, forestwide plan components to maintain cave accessibility for bats and avoid disturbance at known hibernacula (and maternity roosts, if any are discovered) would maintain, improve, or restore key ecosystem characteristics described in the “Affected environment” section (see section 3.7.4, subsections “Cliff, cave, scree and rock habitats” and “Aquatic, wetland, and riparian habitats”). Forestwide guideline FW-GDL-CAVES-03 protects all bats, including Townsend’s big-eared bat, because it states that if caves being used as roosts or hibernacula by bats are closed to reduce safety hazards or vandalism, bat-friendly closures should be installed unless alternative entries for bats are known to be available. Desired condition FW-DC-WTR-14 provides for the foraging habitat of this bat species. This desired condition states that beavers play an important ecological role, benefiting groundwater, surface water, stream aquatic habitat complexity, and adaptation to changing climate conditions. Guidelines FW-GDL-RMZ-08 through 10 provide for ecological conditions that support feeding and day roosting.

Cumulative effects

Some people are intolerant of bats, and this can lead to disturbance of bats, loss of access to roost sites, or bat mortality. Biologists in Montana are working to increase public understanding of bats and their ecological role as insect predators.

Past timber harvest on all lands has likely altered the availability of snags used for roosting in some localized areas, but insects and disease, as well as increases in wildfire (recent and anticipated for the future) have created abundant snags that can be used for roosting across the landscape (including Glacier

National Park adjacent to the Forest and riparian forest habitats, wilderness areas, and inventoried roadless areas on the Forest) (see section 3.3 for more details).

Aquatic, wetland, and riparian habitats host an abundance of insects, in addition to water for bats. The Townsend's big-eared bat uses large lakes and rivers for feeding, which may have high levels of human development if surrounded by private lands. Lights associated with human developments may attract insects that bats feed upon (and also bats), whereas the use of insecticides can decrease populations of insects that bats feed upon. Since bats are nocturnal, human disturbance has a minor direct effect on feeding.

Changing climate conditions could alter prey abundance, but because the key ecosystem characteristics for bats are abundant on the Forest, this effect is expected to be minor. Grazing will continue on other ownerships, and if it reduces the availability of riparian shrub habitats, there could be a reduction in bat foraging habitat. Grazing has declined on the Forest in recent decades and there are standards to limit increases in the future, which provides for bat foraging habitat on NFS lands.

Surface temperature changes may change the interior temperatures of caves and abandoned mines. Because bats are selective regarding the microclimates in which they will roost, this may cause bats to shift their use elsewhere inside caves or abandon some altogether. There is currently a high degree of uncertainty regarding temperature changes in caves, but a volunteer caving group is helping to monitor this factor.

Mountain goat

Affected environment

The mountain goat is distributed across most of British Columbia as well as in the mountainous regions of Alaska, Washington, Idaho, Montana, and Colorado. On the Forest, mountain goat densities are highest in Glacier National Park and adjacent wilderness and roadless areas of the Forest, including the Bob Marshall Wilderness Complex, Mission Mountains Wilderness, Jewel Basin Hiking Area, and adjacent high-elevation lands. These areas are located in the Swan Valley, Hungry Horse, South Fork, and Middle Fork geographic areas (Kuennen, 2013e). The Salish Mountains and North Fork geographic areas do not have mountain goat populations. Mountain goats on the Forest are within the "Bob Marshall regional population" and have an estimated population of about 360 (range 322-367); about 13 harvest permits are issued annually (Smith & DeCesare, 2017). Weaver (2014) developed models of mountain goat habitat for the Forest and determined that the Forest has about 61,643 acres of winter habitat and about 189,621 acres of summer habitat (Weaver, 2014p. 59, table 5). Weaver's summer and winter habitat data layers were discussed with MFWP biologists and helped refine information used in the Flathead's assessment (USDA, 2014b).

Mountain goats are usually found in the most rugged mountainous areas of steep cliffs and rock bluffs, narrow ledges, rocky canyons, talus, and rock slopes. They are considered nonmigratory, although there may be movement from high-elevation summer habitats to slightly lower elevations during the winter period. In northwest Montana in the Swan Range, mountain goats occur at elevations of about 5,000 feet to 7,600 feet (T. Thier, MFWP, personal communication, 2016). Highly traditional behavior restricts mountain goats to regular seasonal use patterns. Mountain goats feed on grasses, sedges, lichens, forbs, and shrubs.

The kidding time period when females are giving birth to young is a critical time period for mountain goats. Compared to other ungulates, according to a 1991 study by Baily, mountain goats have low reproductive success, and survivorship of goat populations is closely tied to the health of mountain goat nursery groups (Festa-Bianchet, Urquhart, & Smith, 1994). Winter is also a critical time period for mountain goat survival. According to Varley, in winter they use cliffs on south-facing slopes and wind-swept areas where snow accumulations are lower (NWSGC, 1998). Compared to other North American ungulates, mountain goats have a high natural mortality rate (Chadwick, 1977). Mountain goat populations on the Forest are also affected by mortality due to hunting, but the impact is estimated to be minimal given the small number of annual permits issued and the low success rate of permitted hunters.

Mountain goats are hunted under a permit-drawing system with mandatory reporting that is regulated by MFWP. All or portions of about half a dozen mountain goat hunting districts are located on the Forest. In the Bob Marshall Wilderness Complex, mountain goat populations appear stable in recent years but below historical population levels. In an effort to increase mountain goat populations, hunting licenses issued for native mountain goat populations have declined nearly tenfold from the 1960s to the present, as has the annual harvest (Smith & DeCesare, 2017). After extensive aerial surveys in both the Cabinet Mountains and the Bob Marshall Wilderness Complex, biologists observed an overall recruitment rate of 27 kids per 100 adults in 2008, indicating good kid production (J. Vore, 2013). A survey of hunting district #140 conducted by MFWP in 2013 detected 50 mountain goats in the area from the Middle Fork of the Flathead River to the Hungry Horse Reservoir, and the ratio was 32 kids:100 adults—the highest kid production recorded since 1982 (J. Vore, 2013).

Some types of human disturbance have been shown to alter goat behavior and cause a physiological response (Jim Williams, MFWP, personal communication, 2015). In summer, mountain goats are tolerant of humans on foot and also of predictable traffic on roads. Mountain goats may become habituated to humans on trails. Varley reported that sudden loud noises such as blasting or low-altitude helicopter flights elicited extreme alarm responses by goats (NWSGC, 1998).

In winter, goats are at risk of disturbance due to some types of human activities. Varley's review of human disturbance on mountain goats concluded that human disturbance such as motorized over-snow vehicle use on mountain goat winter habitats is rare due to the steepness, ruggedness, and low snow accumulations of mountain goat winter habitats. Snowmobilers seek out the deep snow that mountain goats avoid. However, the author noted that the use of helicopters within 1 mile of winter habitat (e.g., being used to drop off backcountry skiers in remote areas) may pose a threat to mountain goats in winter (NWSGC, 1998).

Geist reported in 1971 that aircraft overflights can alter mountain goat behavior and cause negative physiological responses, which may reduce survivorship (Varley, 1998). Foster and Rahs (1983) reported that mountain goats in British Columbia responded to aircraft with a "severe flight response" during 33 percent of observations. Fifty-five percent of severe flight responses were observed when disturbances occurred at distances less than about 500 feet. Response behavior was correlated with distance to disturbance and distance at which the disturbance was visible, as well as to available security cover, but was not dependent on time of year, group size, or direction of the approach from above or below. Foster and Rahs (1983) also detected temporary range abandonment as a result of disturbance. Recommended separation from known mountain goat habitat (especially nursery groups) ranges from about 500-650 feet (Wilson & Shackleton, 2001). According to Penner in 1998, the strongest responses were elicited by helicopters (Varley, 1998). Of the available literature, Côté in 1996 (Varley, 1998) and Foster and Rahs (1983) studied the effects of helicopters on mountain goats based upon observational data. The two studies independently suggested a 1.25-mile buffer around mountain goats to completely avoid harassment. In a more recent study, Gordon and Wilson (2004) recommended that helicopter activity within about 1,650 yards of occupied mountain goat habitat should be managed to reduce behavioral disruptions.

Female mountain goats show strong fidelity to established seasonal ranges, whereas males are more likely to cross ranges to access females during the breeding season (Chadwick, 1977). Mountain goats may cross highways, and they may be killed when they do so. The behavior of mountain goats in relation to their crossing U.S. Highway 2 near Glacier National Park was studied by Singer (1978), leading him to recommend construction of a highway crossing to reduce the mortality of mountain goats. Two highway underpasses were subsequently built during highway reconstruction by the U.S. Department of Transportation and Montana Department of Highways. These underpasses received high levels of use by mountain goats, and crossing success increased (Singer & Doherty, 1985).

Key stressors

Human disturbance

Activities such as low-altitude fixed-wing or helicopter flights can disturb mountain goats, especially during the time periods when they are raising young or during the winter. The Federal Aviation Authority regulates aircraft. The Forest Service does not have statutory authority over public aviation. The Forest Service does have authority over its own use of aircraft, and it authorizes helicopter landings for purposes such as timber harvest or recreation on NFS lands. Landing of fixed-wing planes occurs at authorized sites on NFS lands. Motorized vehicle access on NFS lands is managed by the Forest.

Changing climate and weather

Effects of changing climate on mountain goats is currently being investigated (see section 3.7.5, subsection “Wolverine,” for more discussion of anticipated changes in winter climate).

Key indicator for analysis

The following species-specific indicator applies to the mountain goat:

- Risk of human disturbance of summer and winter mountain goat concentration and kidding areas.

In addition, refer to the indicators and effects of alternatives on “Cliff, cave, scree, and rock habitats.”

Environmental consequences

Effects common to all alternatives

Plan components would support key ecosystem characteristics for mountain goats because their cliff habitats would have low levels of disturbance during key time periods. Most of the Forest’s mountain goat habitat is in steep, rugged, remote terrain within existing wilderness and inventoried roadless areas, where there is a relatively low level of human disturbance. Motorized use and mechanized transport does not occur in existing wilderness, and designated aircraft landing strips in wilderness occur only where allowed by enabling legislation. Helicopter landings in wilderness is specifically authorized on a case-by-case basis (e.g., for emergencies). Under all alternatives, plan components to limit motorized access in grizzly bear habitat also benefit mountain goats (see also section 3.7.5, subsection “Grizzly bear”). Alternatives differ with respect to areas suitable for motorized over-snow vehicle use (see figures 1-42-45).

Alternative A

The current forest plan does not have management direction specific to mountain goats but does have an objective of providing sufficient habitat to contribute to meeting the objectives of MFWP management plans (p. II-8). Management direction for the Jewel Basin Hiking Area (which overlaps areas of summer and winter mountain goat habitat) does not allow motorized use, reducing the risk of mountain goat disturbance. Under this alternative, existing motorized over-snow vehicle use would continue where it is currently allowed, which includes small areas that overlap with winter mountain goat habitat (see figure 1-14).

Alternatives B modified, C, and D

Forestwide guideline FW-GDL–WL DIV-04 would limit the impacts of helicopter disturbance to known mountain goat winter concentration and kidding areas from December 1 to July 15. Under all action alternatives, the risk of disturbance to mountain goats from motorized over-snow vehicle use or wheeled motorized trail use would be low because most mountain goat habitat on the Forest is already in existing wilderness, backcountry nonmotorized use areas, or the Jewel Basin hiking area, where these uses are not allowed. Although all action alternatives have a very low risk of disturbing mountain goats because mountain goats use very steep terrain, alternative C is slightly more protective because all modeled mountain goat habitat would be in recommended wilderness (management area 1b). Under alternative B modified, most mountain goat habitat would be in existing or recommended wilderness. Under alternatives B modified and C, mechanized transport or motorized use (e.g., mountain bikes, chainsaw use) would not be suitable in management area 1b (see figures 1-15 through 1-17).

Cumulative effects

Mountain goat habitat is found in Glacier National Park, adjacent to the Forest, and on the Forest itself. Connectivity between Glacier National Park and NFS lands in the Middle Fork of the Flathead River has been maintained by an existing highway underpass that is used by mountain goats to access a mineral lick on the Forest Service side of U.S. Highway 2. Glacier National Park, encompassing about a million acres adjacent to the Forest, is closed to mountain goat hunting.

Past habitat management and hunting of mountain goats has been at levels that have sustained the population in most areas. Mountain goats occurred along the Whitefish Divide in the North Fork geographic area at one time but have been absent for close to 50 years. They were probably over-harvested at a time when regulations and road access made goat hunting easier (T. Thier, MFWP, personal communication, 2011). In the past few decades, the Forest has closed many miles of roads in the Whitefish Range. Montana Fish, Wildlife and Parks may reintroduce mountain goats to an area of the Whitefish Range in the future, but this is currently highly uncertain.

Mountain goats may be affected by increases in recreation near their kidding areas or winter habitat, but in the heavily used Jewel Basin and adjacent Glacier National Park, they generally appear to be tolerant of people and may even become habituated to people. Mountain goats are generally not tolerant of dogs, so people hiking with dogs have had conflicts with mountain goats. Recreation personnel in the Glacier Park and the Jewel Basin are working to educate hikers to reduce the risk of conflicts.

Research on mountain goat-human interactions and on the impacts of climate change are underway in Glacier National Park. In the future, summer heat stress and the timing of snowmelt may affect mountain goats; however, there is a level of uncertainty about the effects of winter climate change at the highest elevations where mountain goats live. Glacier National Park, tribal lands of the Confederated Salish and Kootenai Tribes, and Forest lands provide a combined acreage of over 2 million acres where disturbance to mountain goats is relatively low.

Peregrine falcon

Affected environment

The peregrine falcon is a large neotropical migratory bird known to breed across Montana and winter in Mexico and South America. Peregrine falcons are breeding or permanent residents across most of the western United States. They were formerly listed under the Endangered Species Act. Nationwide estimates of territory occupancy, nest success, and productivity all substantially exceeded the target values needed to sustain recovery of the species, and the peregrine falcon was delisted from the endangered species list in 1999 (USFWS, 1999). Peregrine falcon population biology, ecology, habitat, and relationships identified by research are described in the Federal Register (USFWS, 2003b), the Montana Natural Heritage Program (MNHP-MTFWP, 2015b) and the NatureServe Web site (2015b).

Chemical contaminants used in the 1940s built up in the food chain and caused egg shell thinning so that peregrines were unable to produce young. Peregrine falcon populations crashed over most of their known range, and by the early 1980s and there were no known nesting peregrine falcons in the state of Montana. The number of known active peregrine falcon territories in Montana increased dramatically from 14 in 1994-96 to 84 active territories in 2017 (MPI, 2017).

The Montana Peregrine Institute monitors peregrines (www.montanaperegrine.org/index.html). As of 2015, there were 13 reported breeding territories within the Forest geographic areas; four in the Flathead River watershed, one in the Swan, two in the Stillwater, and six listed as being in the vicinity of Whitefish. This includes four new territories with data that is still considered tentative (MPI, 2017), but the monitoring results represent a large increase in reported territories in the last 10 years.

Peregrine falcons typically nest in a scrape on cliff ledges near lakes or major rivers and prey upon birds by diving in the air. Adult falcons demonstrate a high degree of breeding fidelity and are known to reuse the same cliff nest site for several decades (USFWS, 2003b). Nesting habitat is created by geologic factors and has not changed significantly since populations crashed. Habitat for bird species that peregrines prey upon is diverse and generally provides for a high diversity of bird species.

Courtship, nesting, and fledging generally occur between February 1 and mid-August. Falcon nests are generally placed in areas where concentrated human activities do not occur. Human activities have the potential to negatively impact falcons during the nesting period, depending on the type of activity and the distance. Disturbance near active nests can displace individuals and cause nest abandonment (Hamann et al., 1999). Peregrine populations have recovered with the level of human activities currently occurring on NFS lands.

Peregrines are sensitive to some types of human disturbance, such as blasting and low-altitude helicopter flights at nest sites, during the time periods when they are raising young. Activities that may affect peregrine populations also include collection of young for falconry, illegal shooting, and collision with power lines, fences, or cars. Because peregrine falcons do not feed on road-killed animals, they are not as susceptible to vehicle collisions as bald eagles. In the past, peregrine populations were in drastic decline as a result of DDT use on croplands. DDT has been banned in the United States, but contaminants in peregrine winter habitat can reduce their reproduction or cause direct mortality. Many of the activities that may be threats to peregrines are not under the authority of the Forest Service or occur on other land ownerships

Key stressors

Human disturbance

Activities that may occur on NFS lands near peregrine falcon nesting habitat include timber harvest and associated road use, blasting, helicopter use, and some types of human recreation activities (USFWS, 1999). The Federal Aviation Authority regulates aircraft. The Forest Service does not have statutory authority over public aviation. The Forest Service has authority over its use of aircraft and manages helicopter landings on NFS lands. The Forest manages motorized vehicle access to habitat on NFS lands.

Changing climate

Peregrine falcons are not believed to be sensitive to climate changes. Although climate changes may affect the potential prey of peregrine falcons, they prey on a wide variety of other birds, so they would be likely to shift to species that become more abundant as the climate changes. They can move long distances to find food.

Key indicator for analysis

The following species-specific indicator applies to the peregrine falcon:

- Risk of human disturbance near active nest sites

In addition, refer to the key indicator for cliff, rock, scree, and cave habitats.

Environmental consequences

Effects common to all action alternatives

Plan components support key ecosystem characteristics for peregrine falcons because plan components limit disturbance at cliffs used as nesting sites during key time periods and support diverse habitats for a wide variety of bird species to provide prey (as well as for other birds of prey).

Alternative A

Recovery of the species has occurred during implementation of the existing forest plan. The 1986 forest plan provides direction to do a biological evaluation prior to implementing national forest vegetation management activities within 0.25 mile of nests or the use of pesticides within 15 miles of nests and to apply the American Peregrine Falcon Recovery Plan (appendix SS of the 1986 forest plan) during site-specific analysis.

The 1986 forest plan also states that the following guidance will be applied to activities that may affect the peregrine falcon:

- Prohibit disturbance-causing activities such as road construction, logging and seismic exploration using explosives within ½ mile of active peregrine falcon nests during the nesting period; February 1 through August 1.

Alternatives B modified, C, and D

As discussed under section 3.7.4, subsection “Cliff, cave, scree, and rock habitats,” and the “Aquatic, wetland, and riparian habitats,” key ecosystem characteristics described in the “Affected environment” section would be supported by implementation of plan components. Plan components would maintain or improve feeding habitat and promote a diversity of prey species. In addition, species-specific plan components included in all action alternatives would support the peregrine falcon by limiting activities known to disrupt nesting during the nesting season. Forestwide guideline FW-GDL-WL DIV-05 addresses disturbance to peregrine falcons by specifying that new projects or special-use authorizations for activities that are known to disrupt peregrines should be avoided from February 1-August 15 within 0.5 mile of cliffs used as active nest sites (identified in cooperation with MFWP) unless they include strategies or design features to mitigate disturbance. This guideline does not apply to emergency activities or areas identified as suitable for motorized over-snow vehicle use during their designated open season.

Cumulative effects

Because peregrine falcons tend to nest at low elevations along rivers and lakes that are heavily used by people, increases in human population and recreational use of the large rivers and lakes where peregrines nest could increase human disturbance. However, because peregrines often nest in places that are inaccessible to people, this is expected to have a minor effect. There is no known rock climbing in areas of the Forest with peregrine nests. Peregrine falcon nesting territories have increased with existing levels of human use.

Federal and State water quality laws protect waterbodies from contaminants that could affect the food chain of the peregrine falcon. Montana Fish, Wildlife and Parks regulates falconry and enforces penalties for the illegal shooting or poisoning of peregrine falcons. Montana Fish, Wildlife and Parks also works with State and Federal highway departments to ensure that nesting cliffs near highways are not impacted by highway construction.

Persistent grass/forb/shrub habitat

Introduction

About 175 wildlife species and two invertebrate species are known to occur on the Forest that use grass/forb/shrub or meadow habitats to meet at least some of their needs on a seasonal basis (see appendix 6). The Forest manages a small amount of persistent grass/forb/shrub habitats compared with surrounding lands (e.g., tribal lands of the Confederated Salish and Kootenai Tribes, the Helena-Lewis and Clark National Forest). Similar to the hardwood tree-dominated communities, persistent grass/forb/shrub-dominated plant communities are uncommon on the Forest. Less than 5 percent of the Flathead National Forest is estimated to provide this habitat (see appendix D of the forest plan). As a result, many species that are known as grassland species (Daniel Casey, 2000) or that depend upon grass/forb/shrub habitats year-round, are not yearlong residents on the Forest. For example, bighorn sheep are observed feeding on grassy slopes in the Bob Marshall Wilderness Complex along the boundary of the Helena-Lewis and Clark National Forests during the summer months but are not yearlong residents.

Affected environment

On the Forest, much of the persistent grass/forb/shrub habitat occurs in areas where moisture or soil conditions limit tree growth. Many of these areas occur as small patches or stringers surrounded by coniferous forest. Examples of key ecosystem characteristics for species associated with this habitat are abundant grasses, forbs, and shrubs that provide foraging and nesting sites. Species such as great gray owls hunt in wet or dry meadows and pastures(Hayward & Verner, 1994). Species such as elk forage in wet meadows as well as on open grassy slopes. There are no specific species discussed in this section because most of the species on the Forest are also associated with early-successional forest habitats created when disturbances (such as fire, timber harvest, or avalanches) change coniferous forest to transitional grass/forb/shrub habitat, as discussed in section 3.7.4., subsection “Coniferous forest habitats.”

This section assesses the effects to most species associated with persistent grass/forb/shrub habitats.

Key stressors

Because many persistent grass/forb/shrub habitats on the Forest occur in remote areas, fire, fire suppression, and invasive weeds and their treatment are the primary processes or activities that have affected these habitats on the Forest. Non-native plant invasion and livestock grazing can affect the quality or quantity of grass/forb/shrub communities, affecting nesting and feeding habitat or cover for wildlife. Seeds of non-native plants can be carried to NFS lands from other lands by wind, water, motorized and nonmotorized vehicles, machinery, livestock, wild animals and people, so control of this stressor requires a cooperative effort. The Forest has the authority to manage non-native plant invasion on NFS lands.

Key indicator for analysis of most species associated with grass/forb/shrub habitats

In addition to the effects discussed under section 3.3.3 on vegetation composition, the following indicator is used to focus the analysis.

- Quality and quantity of persistent grass/forb/shrub habitats

Environmental consequences

Effects common to all alternatives

Plan components would support key ecosystem characteristics because ecosystem processes (e.g., slow soil development, fire, and avalanches) would maintain or create these habitats and because controlling invasive weeds would maintain or restore the ecological integrity of grass/forb/shrub habitats.

Alternative A

The 1986 forest plan does not have specific objectives to treat grass/forb/shrub habitats with prescribed fire or to treat a certain number of acres to reduce the density or spread of invasive weeds in grass/forb/shrub habitats. However, since the need has been recognized, these activities have been accomplished under the guidance of an invasive species EIS and numerous cooperative projects between the Forest, the counties, the State, and non-government organizations.

Alternatives B modified, C, and D

Alternatives B modified, C, and D would benefit wildlife by having specific plan components to maintain or improve the composition of grass/forb/shrub habitats, to control invasive weeds, and to limit livestock grazing (see also sections 3.6 and 3.24). Desired condition FW-DC-TE&V-09 addresses the diversity of grass/forb/shrub habitats and would benefit wildlife. Desired conditions for grazing (FW-DC-GR-01 through 03) would also benefit wildlife. Standard FW-STD-GR-05 limits cattle grazing in the grizzly bear primary conservation area, which would limit the risk of spread of non-invasive plant species and benefit wildlife because the area covered by cattle allotments would not increase (the Forest does not have sheep grazing allotments).

Under alternatives B modified, C, and D, plan components for non-native invasive plants (FW-DC-NNIP-01 through 04, FW-GDL-NNIP-01, and FW-OBJ-NNIP-01) would benefit wildlife species by controlling invasive species with integrated pest management approaches by treating 12,000 to 16,000 acres over the expected 15-year life of the plan in order to contain or reduce non-native invasive plant density, infestation area, and/or occurrence. Over the life of the plan, a total of 1,500 to 5,000 acres would be treated through management activities such as prescribed burning to maintain persistent grass/forb/shrub plant communities (see FW-OBJ-TE&V-04).

Cumulative effects

This section summarizes the activities and effects that are common to most species associated with grass/forb/shrub habitats. The Forest has very limited persistent grass/forb/shrub habitats because most of the Forest gets sufficient precipitation and has sufficient soil development to support trees.

Grass/forb/shrub habitats have shifted from where they occurred historically and are anticipated to continue to shift over time as human settlement and climate conditions change. In the distant past, prescribed fire was used as a tool by Native Americans to create and sustain persistent grass/forb/shrub habitats, especially in valley bottoms in the warm-dry and warm-moist potential vegetation types where some key wildlife species spent the winter. Subsequently, some Flathead Valley lands were converted to human developments or agricultural lands. If properly managed, livestock grazing is compatible with maintenance of grass/forb/shrub habitats. Some wildlife species have adapted to these changes and now use agricultural lands that provide grasses and forbs. Even where forested lands were not permanently converted to developments, wildfire exclusion has resulted in succession of grass/forb/shrub habitats, especially adjacent to where human developments occur.

It is unlikely that changes in climate on the Forest would reduce precipitation for a long enough period of time to convert forested lands to grasslands, but wildfires are likely to play a dominant role in the future. In the future, if wildfires burn the same acreage more than one time in rapid succession, trees (even lodgepole pine, which produce seed at a relatively young age) may not grow old enough to produce seed between burns, so grass/forb/shrub areas may persist for longer periods of time. This occurred in some areas of the Forest after wildfires in 1910, 1919, and 1926.

In summary, proposed management direction on the Forest, in the context of all lands of the larger landscape, contribute to persistent grass/forb/shrub habitats. Although the Forest does not have authority over all the stressors, the ecological conditions of persistent grass/forb/shrub communities would be provided on NFS lands. This would be accomplished by plan components to support natural ecosystem processes that create these habitats and to restore habitats that have been affected by invasive species. Coarse-filter plan components provide for biodiversity and ecological conditions that support the long-term persistence of the majority of species associated with these habitats. Grass/forb/shrub habitat is distributed across all Forest geographic areas.

High-elevation habitats

Affected environment

High-elevation ecosystems include species associated with krummholz (stunted and wind-deformed trees), high-elevation tree species such as whitebark pine, snow, and alpine habitats (see appendix 6). These habitats occur in portions of the cold potential vegetation type, which covers approximately 335,500 acres, or 14 percent, of the Forest (see appendix D of the forest plan). Most ecosystems that occur at high elevations are not substantially altered from historical conditions. Historically, these ecosystems have been affected by high winds, extreme temperatures, avalanches, unstable rock, poorly developed soils with low organic matter, and/or high ultraviolet radiation levels. Snow retention provides moisture for plants during the growing season, as well as habitat. Examples of species associated with high elevations (that have not been addressed in other sections of this final EIS) include the wolverine, American pipit, golden-mantled ground squirrel, white-tailed ptarmigan, and gray-crowned rosy-finch. Examples of key ecosystem characteristics of high-elevation habitats on the Forest are that they have colder temperatures, more snow cover than lower elevations, and snow that persists into the spring. Wildlife species associated with this habitat may use the accumulated snow for nesting, denning, or shelter from the wind and cold. Some species dig beneath the snow for foraging.

For example, the white-tailed ptarmigan and gray-crowned rosy-finch are restricted to the highest elevations in wilderness areas on the Forest during the breeding season (Kuennen, 2013l, 2013p). Habitat for the white-tailed ptarmigan is alpine locations; moist vegetation near snowfields and streams and willow-dominated (*Salix* spp.) plant communities are present in all areas heavily used by ptarmigan in summer. In winter, according to work by Choate and Scott, ptarmigan occupy rocky areas and patches of krummholz (Choate, 1963). Gray-crowned rosy-finches nest in abandoned buildings, crevices, cliffs, and talus among glaciers or persistent snowfields and forage in barren, rocky, or grassy areas adjacent to the nesting sites.

This section assesses effects to most species associated with high-elevation habitats.

Key stressors

Land management

On the Forest, there have been few stressors to species associated with high-elevation habitats and persistent spring snow because the majority of this habitat is in remote or protected areas on NFS lands, through designation as wilderness and inventoried roadless areas (figure 1-73). The main activities that occur are related to dispersed recreation. Recreational uses and management activities (such as trail construction) may be stressors in some locations.

Changing climate

There is a great deal of uncertainty surrounding climate change and its potential effects on high elevation habitats, because the level of uncertainty associated with winter temperature and precipitation is higher than for summer temperature and precipitation. Whether it is invasive species (e.g., white pine blister rust), drought, uncharacteristic wildfires, or some other agent or combination of agents that serves to stress high-elevation ecosystems, recent research suggests that climate change will likely exacerbate those stressors and that “stress complexes” will continue to manifest (Robert E. Keane et al., in press). Potential effects considerations associated with climate change are described in section 3.1.2, the introduction to section 3.3, and section 3.5.2 under the “Alpine habitat group.”

Key indicators for analysis of most species associated with high-elevation habitats

In addition to the effects discussed under section 3.7.5, subsection “Wolverine,” the following key indicators are used to focus the analysis:

- Land management
- Changing climate

Environmental consequences

Effects common to all alternatives

High-elevation habitats are affected by inherent geologic and climatic conditions. Ecosystem plan components would meet the needs of species associated with high-elevation habitats. Species associated with this habitat live at the highest elevations in existing wilderness where there are generally few, if any, threats to habitat. There are no differences in existing wilderness for any alternative.

There are differences in alternatives with respect to recommended wilderness (figures 1-01 to 1-04) and suitability for motorized over-snow vehicle use (figures 1-42 to 1-45), discussed in detail in the section on wolverines (see section 3.7.5, subsection “Wolverine”).

Cumulative effects

This section summarizes activities and effects that are common to most species associated with high-elevation habitats (for wolverine, see section 3.7.5, subsection “Wolverine”).

During the summer and fall, nonmotorized trails at high elevations receive use primarily by hikers, horseback riders, and mountain bikers. Some NFS roads access high-elevation habitats, but a number of NFS roads as well as some high-elevation wheeled motorized trails have been closed in recent decades, making areas less accessible to people. The area where motorized over-snow vehicle use is allowed was more widespread in the past; it has been limited since implementation of the winter-use provisions of the Flathead’s winter motorized recreation plan, which is amendment 24 to the 1986 forest plan (USDA, 2006). This decision identified areas and routes open and closed to motorized over-snow vehicle use.

Amendment 24 currently allows motorized over-snow vehicle use on about 31 percent of the Flathead National Forest (all outside of wilderness areas), and it is not allowed on about 69 percent of the Forest. Many high-elevation areas are open to motorized over-snow vehicle use from December through March only, but the amendment 24 decision included four “late spring” areas where motorized over-snow vehicle use is allowed during April and May (see section 3.7.5, subsection “Grizzly bear,” for more details).

Glacier National Park, the Mission Mountains Tribal Wilderness (adjacent to the Forest), and State lands managed by Montana Department of Natural Resources and Conservation (in and adjacent to the Forest) also provide high-elevation habitat with persistent spring snow. Glacier National Park and the tribal wilderness are closed to motorized over-snow vehicle use. Montana Department of Natural Resources and Conservation lands on portions of the Stillwater State Forest in the Salish Mountains geographic area, the Coal Creek State Forest in the North Fork geographic area, and the Swan State Forest in the Swan Valley geographic area are generally open to motorized over-snow vehicle use.

Ski areas also are located in high-elevation habitats with persistent spring snow. Whitefish Mountain Resort has operated on NFS lands under a special-use permit as a ski area since the 1940s and as a year-round resort since the 1980s. This area has the highest level of year-round use of any recreation area in persistent snow and high-elevation habitats on the Forest. The Blacktail Mountain Ski Area also operates on NFS lands under a special-use permit, but it is not operated as a year-round resort.

There are no mineral or energy developments in high-elevation habitats on the Forest (see section 3.23 for more details).

Habitat conditions associated with snow that persists through the spring were not a concern in the past but have become a concern in recent decades due to changes in the timing of snowmelt that have been documented worldwide and in areas of Glacier National Park (adjacent to the Forest) over the last century. The most important climate change predictions for this group of species are that the mean monthly minimum temperature (spring and autumn) and the mean monthly maximum temperature (winter) may rise above freezing more months out of the year. Seasonal precipitation is projected to be slightly higher in winter and spring. The combination of these two factors may be beneficial, neutral, or detrimental to these habitats, depending upon whether more precipitation falls as rain or as snow and at what elevations. If the temperature in winter or spring rises above freezing for a more prolonged period of time, snow does not persist as long. However, if increased precipitation falls as snow at high elevations, this could offset the increased melting. Winter climate change predictions have less certainty than summer climate change predictions (see sections 3.1.1 and the Forest assessment (USDA, 2014b) for more details).

In summary, proposed management direction on the Forest, in the context of all lands of the larger landscape, contributes to high-elevation habitats, including those with persistent spring snow. Although the Forest does not have authority over all the stressors to high-elevation habitats, ecological conditions and the processes that maintain them would be provided on NFS lands. High-elevation habitat is distributed across all Forest geographic areas. Coarse-filter plan components provide for biodiversity and ecological conditions that support the long-term persistence of the majority of species.

Coniferous forest habitats

Introduction

Hundreds of vertebrate species and about a dozen invertebrate species that are associated with coniferous forests and their key ecosystem characteristics are known to occur on the Forest (see appendix 6). Plan components for terrestrial wildlife habitats are integrated with the vegetation plan components. Vegetation plan components are specified for potential vegetation types, which are groupings of individual habitat types (Pfister, Kovalchik, Amo, & Presby, 1977). Habitat types are an aggregation of ecological sites of like biophysical environments (such as climate, aspect, soil characteristics) that produce plant communities with similar composition, structure, and function. Potential vegetation types serve as a basis for describing certain ecological conditions across the Forest and are useful in understanding potential productivity, natural biodiversity, and processes that sustain these ecosystem conditions. Forest plan figures B-03 through B-09 display the potential vegetation types, their distribution, and their pattern across the Forest. The potential vegetation types are the warm-dry, warm-moist, cool-moist, and cold coniferous forest types. The cool-moist type is most abundant across the Forest, making up about 68 percent of the Forest's acreage (see forest plan appendix D for more details). Appendix 6 lists the association of wildlife species with potential vegetation type groups.

Because wildfire, insects, and disease have historically created a mosaic of habitats that range from young, open forest with shade-intolerant conifer species to dense, old forest with shade-tolerant species, most of the associated wildlife species are adapted to a complex of successional stages and species compositions that are within the natural range of variation. This complex of successional stages meets their needs for nesting or denning, foraging, resting, cover, and connectivity. For example, the goshawk nests in large trees but hunts in forested areas with an open understory. Some species are habitat generalists that are associated with all coniferous forest types in all successional stages found on the Forest. White-tailed deer spend much of the winter at lower elevations in mature coniferous forests that have sufficient canopy trees to intercept snow, but they forage in all successional stages throughout the year, including in openings. Marten prefer coniferous forest cover but prey on a wide variety of small mammals, including those that have high densities in forest openings. Some species, such as the Clark's nutcracker, are associated with particular tree species for nesting and foraging (e.g., whitebark pine and ponderosa pine) that are uncommon on the Forest. Species such as the Canada lynx and boreal owl are associated with boreal forests in the cool-moist and cold potential vegetation types (Kuennen, 2013e).

Fire and regeneration harvest in coniferous forest create early-successional habitat on a temporary basis. About 175 species on the Forest use early-successional grass/forb/shrub habitats for feeding or breeding during all or portions of the year (see appendix 6). These transitory grass/forb/shrub habitats may be a successional stage of coniferous forest development that lasts approximately 10-20 years following fire or timber harvest, or they may persist for several more decades on harsh sites with slow forest growth or in areas where wildfires have burned the same area more than once in a short period of time (see also section 3.7.4, subsection "Persistent grass/forb/shrub habitat").

Because there are specific key ecosystem characteristics for some wildlife species associated with coniferous forests, the analysis of effects can be found in three subsections of section 3.7.4 of this final EIS: (1) "Coniferous forest habitats," (2) "Old-growth forest: Very large live and dead trees," and (3) "Burned forest and dead tree habitats." Species such as the pileated woodpecker and fisher are associated with forest structure that has snags and downed wood in the very large size class for nesting, resting, feeding, or denning. Species such as the black-backed woodpecker are associated with the abundant dead trees of a wide range of sizes as well as the abundant wood-boring insects found in recently burned forests.

This section assesses the effects to most species associated with coniferous forest habitats in a variety of successional stages. Following the general discussion, five species and one species group (ungulates) are discussed as examples in order to help display differences in effects of alternatives. The five species are the flammulated owl, Clark's nutcracker, gray wolf, northern goshawk, and marten. The ungulate species group includes species such as deer, elk, and moose. For Canada lynx and grizzly bear, see section 3.7.5.

Affected environment

Coniferous forest habitats occur on over 2 million acres, or about 95 percent, of the Forest (see appendix D of the forest plan). Most of these forest habitats are located in relatively undeveloped areas (such as designated wilderness and inventoried roadless areas) and have been influenced primarily by natural ecological processes and disturbances, with a low level of human activity. Cumulative total acres of timber harvested on the Forest from the 1940s through 2012 is about 394,000 acres (about 16 percent of the total Forest acres), reaching a peak in the 1970s and declining since then (see table 18). In contrast, wildfires burned relatively few acres from 1940 to 1990 (see figure 56 in section 3.8.2) but started increasing in the mid 1990s, reaching a peak in the decade 2000 to 2010. Approximately 430,000 acres burned by wildfire on Flathead National Forest lands between 1994 and 2013, or about 18 percent of Forest acres (see table 95 in section 3.8.2, and Trechsel (2014)). The areas burned included about 69,000 acres of forest that had been harvested in the decades prior to the fires. Planting of tree seedlings within areas disturbed by fire or within regeneration harvest units has occurred across approximately 136,000 acres (about 5.6 percent) of Forest lands since 1950. About 61,000 of these acres were planted from 1990 to 2013. Planting is usually conducted to establish desired tree species on a site where natural regeneration is not expected to be sufficient, to increase tree diversity, and to restore species that have been affected by introduced diseases such as white pine blister rust.

Some species prefer the early-successional stages of a forest's development, but others prefer later stages. Some species prefer edge habitats, but other species, called forest-interior species, do not. Forest-interior species need corridors between early-successional forest and mature forest that are wide enough to reduce edge effects that matter to the targeted species (Lidicker & Koenig, 1996). Temple (1986) studied the effects of "edge" on 16 species of forest-interior birds and defined the "core area" of a forest as the area more than about 300 feet from an edge. When mature or old forests remain in small patches or stringers, surrounded by early-successional forest, they are said to be "fragmented." For the 16 bird species studied by Temple, having a core area was a better predictor of bird species presence and abundance than was the total area of the fragment. Problems associated with forest fragmentation include weather-related effects (such as blowdown), loss of forest interior habitat, loss of habitat connectivity, and increased vulnerability to predators or nest parasites (Finch, 1991).

Key stressors

On all lands, timber harvest and associated road access, prescribed fire, wildfire, thinning, and planting can affect the quantity, quality, patch size, and connectivity of coniferous forest wildlife habitats. Fire suppression can alter the historic stand structure important to some species. These activities can also affect habitat connectivity. Habitat connectivity provided by forest cover is discussed following the section on marten. For other aspects of habitat connectivity, see section 3.7.6.

Key indicators for analysis of most species associated with coniferous forest habitats

- Forest size class

Management area suitability for timber production and management areas where timber harvest is allowable (see section 3.21 for more details)

Differences in modeled effects of alternatives on forest size class are used as an indicator of successional stage. Effects of vegetation management were modeled for each alternative. Potential vegetation types (see forest plan figure B-03), key ecosystem characteristics, and key indicators for coniferous forests are discussed in detail in section 3.3.

The SIMPPLLE model was used to estimate the effects of factors such as fire, insects and disease, and forest succession over the next five decades. Although wildfire is difficult to predict, the SIMPPLLE model has associated fire and suppression logic that simulates the effects of wildfire. Vegetation treatments, including timber harvest, were modeled using the Spectrum model, which applies potential management actions to landscapes over a specified time period, using constraints such as anticipated budgets and timber suitability and desired goals (objectives), and displays the resulting outcomes. The two models were used interactively to analyze vegetation conditions. See appendix 2 for more details on the vegetation modeling.

This section discusses potential consequences based upon the likelihood of future conditions as depicted in the simulation modeling processes. Model results are probabilistic and are not intended to produce precise values for vegetation conditions. The results are a useful tool for comparing alternatives and assessing how vegetation might change over time. Model outputs augment other sources of information, including research and professional knowledge of how ecosystem processes (such as succession) and disturbances and stressors (such as fire, insect infestation, timber harvest, and climate) might influence changes in vegetation conditions over time, especially at the scale of the plan area.

There are more similarities than there are differences in the modeled results for changes in vegetation conditions over time between alternatives. Generally, the alternatives almost always follow similar trends, with variation in the rate and degree of change over the five-decade model period. All alternatives have similar amounts of modeled natural disturbances, such as fire and insect or disease activity, which would influence vegetation conditions (including snags, downed wood) and landscape patterns over time. The model does not use prescribed fire as an option for alternative A, although prescribed fire is used to meet wildlife objectives in some areas, such as big game winter habitat. Some management areas are suitable for timber production and some are not suitable for timber production. In some areas, timber harvest is allowable under certain conditions, even if the areas are not suitable for timber production (see sections 3.3 and 3.20 and appendix 2 for more details).

The effects of alternatives on size class are summarized below, with effects on most species associated with coniferous forests in a variety of successional stages described first. The sections on individual species discuss how Ecosystem Research Group modeled the habitat for selected species on the Forest. These species include the flammulated owl, marten, goshawk, elk, moose, and white-tailed deer (see appendix 3 for more details).

Environmental consequences

Summary of modeled alternative consequences

Some wildlife species are associated with particular size classes, but others are associated with a mix of size classes. For, example, some migratory birds prefer nesting or foraging in the seedling/sapling size class where forest conditions are more open and shrubs, grasses, and forbs are more abundant for nest sites or sources of food. Other migratory birds prefer nesting and feeding in the mature size class where forest conditions are characterized by taller trees. Ecosystem plan components would meet the needs of most species associated with coniferous forest habitats in a variety of successional stages. Forest size classes change over time, and the majority of species associated with coniferous forests are adapted to these changing conditions. Conditions change due to forest succession, natural drivers and stressors (e.g., wildfire, insects, disease) and active vegetation management (e.g., timber harvest, fuels reduction, prescribed fire). A variety of successional stages adds to forest diversity.

A summary of the model results for forest size class follows; refer to section 3.3.4 for more detailed information.

Seedling/sapling size class: Model results for all alternatives show that an upward trend in this size class is likely over the next five decades, with the exception of the warm-moist potential vegetation type. In the warm-moist potential vegetation type, early-successional forest in the seedling/sapling size class trends downward for all but alternative A. The modeled trend for the seedling/sapling size class indicates that fire (mostly high-severity wildfire but also some prescribed fire) remains a main driver of vegetation change. Most of the Forest is expected to remain within the range of natural variation for the next five decades. This size class generally provides wildlife benefits of a high quantity of forage, nesting habitat for species that nest in grass/forb/shrub habitats, and connectivity of these habitats. Transitional forests stay in this size class for a period of about 20 years, on average, before moving into the small/medium size class as a result of forest succession. The time it takes can be highly variable, however, depending upon the productivity of the site, density of trees, and whether a site is planted or precommercially thinned.

Small/medium forest size class: Model results for all alternatives show a downward trend by the fifth decade for the acreage in small and medium size classes. Existing amounts of the medium size class are high forestwide and in all potential vegetation types except warm-dry, so the downward trend is generally favorable relative to the desired condition. The small/medium size class does generally not have the benefit of a high quantity of forage, nor does it have the benefit of large and very large trees for wildlife denning or nesting, so its habitat quality for many wildlife species tends to be lower. However, it does provide cover for forest habitat connectivity. Forests on most sites may stay in a small to medium forest size class for 50 to 80 years before moving into the large size class as a result of forest succession. The time it takes can be highly variable, however, depending upon the productivity of the site and the density of trees.

Large forest size class: Modeling for all alternatives indicates there will be a strong increase in the acreage of the large size class by the fifth decade, forestwide and within all potential vegetation types. Natural succession of forests into larger size classes is the main driver of this increase. Model results indicate that natural disturbances have a substantially greater impact on reducing this size class than timber harvest amounts, with fire, insects, and disease the primary disturbances. This size class generally provides the benefit of a high quantity of denning and nesting habitat for species associated with mature forest as well as connectivity of these habitats. The time it takes for a forest to change from the large to the very large size class through forest succession can be highly variable, depending upon the productivity of the site, density of trees, whether a site is planted or precommercially thinned, and the amount and pattern of insect or disease infestation. It may take only 20 or 30 years, or it may never occur, such as in dense forest conditions where tree growth is very limited.

Very large forest size class: Model results show that the acreage in this size class is likely to increase in the warm-dry and warm-moist potential vegetation types; to stay relatively static in the cold type; and to decrease in the cool-moist type. The trend upward in the very large size class in the warm-moist potential vegetation type is likely tied to the higher productivity and growth rates in this type as well as to the fact that most of it occurs in areas where wildfires are likely to be suppressed. Model results indicate that natural disturbances have a substantially greater impact on reducing this size class than timber harvest amounts, with insects and disease the primary disturbances. The downward trend in the cool-moist type is likely due to the effects of stand-replacement fire, which changes the forest to an early-successional stage. Some of the change is also due to the activity of insects and disease, primarily the Douglas-fir beetle. This size class generally provides the benefit of very large trees for nesting, denning, and resting.

Forestwide, alternative C shows the greatest modeled increase in the very large size class, followed by alternative D, alternative B modified, and alternative A. Though alternative C has nearly as many average acres harvested per decade as the other alternatives, the model applied much less regeneration harvest than it did non-regeneration harvest (e.g., commercial thinning), which would result in an increase in the forest size class category. However, actual treatments on the ground may or may not be of the same proportions as the model projected among the alternatives. Treatment prescriptions depend entirely on site-specific conditions and project objectives.

In summary, modeled increases in the large size class and in the very large size class of the warm-dry and warm-moist potential vegetation types would be beneficial to wildlife species associated with mature forest cover and large or very large trees. These size class changes, combined with model results showing an increase in the proportion of western larch, ponderosa pine, and western white pine, would be positive for habitat diversity and many nesting birds. Increases in the seedling/sapling size class are beneficial for species associated with grasses/forb/shrub habitats (see appendix 6). Reductions in the small/medium size class are beneficial for many species as this size class tends to have the lowest diversity.

Effects common to all alternatives

Under all alternatives, about 1.6 million acres of the Forest are lands that are not suitable for timber production because they are in existing wilderness or are in inventoried roadless areas, which are not suitable for timber production under the 2001 Roadless Area Conservation Rule (see table 149 and figures B-25 and B-26).

Timber harvest is allowable on some lands identified as not suitable for timber production for such purposes as salvage, fuels management, insect and disease mitigation, protection or enhancement of wildlife habitat, research or administrative studies, or recreation and scenic resource management (see section 3.21 for more details). Timber harvest on these lands is not scheduled or managed on a rotation basis. Timber harvest on these lands would have to be consistent with other management direction. For example, riparian habitat conservation areas (in alternative A), riparian management zones (in the action alternatives, and the backcountry management areas (5a through 5d in the forest plan) are identified as unsuitable for timber production in the forest plan, although there may be site-specific situations where timber harvest is a desirable tool to use for achieving desired conditions for certain resources, such as fuel reduction treatments to reduce fire hazard. These treatments would have to be consistent with the desired conditions and other plan direction for the area.

There is also plan direction that limits vegetation treatments based on site-specific stand conditions. For example, old-growth forest is identified at the project level, and standards in the plan under all alternatives restrict timber harvest, regardless of management area. Additionally, in Canada lynx habitat, Northern Rockies Lynx Management Direction (NRLMD) vegetation management standards apply regardless of management area (see appendix A in the forest plan). With respect to lands where timber harvest is allowable, consequences to wildlife are difficult to predict with certainty in a programmatic document such as this because it is unknown where wildfires, insects, or disease will occur. Effects to wildlife would be considered during project implementation.

The differences between the consequences for lands suitable for timber production and lands where timber harvest is allowable are compared for each alternative. The primary differences in the alternatives are due to different combinations of management areas, whether the management areas are suitable for timber production, whether timber harvest is allowable, and the intensity of management that may occur.

Alternative A

Management areas in the 1986 forest plan (alternative A) were grouped into the management area categories used for alternatives B modified, C, and D (management areas 1 to 7) (see table 3). Under alternative A, about 534,600 acres are suitable for timber production (see figure 1-09 and table 152), the most under any alternative. Under alternative A, acres where timber harvest is allowable on lands *not* suitable for timber production is 437,700 acres (about 18 percent of the Forest).

In addition to differences in lands where timber harvest is suitable or allowable, other plan components may affect coniferous forest successional stages and their pattern on the landscape. Alternative A has limits on distance to cover and regeneration harvest (until adjacent areas recover) in some portions of the grizzly bear recovery zone/primary conservation area (see "Grizzly bear" subsection of section 3.7.5 for more details). These guidelines tend to result in an initial pattern of numerous small patches of seedling/sapling habitat, with distinct edges along boundaries of regeneration harvest areas and unharvested areas (except in areas where large stand-replacing wildfires have occurred). The seedling/sapling successional stage generally has low tree canopy cover and a distinct edge for a period of about 20 years, on average. The amount and pattern of vegetation management resulting from this alternative would provide the greatest benefits for wildlife species associated with early-successional forests and edge but would provide the least benefit for wildlife species associated with late-successional stages and interior forest habitats (see individual species discussions below).

Alternative B modified

Under alternative B modified, about 465,200 acres are suitable for timber production (see figure 1-10 and table 152). Alternatives B modified and D have similar proportions of management intensity, with approximately 52 percent of lands suitable for timber production allowing for a moderate level of intensity of management (management area 6b) and 48 percent allowing for more intense management (management area 6c). Alternative B modified has about 447,200 acres (19 percent of the Forest) where timber harvest is allowable. Under alternatives B modified and D, approximately half of these acres are comprised of inventoried roadless areas.

In addition to reflecting the differences in lands where timber harvest is suitable vs. those where timber harvest is allowable, other plan components may affect coniferous forest successional stages and their pattern on the landscape. Under this alternative, desired conditions for wildlife have been integrated with desired conditions for vegetation. There are limits on distance to cover in riparian management zones (FW-GDL-RMZ-09). Outside of riparian management zones, there are no distance to cover specifications, but there is a forestwide guideline (FW-GDL-WL DIV-06) that has the intent that connectivity of forest cover should not be severed. In order to move towards desired conditions FW-DC-TE&V-18 and 19 for landscape pattern and desired condition FW-DC-TE&V-14 and forestwide guideline FW-GDL-TE&V-06 would create a trend towards larger and more contiguous patches of the large and very large size classes over time (this is particularly important for some forest-interior species). Seedling/sapling habitat patches in areas of active management are also likely to be larger in size and to have a less distinct edge in some areas. These patterns are more consistent with the natural range of variation and would benefit a wide variety of species. Commercial thinning, small group selection, and prescribed fire would play a strong role in achieving desired conditions under alternative B modified, according to the models. For example, in mixed-species forests containing ponderosa pine and Douglas-fir, greater use of commercial thinning, group selection harvest, and prescribed fire would maintain more cover in the upper canopy and create more of a mosaic of understory vegetation while increasing grass/forb/shrub habitats. This pattern would benefit some of the wildlife species associated with a fine-patch mosaic (see individual species discussions below, section 3.7.6, and section 3.3.8 for more details).

Alternative C

Under alternative C, about 308,200 acres are suitable for timber production (see figure 1-11 and table 152), which is the least of all alternatives. Alternative C has about 403,700 acres (17 percent of the Forest) where timber harvest is allowable. For alternative C, the largest percentage of these acres are those allocated to management area 6a (general forest low-intensity vegetation management). With respect to management area 6, it is likely that there would be less intensive harvest of live conifer trees in management area 6a areas over time because this management area is not suitable for timber production and does not have scheduled timber harvest. Less intensive or extensive timber harvest would be of greater benefit for species associated with late-successional stages or mature forest cover and would be of less benefit for species associated with early-successional stages (see appendix 6 for a list of species). At 63 percent, alternative C has the highest proportion of lands suitable for timber production with a medium intensity of vegetation management (management area 6b), and under this alternative 37 percent of the lands allow more intense management (management area 6c).

In addition to reflecting the differences in lands where timber harvest is suitable vs. those where it is allowable, other plan components may affect coniferous forest successional stages and their pattern on the landscape. The SIMPPLLE model assumes that fire suppression is less likely in wilderness and recommended wilderness management areas than in many other management areas. Because alternative C has more management area 1b (recommended wilderness), modeling for this alternative indicates there would be more acres of the seedling/sapling size class than for the other alternatives. This effect would not be beneficial to species associated with the large and very large size classes or areas of dense cover. This effect would be beneficial for species associated with the seedling/sapling size class, snags, and downed woody material of all sizes. Compared to timber harvest, early seral patches created by wildfire have more snags, are much larger (10,000-40,000 acres in recent decades), have less edge contrast, and create greater reductions in mature forest connectivity (see individual species discussions below, section 3.7.6, and section 3.3.8 for more details).

Alternative D

Under alternative D, about 482,600 acres are suited for timber production (see figure 1-12 and table 152) and there are about 522,600 acres where timber harvest is allowable (22 percent of the Forest; see section 3.20 for more details; see figures 1-09 through 1-12 for timber suitability). Under this alternative, the effects on vegetation pattern would be similar to alternative A, but the model uses prescribed fire to achieve desired conditions in areas where timber harvest is not feasible (see individual species discussions in this section [3.7.4] and in sections 3.3.8, 3.7.5, and 3.7.6).

Cumulative effects

This section summarizes activities and effects that are common to most species associated with coniferous forest habitats. Wildlife habitats provided by a variety of successional stages are constantly changing due to processes such as wildfire, insects or disease, and forest succession as well as timber harvest, thinning, and planting.

In the past, coniferous forest lands in the Flathead Valley bottom were cleared to create agricultural lands. This resulted in loss of habitat for species associated with the dry ponderosa pine forests that formerly occupied much of the valley bottom and created habitat for species associated with grasslands or hay fields. In the past few decades, agricultural lands have been commercially developed or subdivided for residences as the human population has grown. In the future, increased urbanization and population growth of the Flathead Valley is expected to lead to increases in forest land clearing and conversion of habitat on private lands; increased loss of open space and loss of connectivity due to subdivision of agricultural lands; and greater need for structure protection with less firefighting resources available for other suppression activities. In the future, the subdivision of private property has the potential to increase the disturbance or displacement of those species that are sensitive to human disturbance. For some species, private land development may cause them to shift habitat use to undeveloped lands in Glacier National Park, the Forest, other private timberlands, or State lands managed by MFWP or the Montana Department of Natural Resources and Conservation. As a result of a growing human population, higher levels of recreational use (both motorized and nonmotorized) in areas that previously had low levels of use could also affect species that are sensitive to disturbance during certain times of the year (see individual species sections for more details).

Timber harvest, fire suppression, thinning, planting, and wildfires are the past activities that have had the greatest influence on the amount and distribution of forested habitat on NFS lands as well as State and private timber lands. These activities have created a variety of successional stages, structures, tree species mixes, and forest patterns that have been neutral for some wildlife species, beneficial to some wildlife species, and detrimental to others.

In the future, fuels reduction efforts are possible on all land ownerships, in particular in the wildland-urban interface near private residences. In the past, decades of very active fire suppression led to a build-up of fuels at the same time when more people were moving into areas adjacent to and intermingled with NFS lands on the Forest. Fire suppression in the warm-dry potential vegetation type and ponderosa pine portion of the warm-moist potential vegetation type, in particular, has changed stand structure and led to increased tree densities in forests that were historically more open.

In the future, timber harvest (including salvage of fire- or insect-killed trees) occurring on private, State, or NFS lands may cumulatively affect the quantity and quality of wildlife habitat, especially in the valley bottoms where people live. The effects to wildlife are difficult to predict because they would depend on a wide variety of factors (e.g., whether habitat that is outside of historical conditions is restored, where wildfires and infestations of insects or diseases occur, the type and location of vegetation treatments). If vegetation trends towards desired conditions for wildlife, the effects would be beneficial. If not, then habitat quality and quantity may be reduced. The desired conditions for vegetation in the forest plan would maintain or improve the diversity of forested habitats on the Forest (see section 3.3 for more details). Other forest land managers (e.g., the Montana Department of Natural Resources and Conservation) also have land management plans (e.g., the Habitat Conservation Plan of the Montana Department of Natural Resources and Conservation) to address wildlife needs, and other agencies employ wildlife biologists to address desired conditions for wildlife and assess effects of activities on their lands.

In the past, many miles of road were built to access Federal, State, and private lands. Forest roads have resulted in direct loss of habitat for some wildlife species. For example, roads have made adjacent areas more accessible for the removal of snags for firewood gathering, and the impact is greatest near communities (see the sections below on “Burned forest and dead tree habitats” and on individual species for more discussion on the effects of roads). Forest roads have also increased human disturbance to some wildlife species (see sections on individual species).

Many miles of forest roads on all land ownerships have been closed with gates or berms or have been rehabilitated or decommissioned in the last few decades. This has reduced the motorized access for legal hunting and trapping of some wildlife species, the mortality of some species, and the disturbance or displacement of some species. As on NFS lands, effects to wildlife associated with human use of roads will likely continue in the future. Administrative use of roads closed to the public increases during emergency response situations, such as wildfire response, and also during timber harvest preparation and implementation. Animals are likely to continue to be killed by vehicle collisions on highways in the valleys.

In the past, the invasion of Forest lands by non-native species has occurred due to a variety of activities, including road building, timber harvest, livestock, and recreational activities. Multiple agencies, counties, and private organizations are involved in educating the public on the importance of preventing the spread of non-native species, and many agencies engage in management actions to prevent or control infestations. Grazing has occurred and will continue to take place on private lands, which may cause effects such as cowbird nest parasitism on forest-dwelling birds if those Forest lands are close to private lands that house livestock.

In summary, proposed management direction on the Forest, in the context of all lands of the larger landscape, contributes to coniferous forest habitats in a variety of successional stages. Although the Forest does not have authority over all the stressors, the ecological conditions of coniferous forest communities and the processes that maintain them would be provided on NFS lands. Coniferous forest habitat is distributed across all Forest geographic areas. Coarse-filter plan components that provide for biodiversity would support the long-term persistence of the majority of species associated with this habitat.

In addition to effects on most species associated with coniferous forest habitats, the following sections describe species-specific effects. For coniferous forest connectivity, see section 3.7.4, subsection “Old-growth forest, very large live tree habitat, and very large dead tree habitat,” and section 3.3.6.

Flammulated owl (species of conservation concern)

Affected environment

This species is identified as a species of conservation concern by the regional forester of the Northern Region (www.fs.usda.gov/goto/flathead/SCC). The flammulated owl is a small, neotropical migratory bird that breeds in scattered areas of British Columbia and the western United States, including western Montana, and it winters in Mexico. This long-distance migration habit and low natal site fidelity are believed to contribute to genetic interchange between populations in different mountain ranges (COSEWIC, 2010). Arsenault and others reported in 2002 that flammulated owls are usually found in distinct aggregations of up to 10 territories (COSEWIC, 2010). Flammulated owl males had mean home ranges of about 35 acres in Colorado (Linkhart, Reynolds, & Ryder, 1998) and about 40 acres in Oregon (Linkhart & McCallum, 2013). The population status, trend, and home range size of flammulated owls in Montana is unknown.

The Avian Science Center at the University of Montana conducted surveys throughout a large portion of suitable breeding habitat in 2005 (Cilimburg, 2006; K. Smucker, Cilimburg, & Fylling, 2008). They located flammulated owls on all but three of the Forests in the Northern Region; no owls were detected on the Lewis and Clark, Custer, or Gallatin National Forests. The survey detected 243 flammulated owls on 78 transects across the Northern Region, with the highest occupancy rates on the Nez Perce National Forest, followed by the Lolo, Bitterroot, and Helena National Forests. The lowest occupancy rates occurred on the Idaho Panhandle, Clearwater, and Flathead National Forests. There are very few historic records of flammulated owls on the Forest, likely due to detection difficulty and naturally low amounts of suitable forest types that provide key habitats. Suitable landscapes have an abundance of xeric ponderosa pine/Douglas-fir forest, whereas unsuitable landscapes have patches of suitable microhabitat within larger areas of wetter coniferous forest types (J. S. Marks et al., 2016, p. 264). The threshold for the amount of xeric habitat needed at a landscape scale is unknown, but most of the Forest would fall in the latter category. Flammulated owls have been detected in two geographic areas of the Forest: Swan Valley and Salish Mountains (Kuennen, 2013j).

McCallum (1994) and Hayward and Verner (1994) reviewed flammulated owl habitat, behavior, and general ecology. The structure of mature ponderosa pine/Douglas-fir forest is a key ecosystem characteristic for flammulated owls. A forest structure that includes a mosaic of (1) mature and old forest with moderate canopy cover (35 to 65 percent), (2) large snags for nesting, (3) open patches for feeding (up to about 5 acres in size), and (4) dense thickets of small trees and shrubs in the understory for roosting is key (COSEWIC, 2010; Wisdom et al., 2000). On the Flathead National Forest, the warm-dry potential vegetation type and the portion of the warm-moist potential vegetation type with ponderosa pine/Douglas-fir are capable of having these characteristics (see figure B-03).

This cavity-nesting bird primarily nests in ponderosa pine snags (COSEWIC, 2010) in cavities excavated by pileated woodpeckers (Aubry & Raley, 2002), northern flickers, or sapsuckers (Cilimburg, 2006), but it may also nest in large live trees with heart rot. In their study of the breeding status of flammulated owls in Montana, Seidensticker, Holt, and Larson (2013) found that ponderosa pine comprised 72 percent of all cavity-bearing trees used by flammulated owls, Douglas-fir comprised 26 percent, and western larch the remainder. Ninety-three percent were dead trees. Cavity-bearing trees were most often broken-top trees in the 20-50-foot height class. Forty-five percent were in the 14-22 inch d.b.h. class, with a median d.b.h. of 21 inches and a range of 10-46 inches.

Flammulated owls prey primarily on nocturnal moths and insects, which have a higher abundance and are more easily caught in open forest stands or in grassy openings. Prey availability appears to be the primary factor in migration patterns, but winter habitat requirements are poorly known.

Samson (2006a) estimated the amount and distribution of flammulated owl habitat in the Northern Region and for each of the national forests in the Northern Region. Samson (2006b) also developed habitat estimates for maintaining viable populations of flammulated owl in the Northern Region. Bush and Lundberg (2008) provided an update of habitat estimates for the Northern Region conservation assessment. These analyses indicated that the type of habitat used by flammulated owls during the breeding season is abundant and well distributed across the national forests in the Northern Region as a whole. Compared to other national forests in the Northern Region such as the Bitterroot, Nez Perce-Clearwater, and Idaho Panhandle, the Flathead has a low acreage of flammulated owl habitat as well as low potential to provide flammulated owl habitat due to the relatively low potential for xeric ponderosa pine/Douglas-fir forest types on NFS lands in this area.

Much more of the Flathead Valley had xeric ponderosa pine/Douglas-fir forest at one time, but it was cleared long ago for agriculture and the development of communities in the valley bottoms. The natural range of variation for the ponderosa pine dominance type on the Forest is 0.5-3 percent of the forest acres, and current levels are at 0.4 percent, slightly below the natural range of variation. There has been a downward trend in the ponderosa pine dominance type on the Forest, mirroring that documented in the Interior Columbia Basin ecosystem management project assessment for the Northern Rocky Mountain province. That assessment noted significant decreases in shade-intolerant dominance types (including ponderosa pine) across that ecosystem (Paul F. Hessburg et al., 1999; P. F. Hessburg, Smith, Salter, Ottmar, & Alvarado, 2000; USDA, 1996, 2014b). Analysis on the Forest has also identified that trees in both the large and very large size class within the warm-dry and warm-moist potential vegetation types providing potential flammulated owl habitat are below the natural range of variation (see section 3.3.4, subsection “Very large live trees,” for more details). Nearly 90 percent of large/very large ponderosa pine/Douglas-fir forest occurs in the Swan Valley geographic area. The remainder occurs in the south end of the Salish Mountains geographic area and in the South Fork geographic area, including the Bob Marshall Wilderness.

Key stressors

Land management

On all lands, fire suppression in ponderosa pine/Douglas-fir forests can create a dense forest structure that does not provide the structural characteristics needed by flammulated owls. Vegetation management or wildfire that creates a habitat mosaic is beneficial, but stand-replacing wildfires can reduce the mosaic of habitats needed for nesting.

Development

Because this owl's habitat is in a potential vegetation type that occurs in valley areas of the Forest, it is susceptible to threats associated with development of its breeding habitat located on private lands.

Key indicator for analysis

Most of the habitat needs of flammulated owls (Wright, 1996) are addressed by coarse-filter plan components for vegetation. The following species-specific indicator applies:

- Key ecosystem characteristics associated with the habitat mosaic needed by the flammulated owl

In addition, refer to the indicators, and effects described in section 3.7.4 for "Coniferous forest habitats" and "Old-growth forest, very large live tree habitat, and very large dead tree habitat."

Environmental consequences

Summary of modeled alternative consequences

In order to assess key aspects of flammulated owl habitat, Ecosystem Research Group modeled the effects of alternatives on the natural range of variation, current conditions, and effects of alternatives (appendix 3). The natural range of variation was modeled going back about 1,000 years, and the effects of the alternatives were projected for the next 50 years, including anticipated changes in climate, using the fire suppression logic of the model. Modeled habitat included forests with *presence* of ponderosa pine and Douglas-fir with an average diameter greater than 15-inch d.b.h. and average canopy cover of 15-40 percent (resulting in more acres than if only a ponderosa pine *dominance type* was considered). Based upon Forest Inventory and Analysis data, forests with an average diameter greater than 15 inches d.b.h. contain sufficient snags to provide habitat for the species that excavate nesting cavities used by flammulated owls (pileated woodpeckers and flickers; for more details see section 3.7.4, subsections "Old-growth forest, very large live tree habitat, and very large dead tree habitat" and "Burned forest and dead tree habitats"). The logic pathways of the SIMPPLLE model show that dense stands of potential habitat (stands with > 40 percent canopy closure) will convert to highly suitable habitat (stands with 15-40 percent canopy closure) if they are treated by underburning, are burned by low- to moderate-severity wildfire, are attacked by Douglas-fir beetles, or are harvested or commercially thinned to remove understory and midstory trees and retain the largest trees.

The natural range of variation of modeled habitat for flammulated owls ranged from about 12,000-37,000 acres out of approximately 2.4 million acres on the Forest, a very small amount, and a very small range of about 25,000 acres. In the future, acres of habitat will increase from current levels during all five decades under all four alternatives. Under alternatives B modified and D, acres of current habitat are slightly higher than the minimum natural range of variation and increase to levels approximating the maximum natural range of variation by the end of decade 5. The model predicts that alternative C would exceed the maximum natural range of variation by the end of decade 5.

The above modeled results may be attributable to vegetation treatments in combination with natural disturbances. The emphasis on methods used to achieve desired conditions and the rate of their implementation would differ (e.g., timber harvest and/or prescribed fire), according to the mix of management areas for each alternative. Alternative A was modeled without prescribed burning, which likely explains why it consistently produces less flammulated owl habitat through the five-decade time period. Alternative B (similar to B modified) produces the most flammulated owl habitat, likely as a result of modeled vegetation treatments to achieve desired conditions by including timber harvest, precommercial thinning, and prescribed fire. Alternative C would achieve desired conditions with a greater emphasis on the use of prescribed fire compared to the other alternatives. Alternative D would produce slightly less habitat than B because the model was directed to manage for maximum timber production under this alternative. These effects would also be dependent upon budget (see sections 3.21 and 3.3 for more detail).

In the warm-dry potential vegetation type on the Flathead National Forest, vegetation modeling shows that over the next 50 years all alternatives would have a strong upward trend in the presence of ponderosa pine associated with a strong decrease in Douglas-fir and in stand densities. This is a desirable trend to increase the overall resilience of the forest at the landscape scale and would benefit the flammulated owl, provided it resulted in the small-patch mosaic described in desired conditions for the flammulated owl (see section 3.3.8 for more details on landscape pattern). Because most flammulated owl habitat is at low elevations and in the wildland-urban interface, wildfires would be actively suppressed under all alternatives in most cases. Since flammulated owls prefer more open forests, it would be necessary to use timber harvest and prescribed burning as tools to achieve desired conditions. In the wildland-urban interface, the most likely source of future snags would be those created by insects and disease or prescribed fire.

Under all alternatives, USFS policy and regulations regarding firewood gathering on NFS lands would apply. These regulations restrict firewood gathering to within 200 feet of open roads, thus limiting the magnitude and extent of snag loss across the Forest.

Alternative A

The 1986 forest plan does not have management direction specific to flammulated owls, but standards for the retention of old-growth, snags, and downed wood benefit flammulated owls.

Alternatives B modified, C, and D

Desired condition FW-DC-WL DIV-01 addresses key ecosystem characteristics for the flammulated owl, including composition, structure, density, pattern, and function. No additional species-specific plan components are necessary. Plan components included in all action alternatives would protect existing old-growth ponderosa pine/Douglas-fir forest, promote development and larger patch sizes of future old growth, and provide for retention of large and very large snags and defective live trees (see standard FW-STD-TE&V-01 and 03 and FW-GDL-TE&V-06 and 09). Standards GA-SV-STD-01 and GA-SM-STD-02 for the Swan Valley and Salish Mountains geographic areas specify that all snags of western larch, ponderosa pine, and black cottonwood trees greater than 20 inches shall be retained. If sufficient snags to meet the minimum level of 2-3 snags per acre for the warm-dry and warm-moist potential vegetation types are not present, live replacement trees shall be substituted for each snag. Live replacement trees shall be of the largest size present. These standards benefit flammulated owls by providing for nesting habitat.

Species-specific desired condition FW-DC-WL DIV-01 also describes desired forest composition, structure, and pattern for the flammulated owl. All action alternatives would provide key ecosystem characteristics by creating a variety of successional stages that may be used by flammulated owls for feeding and roosting in the warm-dry and ponderosa pine/Douglas-fir portion of the warm-moist potential vegetation type. By moving towards the desired conditions for vegetation, the amount and distribution of flammulated owl habitat would approximate what would have been present on NFS lands under natural disturbance processes over the long term. However, in portions of the Forest where large and very large ponderosa pine/Douglas-fir snags and/or live trees have been removed, it may take many decades for this benefit to occur. Vegetation treatments to move forests towards desired conditions for flammulated owls would also make ponderosa pine/Douglas-fir forests more resilient to drought and stand-replacing wildfires because dense, intermediate-sized trees that have accumulated over decades and could carry fire into the crowns of larger trees would be reduced. If large and very large ponderosa pine trees are killed by mountain pine beetles or very large Douglas-fir trees are killed by bark beetles or root rot, this would provide nesting snags that could be used by flammulated owls.

Additional standards and guidelines may be beneficial to flammulated owls but would depend upon site-specific application. Road access restrictions (FW-STD-IFS-02, GA-SM-STD-01, GA-SV-OBJ-04) could indirectly help to retain very large ponderosa pine snags that have the potential of being used by flammulated owls for nesting if road closures occur in suitable habitat. Temporary public access for firewood gathering allowed under FW-STD-IFS-04 could result in snag loss, but guideline FW-GDL-OFP-01 states, “Prior to temporarily opening a road to provide public access for gathering firewood, measures should be taken to protect the most valuable snag(s) as habitat for wildlife (e.g., by placing “wildlife tree—no cutting” signs on selected snags),” which would help to retain snags that are highly suitable for use by flammulated owls.

The 2012 planning rule requires the Forest to determine whether the plan components provide the ecological conditions necessary to maintain or restore a viable population of a species of conservation concern in the planning area (36 CFR 219.9(b)(1)). Key ecosystem characteristics include dry ponderosa pine/Douglas-fir forests with a mosaic of (1) large and very large snags for nesting, (2) an open midstory, (3) patches of dense Douglas-fir and ponderosa pine seedlings/saplings, (4) small openings for foraging, and (5) a landscape with an abundance of dry ponderosa pine/Douglas-fir forest.

It is likely beyond the authority of the Forest Service or not within the capability of the plan area to maintain long-term persistence of the flammulated owl in the plan area. However, the forest plan has plan components, including standards and guidelines, to maintain, improve, and restore ecological conditions within the plan area to contribute to maintaining a viable population of the species within its range, considering the following:

- The Forest is at the edge of the range of the flammulated owl and does not have landscapes with an abundance of dry ponderosa pine/Douglas-fir.
- The life requisites of the flammulated owl operate at scales much larger than the plan area in that they migrate to the neotropics in winter and are in the plan area only during the breeding season.
- Most private lands in the Flathead Valley that once provided very large ponderosa pine on xeric (dry) sites have been developed or converted to agriculture. Much of the NFS land with the potential to provide highly suitable habitat is characterized by intermingled private ownership and open roads providing access to private lands. The Forest Service does not have authority over private lands and lacks the authority to close roads that are needed to access private land.
- Breeding season habitat on the Forest is inherently limited in the plan area by the lack of ecological conditions capable of growing large, contiguous areas of xeric ponderosa pine/Douglas-fir forest across a large landscape area. Habitat with the potential to be highly suitable for flammulated owls is limited, is distributed in lower elevations of two Forest geographic areas, and may not occur in large enough areas to support clusters of nesting birds.
- The structure of the warm-dry potential vegetation type that provides potential habitat for flammulated owls is the type that has been most impacted by past fire suppression and historic timber harvest. These factors affect the Forest’s ability to restore the composition, structure, function, and pattern of habitat for this species over the anticipated life of the plan.

Although the Forest does not have authority over all the stressors that may affect the flammulated owl, the action alternatives includes plan components that would maintain, improve, and restore ponderosa pine forests that are more similar to historic conditions and are anticipated to be more resilient in likely future environments. This would be accomplished by plan components, including standards and guidelines, to maintain existing old-growth ponderosa pine/Douglas-fir forests and to retain large/very large ponderosa pine, Douglas-fir, and western larch snags and live trees in other forest stands. Plan components for the flammulated owl have been integrated with plan components for ecosystem services and multiple uses (36 CFR § 219.10).

Cumulative effects

On managed lands in the Swan Valley and Salish Mountains geographic areas, past timber harvest, firewood gathering, and conversion of ponderosa pine forests to agriculture or developed sites on private lands have caused habitat declines. NFS lands in the Swan Valley still have very large ponderosa pine trees. The habitat structure for the flammulated owl also declined from the 1940s to 1980s, due in part to fire suppression (Daniel Casey, 2000). Fire suppression allowed young Douglas-fir trees to suppress the recruitment of shade-intolerant ponderosa pine, increased stand densities, and reduced the amount of open understory and moderate canopy needed by this owl for foraging. The buildup of dense ladder fuels may also place flammulated owl habitat at higher risk of stand-replacing disturbance (wildfire and/or insect epidemics). Reduction of stand densities on all lands would make forests more resilient to wildfire and drought. Much of the ponderosa pine on the Flathead National Forest is in the wildland-urban interface with areas of intermingled private ownership, so the use of fire for restoration may be limited. Adjacent national and State forest land managers have instituted programs to retain old growth and to restore the structure and composition of ponderosa pine forests on suitable lands.

The preliminary Northern Region Adaptation Partnership risk assessment for the flammulated owl stated that, rangewide, the expected effects of changing climate conditions are not straightforward, with an unknown magnitude and likelihood. If the climate becomes warmer, it would favor the vegetation conditions that flammulated owls prefer (open ponderosa pine or dry forest habitats). Within mature ponderosa pine forests of the Bob Marshall Wilderness, for example, snags and decayed live trees suitable for nesting are abundant due to recent wildfires (and are not accessible for firewood gathering). Disturbances such as stand-replacing wildfire could also reduce current mature dry forests, turning large acreages into primarily young forests (or to grasslands or shrublands), or these changes could be offset by increases in dry forest habitats (McKelvey & Buotte, in press). Changes in the timing of prey availability may also affect flammulated owls (T. Jones & Cresswell, 2010), but this is uncertain.

Clark's nutcracker (species of conservation concern)

Affected environment

The Clark's nutcracker is identified as a species of conservation concern by the regional forester of the Northern region (www.fs.usda.gov/goto/flathead/SCC). This species is distributed across the western United States and southwestern Canada. The Clark's nutcracker occurs in northwest Montana year-round (Kuennen, 2013h). Although it is not at risk across its range, there is concern on the scale of the plan area due to an introduced disease that has caused a substantial decline in the primary habitat of this species, which is mature whitebark pine. Additionally, the Clark's nutcracker has a mutualistic relationship with whitebark pine (a candidate species), so each species needs the other. The Clark's nutcracker is the primary disperser of the large whitebark pine seeds, helping to perpetuate its primary food source. Because the Clark's nutcracker has a mutualistic relationship with whitebark pine trees, the decline in whitebark pine puts both Clark's nutcrackers and whitebark pine trees at risk in localized areas due to human-caused disruption of seed-dispersal mechanisms (McKinney, Fiedler, & Tomback, 2009).

Key ecosystem characteristics for the Clark's nutcracker include high-elevation conifer forests found in the cold potential vegetation type (see figures B-03 through B-09) with the presence of live, seed-producing whitebark pine to provide sufficient food to support nesting. Outside the breeding season, this species is associated with live, seed-producing ponderosa pine found in the warm-dry and warm-moist potential vegetation types at lower elevations.

The Clark's nutcracker is a specialist on large conifer seeds (Tomback & Linhart, 1990). Adult nutcrackers are heavily dependent on seeds from live whitebark and limber pine during the breeding season (Tomback & Linhart, 1990), especially during the summer post-fledging period (Vander Wall & Hutchins, 1983). Unlike national forests to the east of the Continental Divide, the Flathead National Forest does not have limber pine. Loss of mature whitebark, limber, and ponderosa pines to disease, insect outbreaks, and fire may lead to local and widespread nutcracker population declines (Tomback, 1998). Clark's nutcrackers appear to be in decline in some areas of northwest Montana. Sightings of this species have declined in Glacier National Park as well as on the Forest. Teresa Lorenz, research wildlife biologist with the Pacific Northwest Research Station, visited the Flathead National Forest and Glacier National Park in 2009 with the intent of beginning a study but could not locate enough birds. Breeding bird surveys, used to monitor populations of Clark's nutcrackers in Montana, indicate a nonsignificant decline in numbers of Clark's nutcrackers of 2.2 percent per year in Montana from 1980-2007, coincident with declines in whitebark pine due to blister rust infection in northwest Montana. Obtaining statistically significant trends for this species is difficult. According to Lorenz (2008), breeding bird survey data are particularly limited in value for monitoring species such as the Clark's nutcracker because they are non-territorial and wide-ranging and may not be actively nesting when counts are conducted.

The effects of long-term whitebark pine seed declines on Clark's nutcrackers are unknown. Although they are known to feed on Douglas-fir seeds, this is a low-energy seed that may not be sufficient to support breeding (D. Tomback, University of Colorado, personal communication with Cara Staab, 2015). Observations of nesting nutcrackers over the years suggest that adults attempt to breed only in the years when they have sufficiently large stores of seeds (Tomback, 1998). As summarized by Lorenz (2008),

> On a landscape scale, conifers do not produce the same amounts of seed every year. Years of heavy seed production are often followed by 1 to 3 years of low or moderate production. Nutcrackers therefore must be highly opportunistic and adaptable in order to survive years of low seed production. Many aspects of the nutcracker's life history, such as their varied diet and their yearly movements, reflect this opportunistic nature. Other aspects, including morphology and the timing of the breeding season, reflect their dependence on conifer seed. (p. 22)

If large-scale mortality of whitebark pine is leading to an increase in the number of non-breeding years for Clark's nutcrackers, there could be population- and ecosystem-level consequences (Schaming, 2015). Schaming (2015) studied Clark's nutcrackers in the Greater Yellowstone Ecosystem and found population-wide failure to breed during years of low whitebark pine cone production. If the birds did not have sufficient stores of cached seeds in the fall, they did not breed the following year. Schaming also measured body condition index during the breeding season and found that it was significantly lower in non-breeding years. The habitat carrying capacity for this species is diminished due to the loss of a key breeding season food source and the lack of a high-calorie back-up seed source west of the Continental Divide (D. Tomback, Department of Integrative Biology, University of Colorado Denver, personal communication, 2016).

McKinney and others estimated that forests must have a basal area of at least 21.8 square feet/acre for a high likelihood of seed dispersal by nutcrackers (McKinney et al., 2009). Of all the whitebark pine ecosystems studied, Clark's nutcracker occurrence, seed dispersal, and whitebark pine regeneration are lowest in northern Montana (Robert E Keane & Parsons, 2010). According to Forest Inventory and Analysis data (Trechsel, 2016), from a landscape perspective, the Forest is well below the threshold specified by McKinney et al. (see table 47), though there may be individual stands in some parts of the

Forest where whitebark pine is more abundant, perhaps exceeding the minimum 21.8 square feet/acre basal area. Forestwide, there are also few trees per acre of potential cone-bearing whitebark pine trees (see table 47), and whitebark pine presence is below the natural range of variation both forestwide and in the cold potential vegetation type (Trechsel, 2017a).

Table 47. Basal area and trees per acre of live whitebark pine on the Forest in the cold and cool-moist potential vegetation types (PVTs)

Live Whitebark Pine Trees	Cold PVT (square feet/acre)	Cool-moist PVT (square feet/acre)
Total basal area	11.4	1.3
Trees per acre ≥ 10” d.b.h. (“mature,” may be producing cones)	6.95	0.88
Trees per acre ≥ 15” d.b.h. (“mature,” more likely to be producing cones)	1.86	0.15

The natural range of variation for the whitebark pine dominance type on the Forest is about 2-7 percent of NFS lands on the Forest; current levels are about 2.4 percent (see sections 3.3.4 and 3.5.1 for more details).The Forest is in the Northern Divide ecosystem for whitebark pine, where forests have been suffering from introduced blister rust infection for a longer period of time than forests in other regions (Fiedler & McKinney, 2014). Refer to sections 3.3.1, 3.3.4, and 3.5.1 for more details on the existing condition of whitebark pine.

Key stressors

Land management

Management actions can affect the maintenance and restoration of live, seed-producing whitebark pine and ponderosa pine. Other than on NFS lands, most whitebark pine habitat in the vicinity of the plan area is in Glacier National Park. Tribal lands of the Confederated Salish and Kootenai Tribes also have whitebark pine and ponderosa pine.

Changing climate

Changing climate has the potential to have positive or negative impacts on whitebark pine and ponderosa pine ecosystems (Bartlein, Whitlock, & Shafter, 1997), as well as on Clark’s nutcrackers.

Key indicator for analysis

- Key ecosystem characteristics, including live, seed-producing whitebark pine and ponderosa pine.

See section 3.3.3 for more details on both these tree species and section 3.5.1 for details on whitebark pine.

Environmental consequences

Summary of modeled alternative consequences

Modeling of future vegetation shows that whitebark pine dominance type would continue to decline forestwide over the next five decades, but there might be a slow upward trend in its presence within the cold potential vegetation type. None of the alternatives achieves the desired minimum level of whitebark pine presence forestwide within the next five decades. Due to the severe effect of blister rust and the insufficient density of cone-producing trees to support Clark’s nutcrackers to disperse seed, a great deal of time, along with an aggressive restoration program, including planting of rust-resistant seedlings, would likely be needed to accelerate the rate of recovery for whitebark pine and increase live, seed-producing whitebark pine, as well as nutcrackers, over time. Treatments would increase the likelihood that blister rust-resistant whitebark pine of all sizes would have an increased chance of surviving in likely future environments that might include drought, wildfire, disease, and insects, benefiting Clark's nutcrackers.

Alternative A

The 1986 forest plan did not have management direction for Clark's nutcrackers, for restoring the whitebark pine forests they nest in, or for their ponderosa pine winter habitat. Nevertheless, efforts have been made to cage cones to collect whitebark pine seeds to grow nursery stock. Cooperative projects to plant whitebark pine in recently burned areas have also occurred.

Alternatives B modified, C, and D

All action alternatives include plan components to restore the ecological integrity of whitebark pine communities. To contribute to rangewide restoration efforts, the design, planning, and implementation of whitebark pine treatments on the Forest would be guided by the principles within a whitebark pine restoration strategy developed by Keane and others (2012) under all alternatives. To the degree possible at the forestwide scale, restoration efforts would be directed towards promoting whitebark pine rust resistance, conserving genetic diversity, saving seed sources, and implementing restoration treatments. Restoration of whitebark pine is a long-term undertaking.

Desired condition FW-DC-WL DIV-01 addresses the Clark's nutcracker, and no additional species-specific plan components are necessary. Plan components of the action alternatives would support key ecosystem characteristics for the Clark's nutcracker by providing for whitebark pine restoration. Plan components would allow for the reduction of competing trees and ladder fuels around existing disease-resistant survivors, allow for the collection of seeds to grow nursery stock, and allow for planting (see sections 3.3.4 and 3.5.1 for more details on whitebark pine and ponderosa pine). Plan components FW-DC-PLANT-03 and 04, and FW-OBJ-PLANT-01 would promote the restoration of mature, seed-producing whitebark pine. FW-DC-TE&V-07 and 08 and FW-OBJ-TE&V-01 would promote the restoration of ponderosa pine. These coarse-filter plan components would support key ecosystem characteristics for the Clark's nutcracker on NFS lands.

The 2012 planning rule requires the Forest to determine whether the plan components provide the ecological conditions necessary to maintain or restore a viable population of a species of conservation concern in the planning area (36 CFR 219.9(b)(1)). Key ecosystem characteristics include high-elevation conifer forests in the cold potential vegetation type (see figure B-03) with the presence of live, seed-producing whitebark pine to provide sufficient food to support nesting and low-elevation conifer forests in the warm-dry and warm-moist potential vegetation type with seed-producing ponderosa pine for winter feeding.

Plan components provide for ecological conditions to maintain the persistence of the Clark's nutcracker within the plan area, considering the following:

- The species persists year-round with a limited population in the plan area, even though an introduced disease has caused substantial declines in whitebark pine trees that provide key food resources during the breeding season.
- The Forest has the potential to provide breeding habitat at high elevations distributed across all but one geographic area of the Forest, so there would be sufficient distribution to be adaptable to likely future stressors. The Clark's nutcracker is widely distributed and is not threatened across its range.

- The co-evolved, mutualistic whitebark pine-nutcracker interaction facilitates rapid regeneration of whitebark pine after fire, but if Clark's nutcrackers are not present because seed densities are too low, the tree is not likely to regenerate naturally, even with favorable environmental conditions. The preferred alternative includes plan components that would actively maintain, improve, and restore seed-producing whitebark pine (see section 3.3 for more details).

- Although it would take decades for whitebark pine trees to increase in abundance and for young trees to reach cone-producing size, Clark's nutcrackers are highly mobile and are adapted to seeking out food sources across broad landscapes. As long as the species persists in the Rocky Mountains, it is likely that it would recolonize suitable habitats on the Forest as they are restored.

- Management treatments to move ponderosa pine forests towards desired future conditions would provide ecological conditions that are more similar to historic conditions and that are anticipated to be more resilient in anticipated future climates (see section 3.3 for more details). Ponderosa pine forests would provide winter habitat for Clark's nutcrackers.

Although the Forest does not have authority over all the stressors that may affect Clark's nutcrackers, the preferred alternative includes plan components that would maintain, improve, and restore the ecological conditions of key nesting and wintering habitats.

Cumulative effects

Whitebark pine occurs at high elevations in Glacier National Park and the Mission Mountains Tribal Wilderness, adjacent to the Forest, where it is also in decline. After enough consecutive years with low seed production, Clark's nutcrackers may not continue to reproduce on the west side of the Continental Divide but may continue to reproduce east of the Continental Divide where there are live, seed-producing limber pine, another breeding-season food source.

Many land managers on the west side of the Continental Divide, as well as several private organizations, have an interest in maintaining and increasing the live whitebark pine trees that support breeding populations of Clark's nutcrackers (see section 3.3.1 for more details). A changing future climate may result in more high-elevation wildfires that would create a suitable environment for natural regeneration of whitebark pine, but this is anticipated to occur only if there are enough nutcrackers and enough seeds for them to cache. If fires are too frequent, established regeneration will never grow above the lethal scorch height and mature individuals would not become established, affecting nesting season food availability for Clark's nutcrackers. These effects could occur on all lands.

As the climate changes, ponderosa pine in the Northern Region is expected to handle rising temperatures and deeper, longer droughts with only moderate difficulty. Increasing fire severity and occurrence could eliminate many live, mature ponderosa pine (Robert E. Keane et al., in press), but on the Forest most mature ponderosa pine is in the wildland-urban interface (see figure 1-13), where fires are likely to be suppressed.

Forest ungulates

Ungulates—white-tailed deer, mule deer, moose, and elk—are also known as big game species because they are hunted in accordance with State regulations. These species are discussed in the following sections.

Affected environment

White-tailed deer: Population, life history, habitat, and distribution

White-tailed deer are distributed across most of the United States, southern Canada, and Central America. They are widely distributed across Montana and are the most abundant ungulate species on the Forest (MFWP, 2015a). As of 1998, white-tailed deer populations in northwest Montana had increased to an apparent record high level (compared to the previous 20 years). Mackie et al. (Mackie, Pac, Hamlin, & Dusek, 1998) stated that this likely resulted from favorable habitat changes, mild winters, low hunter harvest rates, and possibly a numerical advantage favoring deer in the presence of predators. White-tailed deer numbers have varied considerably since 1998, but MFWP reports that numbers are currently increasing (MFWP, 2015a) (T. Thier, MFWP, personal communication, 2016).

White-tailed deer are opportunistic in their habitat use during mild winters but may rely on an energy-conservation strategy during harsh winters. Compared to other ungulates, white-tailed deer may be more sensitive to harsh winter conditions due to their small body size and short legs, with fawns being particularly susceptible to mortality during February and March (Dusek, Wood, Hoekman, Sime, & Morgan, 2006). During or following particularly hard winters, mortality due to malnutrition occurs, and snow accumulation may also make white-tailed deer more susceptible to being killed by a host of predators, especially mountain lions (Dusek et al., 2006). If adult female harvest rates are high in conjunction with high predation and poor fawn recruitment, a significantly lower population could persist for a time, even after a return to favorable environmental conditions (Mackie et al., 1998). In winter, white-tailed deer primarily feed within forested areas with an understory that is open enough to support shrubs and small trees. Oregon grape, Douglas-fir, and lodgepole pine seedlings/saplings, willows, and serviceberry shrubs make up a large portion of their winter diet. The conifer canopy also provides arboreal lichens that are blown to the ground or are available when the tops of young trees are bent over by the snow (Dusek et al., 2006). The nutritional condition of white-tailed deer going into winter is also important. Several studies of white-tailed deer have been conducted in northwest Montana, including on the Forest (Dusek et al., 2006; Morgan, 1993; Mundinger, 1984).

White-tailed deer are distributed across the Forest in spring, summer, and fall and are associated with a wide variety of cover conditions and foods. Mackie and others (1998) stated that timber management to optimize deer habitats in western Montana “should emphasize perpetuation or enhancement of habitat diversity” (p. 136). A study of white-tailed deer occupying northwest montane forests in the Salish Mountains geographic area of the Forest concluded that riparian areas and adjacent uplands containing pole/immature timber were very important as centers of deer use in summer (Morgan, 1993).

Summer habitats are managed primarily by the USFS, whereas in winter habitat, NFS lands are often adjacent to or intermingled with private lands. In winter, white-tailed deer are found in all the major river valleys of the Forest (see figures 1-22 through 25). Dusek et al. (2006) reported that in the Salish Mountains geographic area, white-tailed deer winter primarily along the eastern fringe of lower foothills from Little Bitterroot Lake east to Ashley Creek, south to Smith Lake/Truman Creek, and north to Pilot Knob . In the Stillwater River Valley, white-tailed deer winter from Lost Creek to the northernmost extent of Pete Ridge near Tally Lake (Dusek et al., 2006). In the Swan Valley, white-tailed deer winter from the area around Swan Lake south to the area near Holland Lake. Vegetation management on the Forest has created diverse composition and structure, providing white-tailed deer habitat quantity and quality.

Elk

Elk are distributed across western North America and all of Montana. The trend for elk populations on the Forest appears to be stable (T. Thier, MFWP, personal communication, 2016). In 2004, MFWP reported that elk populations wintering in hunting districts that include the Forest were lower in number than in past decades, likely due to forest succession in the absence of wildfire. Acres of elk habitat burned by wildfire have increased since 2003, and many of the burned areas are now providing abundant forage.

Mule deer

Mule deer are distributed across western North America and all of Montana. Mule deer are distributed throughout the Rocky Mountains and have spotty distribution elsewhere in the western United States and Canada. They occur in most of western and central Montana. According to MFWP, mule deer numbers in MFWP Region 1 appeared to hit a record low in 2011 after two severe winters in 2009-2010 and 2010-2011, but numbers were beginning to rebound in some areas in 2013 (T. Thier, MFWP, personal communication, 2013).

In mountainous regions such as the Forest, many of the mule deer and elk have similar habitat use patterns. They use distinct seasonal ranges, migrating locally through “transitional habitats” to lower elevations for all or a portion of the winter and moving to moist riparian habitats and higher elevations for the summer. Elk and mule deer habitat, mapped by MFWP (MFWP, 2013a, 2013c), is discussed in more detail in the Forest assessment (USDA, 2014b). There have been several studies of elk habitat use on the Forest (Biggins, 1975; Bureau, 1992; Fuller, 1976; Simmons, 1974; J. M. Vore, Hartman, & Wood, 2007; J. M. Vore & Schmidt, 2001) and one study of mule deer habitat use on the adjacent Kootenai National Forest (Stansberry, 1991). Nonwinter elk and mule deer habitat occurs across the whole Forest. Winter habitat overlaps with the valley-bottom white-tailed deer winter habitat in some areas but also occurs in areas associated with steep south- and west-facing slopes where wind and sun exposure reduce winter snow depths. Elk and mule deer are not as strongly associated with large areas of winter snow intercept cover at low elevations as white-tailed deer are. Elk and mule deer are less common on the Forest than white-tailed deer but are of high interest for hunting and observing.

Stansberry (1991) found that steep south-, southwest-, and west-facing slopes were used by mule deer in greater proportion than their availability on the landscape during all seasons. Mule deer use all forest types, especially those with a fine-grained or small-patch mosaic. In winter, patches of conifer cover help to moderate temperature extremes, reduce wind velocity, and reduce radiant heat loss. Snow depth under the conifer canopy is also minimized, providing easier access to foraging sites during harsh winters (Youmans, 1979). Spring and summer habitat use by mule deer on the Forest is similar to elk. In late fall and winter, mule deer may be found on small rocky cliffs interspersed with coniferous forests. Moist habitats are especially important to elk during calving. Research conducted during the 1970s on the Forest found that elk calving areas varied from year to year, depending upon snow depth.

Recent research has shown that forage and the condition of ungulates going into winter is just as important as the ungulate condition and forage during winter. Recent studies have indicated that management can be improved by integrating nutritional ecology on elk summer range (Cook, 2011). For example, many of the important food plants, including shrubs such as redstem ceanothus, serviceberry, Rocky Mountain maple, and grasses, grow only in forest openings or in forests with a more open canopy. Proffitt and others (2016) found that plant composition following fires was the biggest driver of differences in nutritional resources, suggesting that maintaining a fire mosaic will likely benefit ungulate populations. These authors reported that decades of fire suppression, resulting in forest maturation and a more closed canopy, may have reduced ungulate nutritional resources and population carrying capacity in their western Montana study area. Elk and mule deer are known to forage on grasses, forbs, and shrubs in areas that are transitionally or permanently non-forested areas interspersed with forested areas providing cover and security.

Research indicates that elk prefer to have hiding cover near open habitats used for foraging (Thomas & Toweill, 1982). Controlled burns, timber harvest, precommercial thinning, or other vegetation management strategies aimed at creating a mosaic of forest conditions can be beneficial to elk by providing abundant food resources in close proximity to cover and maintaining forage beneath the canopy of forested areas. On the Forest, very large stand-replacing fires have created large areas of forage where there may be a long distance to cover for the first 10-20 years after the fire. After a few decades, cover is restored, but trees may create enough shade to substantially reduce forage.

Elk winter habitat is mapped by MFWP. The Flathead National Forest has many areas where small groups of elk occur in the winter and two key elk wintering areas. One is in the Dry Parks/Horse Ridge/Spotted Bear River/Spotted Bear Mountain winter range areas of the South Fork geographic area. This area has steep, open south- and west-facing slopes interspersed with mature trees that provide winter habitat for approximately 300-400 elk, based upon MFWP annual survey reports. The Spotted Bear River portion of this elk habitat area was affected by high-severity wildfires in 2015, resulting in extensive regeneration of winter habitat cover and forage. The other area is the Firefighter area in the Hungry Horse geographic area, which provides winter habitat for approximately 100 elk. These elk tend to use winter habitat with heavier cover of lodgepole pine forest (J. M. Vore et al., 2007). The number of elk and mule deer wintering on other portions of the Forest has not been studied, but they appear to be mostly smaller groups of about 20-50 (J. Vore, personal communications, 2009, 2013).

Developments, roads, recreational activities, forest cover, and topographic variation affect elk habitat security and connectivity. Naylor et al. (2009) found that elk will move in response to a variety of recreational activities. They found that elk moved more when exposed to off-highway vehicles, followed by mountain biking, hiking, and then horseback riding. The effects of this increased movement are unknown. Elk response to human activities facilitated by open roads was studied extensively in the 1980s. The Montana Cooperative Elk-Logging Study (Lyon et al., 1985) defined security areas as habitat where elk can go to avoid disturbance due to human activities such as hunting, logging, and recreational motorized vehicle use. Road access on public lands, combined with hunting season limits set by the State, have a combined effect on elk mortality and hunter opportunity (Christensen, Lyon, & Unsworth, 1993). Research has also shown that there is a direct relationship between level of road access and bull elk mortality (Leptich & Zager, 1991; Unsworth & Kuck, 1991), so availability of security areas is especially important during the fall hunting season.

During the hunting season, elk in northwest Montana are known to select habitats with contiguous, nonlinear hiding cover patches over 250 acres in size and more than 0.5 mile from open roads (Hillis et al., 1991). These “security areas” help to maintain an elk population that is sufficient to provide hunter opportunity (Canfield, Lyon, Hillis, & Thompson, 1999). All or portions of about 11 elk and deer hunting districts occur on the Forest and are regulated by MFWP. Figure 1-30 displays elk security areas (see also section 3.7.5, subsection “Grizzly bear,” since areas providing grizzly bear habitat security also provide elk security).

Elk may make long-distance seasonal movements. Tracking of elk with satellite transmitters has shown that they move from winter habitat on the Flathead Indian Reservation to summer habitat west of Flathead Lake, which extends as far as 60 miles north to Kootenai National Forest lands near Fortine (Mann, 2013). In northwest Montana, localized movements between seasonal habitats are not known to follow any particular travel corridor or linkage area (Stansberry, 1991).

Human disturbance in areas where elk winter may stress the elk. Research in Montana has found that cross-country skiers may be more disturbing to elk than motorized users (Canfield et al., 1999). On the Forest, two areas have with groomed cross-country ski routes, but they are not in areas mapped as winter elk habitat by MFWP. Key winter elk habitat areas in the South Fork geographic area are closed to motorized over-snow vehicle use in winter, also making them less accessible to cross-country skiers due to long travel distances.

Moose

Moose are of interest for hunting and observing and are of key interest to the Confederated Salish and Kootenai Tribes for subsistence. Moose populations have been largest in MFWP Region 1 (northwest Montana) and Region 3 (southwest Montana), where moose populations increased and expanded in range through the early 1990s. This is believed to be due to the prevalence of early-successional forest created by fire and timber harvest (Brown, 2006). Since the 1990s, aerial survey trends and hunter harvest statistics indicate that populations in Montana have declined, but much uncertainty about the significance and causes of the apparent trends are unknown (T. Smucker, Garrot, & Gude, 2011).

Potential limiting factors to moose populations have been identified as hunting harvest, predation, vegetative succession and degradation, parasites, and climatic conditions (N. J. DeCesare, Smucker, Garrott, & Gude, 2014). In 2013, MFWP began a 10-year study designed to improve understanding of means to monitor the current status and trends of moose populations as well as the relative importance of factors limiting their population growth (N. DeCesare & Newby, 2016). The Cabinet-Fisher portion of the study area has habitat most similar to habitat on the Forest. In the first two years of the study, moose in the Cabinet-Fisher study area had the lowest calf survival rate of the three Montana study areas but the highest adult survival rate (MTFWP, 2015b).

In winter, moose are primarily found in the Salish and Hungry Horse geographic areas of the Forest (MFWP, 2013b). Moose are distributed across the Forest in summer. In summer, high-quality moose habitat is provided by shrubs (e.g., willow, alder, red osier dogwood, paxistima) that occur in a variety of riparian areas as well as in burns and harvest areas. Aquatic and riparian areas are key in summer, when moose may move from high-elevation habitats where they feed upon shrubs, to low-elevation feeding sites where they feed upon aquatic plants (Matchett, 1985). Johnson and Carothers reported in 1982 that in some parts of the western United States, cottonwood/willow riparian habitats have been reduced by as much as 90‑95 percent (N. J. DeCesare et al., 2014). According to a 2007 study by Peek, persistent riparian habitat along rivers and streams may have provided long-term stability historically to moose populations and functioned as corridors to allow moose to expand into post-fire habitats (N. J. DeCesare et al., 2014). According to Eastman in 1974 as well as others, moose frequently use both logged and burned forest habitat in the first 10 to 30 years after harvest or fire (Brown, 2006; T. Smucker et al., 2011; Telfer, 1995). In the Yaak River drainage of northwest Montana, moose selected for clearcut areas that had been logged 15–30 years prior as well as areas within 100 meters of a cutting unit (Matchett, 1985). If deep, soft snow has accumulated, moose use forested riparian areas and other areas of mature forest, feeding upon species such as Pacific yew beneath the canopy. By late winter and early spring, when the snow crusts over, moose may move up in elevation and feed on deciduous shrubs in openings. Unlike elk, moose do not avoid roads or motorized use and do not appear to select cover for travel (Matchett, 1985). Moose are known to travel on roads or compacted snowmobile trails in winter. Individual moose may be more vulnerable to hunter harvest in areas of high road density, but allowable harvest levels are currently limited by a permit drawing, with regulations set by MFWP. The Confederated Salish and Kootenai Tribes also have treaty rights to hunt moose. All or portions of about seven moose hunting districts are located on the Forest. The number of moose permits in MFWP Region 1 gradually doubled between 1983 and 1995. Between 1995 and 2010, the number of moose permits issued in Montana was reduced by 40 percent, with most of this reduction occurring in Regions 1 and 3. The highest moose harvest has been in the Salish, North Fork, and Hungry Horse geographic areas.

Moose have a northern distribution across most of Alaska, Canada, and the northern tier of the United States, but the factors that define the southern limits of their current distribution are not well understood (Lowe, Patterson, & Schaefer, 2010). Moose populations and their distribution may be affected by a changing climate, but there is scientific uncertainty on specific effects. Within Montana it is unclear whether any climatic variables underlie spatial variation in the productivity of local populations (N. J.

DeCesare et al., 2014). DeCesare and Newby's 2015 annual report on moose research in Montana summarized information about moose and climate change (MTFWP, 2015b). Climate and weather conditions can directly and indirectly influence moose populations, according to Karns and Van Ballenberghe in 2007, Ballard in 2007, and Brown in 2011 (MTFWP, 2015b). Climatic patterns determining the timing of spring green-up, summer precipitation, and winter snow conditions can influence survival and recruitment indirectly through effects on forage availability and quality (MTFWP, 2015b) and, according to Samuel in 2007, through climate-mediated effects on parasite densities, such as winter ticks (MTFWP, 2015b). Although data are not available on the impact of ticks on moose in Montana, negative effects of ticks on moose populations have been well documented elsewhere, so negative effects of ticks on moose in Montana seem likely (N. J. DeCesare et al., 2014). Effects of climate on moose can be seen in their metabolic response to temperatures and in the energetic costs of traveling through deep snow, according to Renecker and Hudson in 1986 (MTFWP, 2015b). Moose are well adapted to cold temperatures and have been shown to modify their movements and habitat use if they become heat stressed.

All ungulate species are susceptible to predation. Mountain lions (cougars), grizzly bears, wolves, black bears, and coyotes can be effective predators of newborn elk calves through their first few months of life. According to a 1976 study by Schlegel, black bears have been documented as predators of newborn elk calves in mountain environments (Mackie et al., 1998). Young and old moose may be susceptible to predation by wolves and bears (Kunkel & Pletscher, 1999).

Key stressors

Land management

On all lands, vegetation and fire management can affect ungulate habitat by increasing or decreasing habitat diversity and quality. Riparian habitats and other high-elevation moist sites are key for ungulate species in spring, summer, and fall. Patches of tree canopy that mitigate the effects of periodic hard winters are key at lower elevations. Excessive density of roads open to motorized public use during the hunting season can decrease habitat security and have indirect effects on hunter harvest and retention of bulls or bucks in ungulate populations.

Changing climate and weather

Elk and deer have wide ranges and a high degree of plasticity towards habitat, which is likely to make them resilient to a changing climate. Moose may be more susceptible to effects of a changing climate, but effects are uncertain and are currently under study.

Key indicators for analysis

The following indicators are used for analysis of effects on forest ungulates (e.g. elk, moose, mule deer, and white-tailed deer):

- Key ecosystem characteristics providing snow intercept cover in key winter habitats
- Key ecosystem characteristics providing habitat diversity
- Security in key habitat areas

In addition, refer to indicators for coniferous forest and wildlife associated with aquatic, wetland, and riparian habitats.

Environmental consequences

Summary of modeled of alternative consequences

Ecosystem Research Group modeled winter cover for white-tailed deer, since winter conditions are most limiting for this ungulate species, and they also modeled forage for all ungulate species (see appendix 3 for more details).

Ecosystem Research Group interpreted vegetation model outputs over the next five decades in comparison to the natural range of variation going back about 1,000 years. The natural range of variation for snow intercept cover in areas modeled as white-tailed deer winter range varies from about 29,518 to 110,721 acres out of approximately 325,491 acres of modeled winter habitat on the Forest. The current level of habitat is estimated to be at the midpoint of the natural range of variation. In the future, modeled winter snow intercept cover initially increases and then declines to below current levels by the end of the fifth decade under all alternatives due to modeled effects of Douglas-fir beetle on mature trees. Alternatives B modified and D provide slightly less modeled snow intercept cover than alternatives A or C, likely due to vegetation treatments to meet other desired conditions in the warm-dry and warm-moist potential vegetation types, which are mainly in the wildland-urban interface (see figure 1-13).

Most of the white-tailed deer winter habitat on the Forest is in the warm-dry and warm-moist potential vegetation types where forest structure is most altered by fire suppression, timber harvest, and fuels reduction. Fire suppression targets much of the warm-dry and warm-moist potential vegetation types because it overlaps the more heavily roaded, valley-bottom areas where people live (the wildland-urban interface). In some of these areas, fire suppression has resulted in a dense midstory of Douglas-fir trees, creating a forest structure that provides snow interception for white-tailed deer but is not characteristic of historic conditions and is not anticipated to be sustainable under anticipated future summer climate conditions (see section 3.3 for more details). Because most white-tailed deer winter habitat is in the wildland-urban interface, wildfires would be expected to continue to be suppressed under all alternatives. As a result, desired conditions for vegetation would primarily be accomplished by a combination of timber harvest, precommercial thinning, planting, and use of prescribed fire to provide a sustainable mosaic of forest conditions. The model predicts that all alternatives would stay within the minimum and maximum range of the natural range of variation over the five-decade time period. The modeled reductions in snow interception by the fifth decade could cause higher levels of winter stress or mortality during harsh winters, but this effect would be less frequent if a changing climate causes more precipitation to fall as rain rather than snow in the valleys where winter habitat is located.

In order to assess key aspects of habitat diversity for ungulates outside the winter time period, the effects of the alternatives on nonwinter forage were modeled by Ecosystem Research Group (see appendix 3). The natural range of variation was modeled going back about 1,000 years, and the effects of the alternatives were projected for the next 50 years. The model predicts that all alternatives would stay within the minimum and maximum range of the natural range of variation over the five-decade time period, hovering somewhere around the midpoint of the natural range of variation and current levels. The natural range of variation of foraging habitat for elk ranges from about 290,000 to 1,100,000 acres out of approximately 2.4 million acres on the Forest, a very large range. Under all alternatives, the number of acres of habitat initially increases slightly and then declines back to current levels. In the future, there are very slight differences in alternatives. Model results for alternative A show less forage than the other alternatives, most likely due to the lack of prescribed fire modeled for that alternative. Model results for the other alternatives show slightly more forage, likely due to higher amounts of prescribed burning to meet desired conditions.

Alternative A

The 1986 forest plan includes “Big game” management direction and management area direction. Management area direction for white-tailed deer winter habitat (management area 9 in the existing plan) includes preparation of a long-range activity schedule for each winter range to provide the size, age, diversity, and distribution of habitat needed by this species; implementing habitat improvement projects; timber harvest to create small openings; and maintenance of winter thermal/snow intercept cover in each winter habitat block. The 1986 forest plan closes key big game winter habitat areas on NFS lands in management area 9 to public motorized over-snow vehicle use (e.g., Pilot Knob and Pete Ridge in the Salish geographic area). Winter habitat management is coordinated with MFWP to support white-tailed deer populations that use Forest lands. Management area direction for roaded and unroaded lands that provide elk winter habitat (management area 13) includes (1) preparation of a long-range activity schedule for each winter range to provide the size, age, diversity, and distribution of habitat needed by these species when implementing habitat improvement projects and (2) maintaining at least 30 percent winter thermal cover. Areas allocated as management area 13 that are steep and have sparse tree cover are listed as not suitable for timber production, whereas more heavily timbered winter habitat areas are listed as suitable for timber production. Management area 13 in the existing plan also includes direction to close key winter range areas to motorized over-snow vehicle use if there are conflicts. These actions are coordinated with MFWP and other private cooperators (e.g., the Rocky Mountain Elk Foundation) to support elk populations that use Forest lands.

Forestwide, big game management direction includes incorporating moist site and security area recommendations displayed in appendix DD of the 1986 forest plan. Moist sites and security areas are analyzed at the project level. Other forestwide management direction also provides for elk security. The 1986 forest plan has limits for open motorized access density, total motorized access density, and security core in the grizzly bear recovery zone/primary conservation area that indirectly provides high levels of habitat security for elk during all seasons (and also for other ungulates). In the Salish Mountains geographic area on the Tally Lake and Swan Lake Ranger Districts (grizzly bear management zone 1), elk security is addressed through unrestricted road density requirements. These requirements specify a range in miles per square mile of roads open to public motorized vehicle use and apply to smaller geographic *units* (see discussion in section 3.7.4, subsection “Grizzly bears”). In winter, some areas providing winter habitat for forest ungulates are open to motorized over-snow vehicle use, but this use is restricted near key areas (e.g., Spotted Bear, Rhodes Draw to Tally Lake, the North Fork, Columbia Falls to West Glacier (see figures 1-22 and 1-29), reducing the risk of disturbance. The 1986 forest plan provides for key ecosystem characteristics of the Forest’s ungulate species.

Alternatives B modified, C, and D

The action alternatives do not have management areas specific to elk or deer winter habitat. Under alternatives B modified and D, about 67 percent of the white-tailed deer winter habitat on NFS lands is in management area 6b, 6c, or 4b, where timber harvest would be likely to occur (see sections 3.3.2 and 3.8.3 of this final EIS for more details). Under alternative C, about 50 percent is in these management areas (see figures 1-03). Steep open areas (also providing elk and mule deer winter habitat) are generally mapped as management area 6a (general forest low-intensity vegetation management) under all alternatives. This management area is not suitable for timber production, but timber harvest is allowable under certain conditions, which would be assessed at the project level. Desired conditions for specific geographic areas also address key winter habitats for forest ungulates: GA-HH-DC-02, GA-NF-DC-08, GA–SM-DC-04 and 05, and GA-SV-DC-05 and guideline GA-SM-GDL-01.

The action alternatives have desired conditions for the warm-dry and warm-moist broad potential vegetation types, which is where much of the Forest’s winter habitat for ungulates occurs (see FW-DC-

TE&V-08). Plan components for vegetation structure, composition, and pattern provide for key ecosystem characteristics described in the “Affected environment” section and contribute to diverse and resilient forest conditions. Desired conditions for the warm-dry and warm-moist potential vegetation types would maintain snow intercept cover in forested areas where elk and mule deer winter habitat overlaps with white-tailed deer winter habitat. To achieve desired conditions in the warm-dry and warm-moist potential vegetation types, conifer trees in the understory and midstory would be removed and large, full-crowned trees in the overstory canopy would be retained to provide snow intercept cover. Achieving a lower stand density by removing midstory and understory trees would make forests in key winter habitat areas better able to withstand drought or insect and disease outbreaks that would result in loss of snow intercept cover. However, removing understory Douglas-fir would reduce arboreal lichens and needles that provide forage in the understory canopy layers. As a result, desired conditions specify retention of clumps of conifer seedlings/saplings to provide forage during the winter and to grow into large trees as succession occurs. Achieving a lower stand density would also help to maintain shrubs in the understory and would increase wind in the canopy that blows arboreal lichens to the ground, making them accessible to ungulates for food. Where winter habitat for forest ungulates overlaps with flammulated owl habitat, implementation of these desired conditions and guidelines would allow for restoration of the landscape structure needed by flammulated owls while also providing for the winter habitat needs of white-tailed deer and other forest ungulates.

Key ecosystem characteristics for ungulate habitat during all seasons (described in the “Affected environment” section) would be supported by implementation of plan components for watersheds and riparian management zones as well as vegetation structure, composition, and pattern. Habitat types providing moist sites used by ungulates during the non-winter seasons are generally found in the cool-moist and cold potential vegetation types. Most of the acreage in these types is mapped as lynx habitat, with standards that promote high understory density and cover but limit timber harvest and thinning activities that create openings providing elk forage. However, in areas where wildfires occur, forage for elk and other ungulates is abundant. FW-DC-TE&V-19 states that forests in the cool-moist and cold potential vegetation types provide habitat for a variety of wildlife species. Processes (e.g., fire, wind, insects and disease) that create diverse patches and patch sizes also create openings dominated by grasses, forbs, and shrubs providing nonwinter foraging habitat for wildlife species (e.g., a wide variety of plant species that produce berries for grizzly bears; species such as willow, alder, or yew that provide cover and forage for snowshoe hares and moose). Forestwide guidelines FW-GDL-RMZ-09, 12, 14, and 15 benefit habitat connectivity by promoting retention of understory vegetation and limiting construction of new roads, temporary roads, and landings in riparian management zones.

Motorized and non-motorized access can affect forest ungulates through direct disturbance or increased access by hunters. Areas suitable for motorized over-snow vehicle use vary by alternative. Under alternatives C and D, an area of the North Fork geographic area would become suitable for motorized over-snow vehicle use that is not currently suitable, which would affect less than 1,000 acres of mapped deer or elk winter habitat. Under alternative B modified, the area of mapped deer or elk winter habitat that is suitable for motorized over-snow vehicle use would be reduced in size so that it would be less than under alternatives C or D (see figures 1-22 to 1-29). This addition would have a minor effect on forest ungulates because the majority of winter habitat in the North Fork is not open to motorized over-snow vehicle use. Some areas providing winter habitat for elk are open to motorized over-snow vehicle use, but this use is restricted near key areas (e.g., Spotted Bear, Rhodes Draw to Tally Lake, the North Fork, Columbia Falls to West Glacier), reducing the risk of disturbance. In the grizzly bear recovery zone/primary conservation area, standards FW-STD-IFS-02 and GA-SM-STD-01 for motorized access would indirectly benefit ungulates. Areas that provide secure core for grizzly bears exceed 2,500 acres, distributed across many grizzly bear subunits, and would provide habitat security for ungulates in all but the Salish Mountains geographic area. In the Salish Mountains geographic area, grizzly bear management zone 1 (which encompasses most of the rest of the Forest), standard GA-SM-STD-01 would maintain habitat security for ungulates because it specifies that the linear density of roads open to public motorized vehicle use on NFS lands is limited to the baseline. With respect to the distribution of open roads, GA-SM-GDL-01 states,

> In order to provide elk habitat security, access management actions should not result in a decrease in total acres of NFS lands within the geographic area that are at least 250 contiguous acres and at least one half mile from roads open to wheeled motorized use by the public. If vegetation management occurs in elk security habitat, a mosaic of cover and forage should be provided, in consideration of the site-specific topography and vegetation types. Roads may be temporarily opened, after consultation with a forest wildlife specialist, for up to 30 days during July and August to allow for activities such as firewood gathering.

In summary, this set of plan components would maintain ecological conditions that support MFWP ungulate objectives for all action alternatives. Under alternatives B modified and C, there would be additional management area 1b (recommended wilderness) and an additional limit on motorized access for trails open to public motorized use in the Salish demographic connectivity area, providing a higher level of habitat security but less motorized access for hunters in the future as site-specific decisions are implemented.

Cumulative effects

Since the late 1980s, close to 40,000 acres on NFS lands have had cooperative habitat improvement projects benefiting elk and deer habitat, including prescribed burns, planting, slashing of small conifers to maintain forage openings, and weed control (see also the section on elk in the Forest's assessment (USDA, 2014b).

Residential subdivision of private lands is likely to continue or even increase in the future. The acquisition of former Plum Creek Timber Company lands in the Swan Valley under the Montana Legacy Project by the USFS, Montana Department of Natural Resources and Conservation, and private conservation buyers prevents residential subdivision that could result in loss of white-tailed deer habitat and promotes recovery of white-tailed deer snow intercept cover on lands that have had regeneration harvest. Conservation easements in other geographic areas (such as on the F. H. Stoltze Land & Lumber Company property in Haskill Basin north of Whitefish) also helps to control residential subdivision.

Changing climate conditions are expected to increase the frequency of summer drought and increase fire size and severity. Drought may cause moist vegetation to dry up sooner, decreasing forage quality. In addition, areas burned by high-severity fires provide a seed bed for invasive weeds, which do not provide forage for elk and deer (McKelvey & Buotte, in press). The Forest has experienced an increase in wildfires in areas providing elk habitat in the last few decades (USDA, 2014b), creating an increase in the quality and quantity of nonwinter forage, especially in the North Fork, Hungry Horse, and South Fork geographic areas. This trend has also occurred on lands in Glacier National Park. Vegetation management on all landownerships would benefit white-tailed deer if it is done in a way that maintains snow intercept cover for harsh winters but increases habitat resilience and forage quantity/quality. Whether this will occur or not is unknown, but many forest land managers have professional foresters, silviculturists, and wildlife biologists to coordinate timber management to benefit multiple resources, including ungulates.

Many of the cumulative consequences for moose are the same as those listed for white-tailed deer, elk, and mule deer. However, moose are more of a cool and cold climate species. In the future, increases in temperature associated with a changing climate could directly stress moose or make them more susceptible to other mortality factors, but there is currently a high level of uncertainty with respect to climate effects on moose. The combined effects of climate, parasites, and predation on moose in Montana is currently being investigated.

In the past, severe winters, in combination with high populations of predators, contributed to high mortality of ungulates, especially white-tailed deer. Montana Fish, Wildlife and Parks manages ungulate and predator populations through trapping and hunting regulations, adjusting regulations to meet population and harvest objectives. Deer harvest has been high, but the Forest continues to have very high populations of white-tailed deer. Glacier National Park, encompassing about a million acres adjacent to the Forest, is closed to hunting but has high levels of ungulate predators.

A downward trend in the mileage of roads open to motorized use year-round and during the hunting season has helped to maintain elk and deer habitat security on all lands. In addition to Forest lands, there are many closed roads on Montana Department of Natural Resources and Conservation and private forest lands. This has increased nonmotorized hunting opportunity but has reduced motorized hunting opportunity. Montana Fish, Wildlife and Parks reported on the elk population objective status by hunting district in 2013, and for elk hunting districts with identified objectives, all those on the Forest (including all lands) are “at objective” (see the section on elk in USDA, 2014b for more details).

Subdivision and commercial development of habitat, particularly winter habitat, can reduce habitat quantity and quality for ungulate species. White-tailed deer mortality is high in areas where they are concentrated along county, State, and Federal highways or high-speed roads in the valley bottoms, especially in winter when they are concentrated in these areas.

Gray wolf

Affected environment

The gray wolf is distributed across most of Alaska, Canada, northern Minnesota and Michigan, and throughout the Rocky Mountains, including western Montana. The gray wolf was delisted in Montana and Idaho in May of 2011, with hunting and/or trapping of wolves under State management occurring soon after. According to the USFWS, as of the end of 2013, the northern Rocky Mountain wolf population had exceeded its recovery goals since 2002 (Jimenez, 2014).

Montana wolf pack territories are large and change from year to year, depending on prey availability and relationships with neighboring packs (Bradley et al., 2014). As of 2014, the number of wolf packs within or adjacent to the Forest was well above the targeted recovery level and the wolves were distributed across the Forest. In 2014, MFWP verified a minimum count of 338 wolves and 17 breeding pairs in the Northwest Montana recovery area, compared to 412 wolves and 15 breeding pairs in 2013 (Bradley et al., 2015). Gray wolves commonly hunt in packs. The main prey species in Montana are deer, elk, and moose. Domestic livestock such as cattle and sheep are also preyed upon. Gray wolves may also eat alternative prey, such as rodents, vegetation, and carrion (MTFWP, 2003). At a landscape scale, the gray wolf exhibits no particular habitat preference except for the presence of native ungulates (deer, elk, moose) within its territory on a year-round basis. Ungulate winter ranges, usually located in valley bottoms, are key for wolf survival.

Pack activity is centered on the den site where pups are born and on nearby rendezvous sites where pack members convene from late April until September. Boyd-Heger (1997) found that wolves in the North Fork of the Flathead River drainage of the Forest appeared to select denning and rendezvous sites that had relatively low elevation, flat terrain, and were close to water. The wolf recovery plan stated that key components of wolf habitat are (1) a sufficient, year-round prey base of ungulates and alternative prey, (2) somewhat secluded denning and rendezvous sites, and (3) sufficient space with minimal exposure to humans at a landscape scale (USFWS, 1987). Gray wolves establishing new packs in Montana have demonstrated greater tolerance of human presence and disturbance than was previously thought characteristic of this species (MTFWP, 2003). However, wolves are less abundant in areas of high open road and trail density (Whittington, St Clair, & Mercer, 2005), likely due to higher human-caused mortality in these areas. Many miles of roads on the Forest have been closed in recent decades, providing habitat security for wolves (see section 3.7.5, subsection "Grizzly bear," for more details). With respect to habitat connectivity, NFS roads are not a barrier, and wolves often travel on closed roads (K. Laudon, MFWP, personal communication, 2011).

At a landscape scale, the USFWS conducted a multi-scale assessment for the Northern Rocky Mountain segment of the gray wolf population in 2009 (USFWS, 2009). This assessment stated, "There is more than enough habitat connectivity between occupied wolf habitat in Canada, northwest Montana, and Idaho to ensure exchange of sufficient numbers of dispersing wolves to maintain demographic and genetic diversity in the NRM [Northern Rocky Mountain] wolf metapopulation. We have documented routine movement of radio-collared wolves across the nearly contiguous available suitable habitat between Canada, northwestern Montana, and central Idaho" (p. 15161). The assessment also notes, "Wolf dispersal into northwestern Montana from the more stable resident packs in the core protected area (largely the North Fork of the Flathead River along the western edge of Glacier NP [National Park] and the few large river drainages in the Bob Marshall Wilderness Complex) and the abundant National Forest Service lands largely used for recreation and timber production rather than livestock production, helps to maintain this segment of the NRM wolf population" (p. 15160).

Key stressors

Land management

On all lands, the effect of land management on wolves is primarily a result of effects on wolf prey and security near den sites.

Changing climate

Projected changes in climate could result in negative, neutral, or positive impacts to habitat for the gray wolf and would be strongly influenced by effects to the primary species wolves prey upon—deer, elk, and moose (see section 3.7.4, subsection "Forest ungulates," for more details).

Direct mortality

Montana Fish, Wildlife and Parks allows hunting and trapping of wolves under a regulated season, as directed by the Montana Gray Wolf Conservation and Management Plan (MTFWP, 2004). Wolf-livestock conflicts most often occur with sheep. There are no sheep grazing allotments or permits on NFS lands on the Flathead National Forest. Sheep are grazed on some private lands in the Flathead Valley.

Key indicator for analysis

Wolves are habitat generalists with habitat needs that are largely provided by coniferous forest habitat diversity. Management direction that provides for wolves' ungulate prey species and the habitat security of the prey species also provides for wolves.

The following species-specific indicators are relevant to the gray wolf:

- Key ecosystem characteristics of wolf habitat and risk of human disturbance near active wolf den and rendezvous sites

Environmental consequences

Alternative A

The 1986 forest plan provides forestwide management direction specific to the gray wolf, which contributes to habitats that support wolves. Management direction specific to wolves includes timing limitations for timber harvest near dens and rendezvous sites. Implementation of big game management direction benefits wolves by providing habitat conditions to support wolf prey species. Implementation of amendment 19 benefits wolves by providing security for wolves and their big game prey species and also reduces the risk of wolf mortality.

Alternatives B modified, C, and D

Key ecosystem characteristics described in the “Affected environment” section would be supported by implementation of plan components for watersheds and riparian management zones as well as plan components for diverse vegetation included in all action alternatives. In addition, standards for motorized access would maintain baseline open road densities across the Forest, as well as baseline total route densities and secure core in the grizzly bear recovery zone/primary conservation area, providing secure habitat for wolves and reducing the risk of excessive wolf mortality. Plan components would also benefit wolf prey species. Guideline FW-GDL-WL-DIV-05 provides direction to limit disturbance within 0.25 mile of known, active dens and rendezvous sites, incorporating measures to avoid or mitigate impacts of activities from April 1 to July 1. The distance from active den and rendezvous sites is less under the action alternatives than under alternative A but is expected to have minor effects because wolves have been found to be more tolerant of human activities than previously thought (MTFWP, 2003). In order to protect wolves, wolf den sites are not mapped, but the USFS coordinates with MFWP to gather information on known den and rendezvous sites. Forestwide guidelines FW-GDL-09, 12, 14, and 15 benefit habitat connectivity by promoting the retention of understory vegetation and limiting construction of new roads, temporary roads, and landings in riparian management zones.

Cumulative effects

Montana Fish, Wildlife and Parks adjusts hunting and trapping regulations to meet population and harvest objectives. Glacier National Park, encompassing about a million acres adjacent to the Forest, is closed to hunting and trapping. Elsewhere, wolf hunting and trapping has been allowed from 2011 to present. The minimum known wolf population dropped from about 650 in 2011 to about 536 and 32 breeding pairs in 2015 but was still well above the target population of 10 breeding pairs for three consecutive years established for recovery. In the future, the wolf population may see a decreased growth rate or see a population decline, but hunting and trapping have not kept wolf populations from exceeding recovery goals.

Human-wolf conflicts can occur when wolves prey upon livestock, sometimes leading to removal of individual wolves or packs. Because grazing has been very limited on the Forest as well as on State and private lands in recent decades, only one wolf pack has been removed due to past livestock conflicts. On NFS lands, limits on livestock allotments adopted for the grizzly bear would also benefit wolves.

Timber harvest occurring on private, State, or other lands may affect the distribution, amount, and quality of ungulate habitat or cause disturbance to wolves. The wolf population in northwest Montana increased exponentially while these activities were going on within their habitat, so it is unlikely there have been any substantial effects. Access management has trended towards reducing the miles of open roads and so has improved wolf habitat security and likely decreased mortality on NFS lands as well as on State and some private timber lands. Glacier National Park provides a high level of wolf security and has very few miles of roads. The desired condition for connectivity in the forest plan directs the Forest to work with other agencies and landowners when highways are proposed for construction or reconstruction to incorporate crossing structures where needed. This should aid in minimizing the risk of vehicle collisions with wolves or their prey and would also aid in maintaining connectivity between areas of NFS lands as private lands are subdivided in the future (see also section 3.7.4., subsection “Forest ungulates,” and section 3.7.5, “Grizzly bear”).

Because wolves and their prey are habitat generalists, changes in climate are expected to have a minor effect on their habitat (see ungulate section above for more details).

Northern goshawk

Affected environment

The goshawk is a breeding resident across most of Alaska, Canada, and the western United States. A 2005 survey effort across road-accessible NFS lands in the Northern Region estimated that goshawks were present in 39 percent of the territory-sized sample units (95 percent confidence interval = 29-50 percent) (Kowalski, 2006a, 2006b). Although the survey design did not estimate goshawk occupancy rates for any individual national forest, it did indicate that goshawks are fairly common and are widely distributed across managed areas of the Northern Region, including the Flathead National Forest. The northern goshawk is a large bird with a large territory and is distributed across all Forest geographic areas. Presence of the northern goshawk has been reported on the Flathead National Forest (Kuennen, 2013k), with 44 “positive” observations recorded from 1982 to 2000 (including observations of nests and young) and numerous observations reported from 2000-2010 (USDA, 2017).

In their status review of the northern goshawk, the USFWS found that the goshawk typically uses mature forests or larger trees for nesting habitat (the nest area); however, it is considered a forest habitat generalist at larger spatial scales. The USFWS found no evidence that the goshawk is dependent on large, unbroken tracts of “old growth” or mature forest (USFWS, 1998). However, nest areas include forests with a narrow range of structural conditions (R. T. Reynolds, Graham, & Boyce Jr., 2008; J. R. Squires & Reynolds, 1997). Goshawks generally select stands based on structure, but selection varies by forest type. For example, in lodgepole pine stands, canopy closure ranged from a mean of 34 to 80 percent and the tree size ranged from 9 to 15 inches d.b.h. Hayward and Escano (1989) found that nest sites in mixed species stands of northwest Montana were often located in stands that supported widely spaced large trees. Squires and Kennedy (2006) found that nest areas are usually mature forests with medium to large trees, canopy closure of 60 to 90 percent, and an open understory. On the Forest, nests have also been found in more dense mixed-species stands where there is a break in the topography or canopy that provides an open approach to the nest.

Goshawks use large landscapes, integrating a diversity of vegetation types to meet their life-cycle needs (J. R. Squires & Kennedy, 2006). The average patch size of core nesting areas varies according to available habitat conditions but averaged 40 acres in west-central Montana. The post-fledging area of 200-500 acres is defined as the area used by the family group from the time the young fledge until they are no longer dependent on the adults for food (R. T. Reynolds, Graham, & Reiser, 1992). In warm and dry forest communities, reducing tree densities by “thinning from below” may reduce forest fuels while simultaneously creating stand conditions that are favorable for goshawk foraging (R. T. Reynolds et al., 1992; J. R. Squires & Kennedy, 2006).

Key stressors

Land management

On all lands, goshawks may be negatively affected by timber harvest that removes nest trees, by associated disturbance too close to nesting sites, or by fire suppression that creates a forest structure that is too dense for hunting. Vegetation management activities and wildfire can be beneficial if they maintain or create desirable forest structure.

Changing climate

Goshawks are habitat generalists that are not expected to be sensitive to the effects of changing climate. Effects of changing climate conditions on goshawks could be positive, negative, or neutral.

Key indicator for analysis

The following species-specific indicator applies to the goshawk:

- Key ecosystem characteristics of goshawk habitat and the risk of human disturbance near known active nest sites

Environmental consequences

Summary of modeled alternative consequences

In order to assess key aspects of habitat for goshawks, Ecosystem Research Group modeled the effects of the alternatives (appendix 3). The natural range of variation was modeled going back about 1,000 years and the effects of alternatives were projected for the next 50 years, including anticipated changes in climate and the fire suppression logic of the model.

Goshawk habitat was modeled based upon habitat type group, including tree size classes greater than 10 inches d.b.h. and canopy cover greater than 40 percent (Greenwald, Crocker-Bedford, Broberg, Suckling, & Tibbitts, 2005) The northern goshawk habitat model assessed nesting habitat because it is assumed that post-fledging and foraging habitat is not limiting (Brewer, Bush, Canfield, & Dohmen, 2009; Kennedy, 2003). These aspects of goshawk habitat are addressed in discussions of vegetation structure in section 3.3.

Modeling shows that acres of nesting habitat increase to near the maximum natural range of variation in the first two decades and then declines to near the minimum natural range of variation by the fifth decade. Vegetation modeling results suggest that forestwide there would be an upward trend in the large tree size class forestwide and within all potential vegetation types. Natural succession of forests into larger size classes is the main driver of this increase. Model results indicate that natural disturbances have a substantially greater impact on reducing this size class than timber harvest amounts, with fire, insects, and disease the primary disturbances. The combination of increased fire, insects, and disease results in a substantial decline in modeled canopy closure (which reduces goshawk nesting habitat quality and quantity but may increase foraging habitat quality and quantity). Because alternatives B modified and D provide slightly less modeled nesting habitat than alternatives A and C, timber harvest also likely plays a role in reduced canopy closure. Although the modeled nesting habitat declines over the five decades, it remains within the natural range of variation under all alternatives.

The modeled outcomes estimate acres of nesting habitat with no consideration of distribution across the landscape. For that reason, modeled levels of nesting habitat may have little relationship to the actual density of nesting goshawks because they are highly territorial and can nest in relatively small, isolated parcels of nest habitat (R. T. Reynolds et al., 1992). Research has shown that landscapes fragmented by timber harvest support nest densities comparable to unfragmented landscapes as long as nest habitat persists at levels sufficient to support goshawks at maximum densities based on territoriality (Clough, 2000).

Alternative A

The 1986 forest plan does not have management direction specific to goshawks but does have standards to maintain existing old growth.

Alternatives B modified, C, and D

Under all action alternatives, plan components would support key ecosystem characteristics for goshawks because (1) all alternatives protect existing old-growth forest and old-growth forest habitat (FW-STD-TE&V-01), (2) all alternatives have forest plan direction that provides for retention of larger-diameter live trees and other key stand structural components that would contribute to future old-growth development within harvest units (FW-STD-TE&V-03; FW-GDL-TE&V-06 through 09), (3) all alternatives focus on stand conditions that would make old-growth forest and habitat more resilient in a changing climate, (4) activities known to disrupt goshawks would be restricted during the nesting season in 40-acre or larger stands containing known nest sites (FW-GDL-WL DIV-05), thus reducing the risk of disturbance that would disrupt nesting, and (5) desired conditions would provide diverse forest structure and composition to support post-fledging habitats used by goshawks (see also section 3.3).

Cumulative effects

In the past, regeneration harvest likely resulted in loss of goshawk nesting habitat on NFS lands as well as State and private timber lands. In the future, goshawk habitat could be negatively impacted by loss of large trees for nesting on all lands if drought, insects and disease, or stand-replacing wildfires are extensive and frequent in the future, but habitat suitable for hunting of prey species may be increased by wildfires. On all lands, future effects due to vegetation management as well as effects due to climate changes and the potential for increased fire, insects, and disease would depend upon distribution across the landscape, which cannot be predicted. Because goshawks are highly territorial, their nesting density is naturally low. Goshawks are highly mobile and are likely to be able to find sufficient nesting habitat.

Marten

Affected environment

Marten are distributed across most of Canada, the Rocky Mountains (including western Montana), the Great Lakes region, and portions of the Pacific Coast region. Marten are widely distributed across the Forest and are found in all geographic areas. There are recent observations, or verified DNA from non-invasive monitoring, and trapping records for the last 10 years (Curry et al., 2016; Swanson, 2017; SWCC, 2014; USDA, 2014e). Marten populations fluctuate in response to prey availability, juvenile dispersal, and mortality of adult females. Marten trapping is regulated by MFWP. Population parameters indicate a relatively stable or slightly declining population on a statewide basis (Giddings, 2009). There is speculation that trapper access to public lands has decreased over time from route and area closures to protect other species.

The literature uses a variety of terms to describe marten habitat including mature forest, mid- to late-successional forests, and late seral forest. Very few studies have defined average diameters associated with these descriptions. When citing the literature, the terms used by various authors are retained. However, in describing the current condition on the Forest and when comparing the alternatives, a consistent set of terms is used and their definitions are given.

Marten are “subnivean” (below the snow) foragers (Ruggiero, Aubry, Buskirk, Lyon, & Zielinski, 1994) and are well suited to deep snow conditions. Similar to lynx, marten are often associated with mixed spruce-fir forests during winter (Koehler & Hornocker, 1977). Mesic forests support the greatest understory plant species diversity and the greatest vole populations, the primary prey species for marten in many areas (Koehler & Hornocker, 1977). According to Buskirk and Powell (1994) and Tomson (1999), the American marten is closely associated with late-successional, mesic forests, with an abundance of snags, coarse woody debris, low shrubs, and small understory trees. A complex physical structure near the ground provides refuge sites, access to prey, and a protective thermal environment (Buskirk & Ruggiero, 1994). Baker reports that in summer, marten may also use young forests where coarse woody debris is abundant, although they may be more vulnerable to predation in young forests (Ruggiero et al., 1994; Tomson, 1999).

As stated in the USFS fire effects and management summary for American marten (Stone, 2010), this species generally avoids cover types that lack overhead cover (e.g., prairies, herbaceous parklands or meadows, clearcuts, and tundra) due to an absence of preferred prey, structures for denning, concealment cover, escape cover, and/or access points to subnivean spaces. Although marten tend to avoid openings (Koehler & Hornocker, 1977), they may travel along the edges of open areas or cross open areas. In a northern Idaho study, Tomson (1999) found that although 28 percent of his marten relocations were in non-forested openings, all were less than about 525 feet from cover (similar to the findings of Soutiere (1979) in Maine that marten seldom cross openings greater than about 540 feet). Ruggiero and others (1994) reported that marten avoided patches less than about 40 acres but cautioned managers that the “dearth of knowledge in this area makes managing forested landscapes for martens highly conjectural” (p. 24). Special management of riparian areas may help to provide cover for habitat connectivity and avoidance of predators. In northern Idaho, individual marten were located closer to streams than to random locations, and both resting sites and travel routes were often located near riparian corridors. At temperate latitudes, mesic forests used by marten are commonly riparian, and these areas contain important habitat features such as large amounts of coarse woody debris and/or high prey density, leading to enhanced foraging opportunities.

Some portions of the Flathead National Forest have large openings due to stand-replacing wildfire. A high percentage of the South Fork and North Fork geographic areas has been burned by wildfire in recent decades (18.7 and 20 percent, respectively), whereas a low percentage of the Swan Valley and Salish Mountains geographic areas has been burned by wildfire (2.6 and 2.7 percent, respectively). Regeneration harvest also reduces cover. The Salish Mountains geographic area has the highest percentage recently harvested (8.5 percent), and the Middle Fork geographic area has the lowest (0.1 percent) (USDA, 2014b).

Key stressors

Land management

Timber harvest and fire management affect marten habitat by creating a variety of successional stages and forest structures in a variety of patch sizes, providing diverse habitats for marten and their prey. Timber harvest can also reduce dense cover. In the cool-moist potential vegetation type that provides marten habitat on the Forest, harvest on NFS lands generally creates small openings whereas stand-replacing wildfire creates very large openings.

Changing climate

Increased drought and associated wildfires resulting from a warmer, drier future climate may have detrimental effects on marten habitat. Marten are known to make low use of burns during the first 10 years after fire. Low marten abundance in areas of high-severity fires can persist for up to about 75 years, but after about 75 years, marten are abundant in burned areas (Fisher & Wilkinson, 2005).

Key indicator for analysis

The following species-specific indicator applies to marten:

- Key ecosystem characteristics for marten habitat

For a discussion of key ecosystem characteristics for habitat connectivity, see section 3.7.6.

Environmental consequences

Summary of modeled alternative consequences

Hillis and Lockman (2003) assessed the availability of marten habitat across the Northern Region and determined that the amount of suitable habitat was comparable to historic levels. In order to assess key aspects of marten habitat, Ecosystem Research Group modeled effects of alternatives (appendix 3). The natural range of variation was modeled going back about 1,000 years, and the effects of alternatives were projected for the next 50 years. Modeled marten habitat included the cool-moist and warm-moist potential vegetation types (except for ponderosa pine types). Marten habitat was modeled as coniferous forests with an average tree diameter of at least 10 inches d.b.h. and a canopy cover class of at least 40 percent. The model predicts that all alternatives would stay within the minimum and maximum natural range of variation over the five-decade time period. There is a very wide range of variation between maximum and minimum natural range of variation—about 650,000 acres.

According to the model, in the future, acres of modeled habitat initially increase for all alternatives, with a level near the maximum natural range of variation, likely due to forest succession outpacing fire, insects, disease, and vegetation management treatments. Then, acres of modeled habitat decline under all alternatives. The modeled decline in habitat is steeper than for fisher, likely the result of marten occupying higher-elevation habitats than fisher (where the model indicates more stand-replacing wildfire). Because the marten requires denser stands than the fisher, the combination of increased fire, insects, and disease is resulting in a decline in modeled canopy closure which reduces marten habitat quality and quantity. Even with this decline, habitat remains within the natural range of variation.

Effects common to all alternatives

In addition to consequences discussed in section 3.7.4., subsections “Coniferous forest habitats,” “Old-growth forests, very large live tree habitat, and very large dead tree habitats,” “Burned forest and dead tree habitats,” and “Aquatic, wetland, and riparian habitats,” all alternatives adopt the vegetation standards of the NRLMD (USDA, 2007c), which benefits marten as well as lynx because habitat for these two species overlaps and is abundant in the cool-moist vegetation type (figures B-03 through B-09). Meeting vegetation standards VEG S1, VEG S2, VEG S5, and VEG S6 for lynx (see forest plan appendix A) also benefits marten by promoting a mix of successional stages including multistoried forest and dense young forest, limiting the amount of regeneration harvest per decade, and limiting the amount of forest that does not yet have branches sticking above the snow surface. These standards, in addition to plan components for snags and downed woody material, old growth, and riparian areas, would benefit marten by providing for the key habitat structure they need for denning, hunting, resting, and foraging. Patch size, patch distribution, and distance between patches changes constantly due to wildfire, insects, disease, and vegetation management activities, so these factors are most appropriately analyzed at the project level. Under all alternatives, areas mapped as not suitable for motorized over-snow vehicle use would reduce trapping access (figures 1-42 through 1-45). The mix of activities varies by alternative, as described below, but all alternatives have plan components to provide key ecosystem characteristics of marten habitat.

Alternative A

The 1986 forest plan does not have management direction specific to marten, but plan components for riparian habitat conservation areas and amendment 21 support habitat requirements for marten, as discussed in section 3.7.4, subsections, "Aquatic, wetland, and riparian habitats" and "Old-growth habitat, very large live tree habitat, and very large dead tree habitat." Alternative A would further reduce motorized public access, which would indirectly help to maintain large snags and downed wood.

Alternatives B modified, C, and D

Alternatives B modified, C, and D have plan components for riparian management zones, old growth, snags, and downed wood that would also benefit marten by providing for a mix of successional stages to provide for foraging and denning, cover for travel and avoiding predation, and complex structure near the ground surface to support their subnivean foraging habits. With all action alternatives, access management for no net increase in open roads would help to maintain large snags and downed wood.

Cumulative effects

The cumulative consequences discussed in 3.7.4., subsections "Coniferous forest habitats," "Old-growth forests, very large live tree habitat, and very large dead tree habitat," "Burned forest and dead tree habitat," and "Aquatic, wetland, and riparian habitats," also apply to marten. On all lands, a proportion of the mid-successional forest and the medium tree size class will advance into a late-successional or large tree size class as natural succession progresses over time (see section 3.3 for more details). Timber harvest and/or stand-replacing wildfires (which are characteristic of the cool-moist potential vegetation type) would also be expected to alter or remove existing mid- and late-successional forests in the future. Insects or diseases may kill the older, larger trees, which are often the most susceptible to infestation and mortality. These dead trees would then become snags and downed logs, an important component of marten habitat, if they were not removed by salvage harvest or firewood cutters. On lands in Glacier National Park, adjacent to the Forest, salvage harvest after fire would not occur except to provide for human safety. On private and State lands, dead trees are more likely to be removed.

Montana Fish, Wildlife and Parks manages marten populations through trapping regulations, adjusting the regulations to meet population and harvest objectives. Glacier National Park, encompassing about a million acres adjacent to the Forest, is closed to trapping.

Old-growth forest, very large live tree habitat, and very large dead tree habitat

Introduction

About 30 wildlife species on the Forest are associated with old-growth forest and habitat (see glossary) or its key ecosystem characteristics, described in the following section (N. M. Warren, 1998) (see also appendix 6). Ecosystem plan components would meet the needs of most species associated with old-growth forest and habitat as well as species associated with very large live trees and very large dead trees in other successional stages.

Species associated with old-growth forest use very large live and dead trees in a variety of ways, including for nesting, roosting, denning, feeding, and shelter. For example, several small mammal, amphibian, and invertebrate species use accumulations of large downed woody material, debris, and duff on the forest floor for shelter (Carey, 1996). According to Helms in 1998, variation in live tree size and spacing in old-growth forest also provides canopy gaps and understory patchiness. Patches of open canopy within or adjacent to old-growth habitat provides foraging opportunities for some species. Birds that nest in very large snags prefer various tree species, minimum diameters, minimum snag heights, and types of snag decay (Thomas, 1979). The minimum diameter and density of very large snags used for plan components in the no-action alternative came from a comprehensive publication on managed forests in the Blue Mountains of Oregon and Washington (Thomas, 1979, pp. 68-77, 387; USDA, 1999). Thomas based desired snag densities on territory size for primary excavators (woodpeckers) and the number of pairs per hundred acres because these birds are territorial.

The study by Thomas (1979) listed the following wildlife species, also known to occur on the Flathead National Forest, as requiring snags (and also broken-topped live trees) with a minimum d.b.h of 20 inches for nesting or denning: pileated woodpecker, barred owl, fisher, Vaux's swift, and riparian-associated species including the wood duck, common and Barrow's goldeneye, and common merganser. With the exception of the pileated woodpecker, minimum tree diameters required by these species have not been determined based upon research in Montana. Of the species requiring trees greater than 20 inches d.b.h., only one, the pileated woodpecker, is a primary excavator. Primary excavators hollow out nest and roost sites for themselves that are then used by close to 60 other species on the Forest, some of which are incapable of excavating their own cavity. For example, flying squirrels and fishers are known to use cavities excavated by pileated woodpeckers. Brown creepers are distributed across the Forest (Kuennen, 2013f) and are known to nest in cavities made by pileated woodpeckers or northern flickers or beneath the bark of decaying live trees (Hejl, Newlon, McFadzen, Young, & Ghalambor, 2002). Brown creeper foraging habitat is similar to nesting habitat. Brown creepers forage on tree species with furrowed bark such as Douglas-fir (especially on older, larger trees); they move up tree trunks and probe within bark furrows for insects and small invertebrates (Hejl et al., 2002).

Bate (1995) studied the effects of forest vegetation characteristics on woodpeckers in the warm-dry forests of central Oregon. She found that woodpecker density increased as the density of large live trees greater than 20 inches d.b.h. and hard snags greater than 10 inches d.b.h. increased (excluding lodgepole pine), but she was not able to detect a threshold where woodpecker abundance dramatically changed. As a result, she did not recommend a minimum number of live trees or snags per acre to support woodpeckers. Although minimum snag diameters are known for many species, there may be a high level of uncertainty with respect to minimum snag densities.

The availability of old-growth forest and very large trees varies greatly over time and across the landscape. Unlike some of the forests on the Northwest Coast, in the northern Rocky Mountains very little of the coniferous forest goes for hundreds of years without wildfire (see sections 3.3.6 through 3.3.8 for more details). Tree species in the northern Rocky Mountains have adaptations to survive and persist in areas where natural disturbance regimes are characterized by periodic stand-replacing wildfire (see sections 3.3.1 and 3.3.3). As a result, many of the northern Rocky Mountain wildlife species associated with old-growth forest are also associated with individual components of old-growth forest (very large live, decayed, dead, and large fallen trees) occurring in forest stands that have a predominantly younger age class. Very large trees have wildlife value even when the surrounding area has been burned or logged (Henjum, 1996) and can serve as reservoirs of genetic diversity. Very large remnant trees enrich the subsequent forest stand structure by providing a source of large snags and coarse woody debris and improving the connectivity of the forest landscape for many wildlife species. In western forests, where fire is a dominant disturbance process, maintaining a large and very large-diameter cohort of trees in perpetuity may be an appropriate method to achieve objectives for wildlife and fire resiliency (J. R. Franklin, Berg, Thorburgh, & Tappeiner, 1997; Habeck, 1990).

This section assesses the effects to most species associated with old-growth forest and its key ecosystem characteristics, including very large live and dead trees. Following the general discussion, two species are discussed as examples in order to help display differences in effects of alternatives. The two species are the fisher and pileated woodpecker.

Affected environment

The Forest has adopted the definitions of old-growth forest developed by the Regional Old Growth Task Force and documented in Green et al. (2011) (see glossary). The definitions are specific to forest type (dominant tree species) and habitat type group. Key attributes for identification of old-growth forest are the age, numbers, and diameter of the old tree component within the stand and the overall stand density. Minimum thresholds have been established for these attributes that provide measurable criteria for implementation of standards related to old-growth forest stands. For example, the most common old-growth forest type on the Forest requires at least 10 trees per acre that are at least 180 years in age and 21 inches in diameter, with a minimum stand density of 80 square feet basal area. Standards for old-growth forest are based upon measurable criteria and are monitored using Forest Inventory and Analysis data. These criteria can be used to develop a statistically sound estimate of the amount of old growth across the Forest. Because Forest Inventory and Analysis data is not a spatial data set, patch sizes and connectivity of old growth is unknown at the Forest scale but is analyzed at the project level. Refer also to section 3.3.6 and table 24 for more detailed information on old-growth forest definitions.

Old-growth forest acres on the Forest, as derived from Forest Inventory and Analysis inventory data, comprises about 9.5 percent of the total Forest acres (approximately 232,000 acres). Old-growth forest totals about 3.8 percent of the warm-moist, 8.7 percent of the cold, 9.5 percent of the warm-dry, and 10.9 percent of the cool-moist potential vegetation type. A large amount of Forest lands have burned with stand-replacing wildfire over the past 15 years (see section 3.8.2). Monitoring indicates that these fires are primarily responsible for the loss of an estimated 2.6 percent of old-growth forest (approximately 52,000 acres) over that time period (see section 3.3.6 for more details). In the past, old-growth forest was reduced due to timber harvest, but old-growth forest has not been reduced through harvest treatments for at least 15 years (the current forest plan prohibits the removal of old growth through harvesting).

In addition to the measurable criteria established by Green et al. (2011), associated forest structural conditions provide key ecosystem characteristics for wildlife species (e.g., very large live trees, decayed trees, very large snags, and large fallen trees). These characteristics may be present in forest stands that do not meet all of the Green et al. criteria. This condition is referred to as “old-growth habitat” (see glossary). In addition, mature forest may contain remnant trees that are very large and have survived repeated wildfires but are low in number. Table 48 displays current conditions, forestwide and for each potential vegetation type (see figure B-03), for forest that has at least 10 trees per acre in the very large size class. Table 49 displays current conditions, forestwide and for each potential vegetation type, for forest that has fewer than 10 trees per acre in the very large size class but still has high value for wildlife (see section 3.3.4 for details on very large trees and forest size classes). The threshold for the number of very large live trees per acre needed by wildlife species in the northern Rocky Mountains is unknown.

Density criteria and existing conditions for the very large tree component and for the density and presence of individual very large live trees are displayed in table 48 and table 49. The source of the data for the existing condition is Forest Inventory and Analysis data using the R1 summary database (Hybrid 2011, reports run in 2016) analysis tools. The current proportion from this data set is expressed as an estimated mean percent, with a lower and upper bound estimate provided at a 90 percent confidence interval.

Table 48. Very large live tree component definitions and current estimated percent, forestwide and by potential vegetation types

Potential vegetation type	Very large live tree density criteria	Current estimated percent
Forestwide	Incorporates the criteria specific to each potential vegetation type	14.1 (11.9-16.5)
Warm-Dry	At least 8 trees per acre ≥ 20” d.b.h.	16.4 (10.1-23.3)
Warm-Moist	At least 10 trees per acre ≥ 20” d.b.h.	9.5 (2.9-17.1)
Cool-Moist	At least 10 trees per acre ≥ 20” d.b.h.	16.7 (13.6-20.0)
Cold	At least 10 trees per acre ≥ 15” d.b.h.	8.1 (4.3-12.4)

Table 49. Current estimated density and presence of very large live trees across Forest lands forestwide and by potential vegetation type

Potential vegetation type	Current estimated presence[1]	Current estimated trees per acre	Current predominant species of very large live trees
Forestwide	15.9 (13.5-18.5)	4.2 (3.5-5.0) ≥ 20” d.b.h.	Douglas-fir, western larch, spruce
Warm-Dry	16.4 (10.1-23.3)	4.0 (2.4-5.7) ≥ 20” d.b.h.	Douglas-fir
Warm-Moist	13.6 (5.3-23.3)	2.7 (0.9-4.8) ≥ 20” d.b.h.	Douglas-fir
Cool-Moist	19.1 (15.7-22.6)	5.2 (4.2-6.4) ≥ 20” d.b.h.	Western larch, Douglas-fir
Cold	8.5 (4.4-13.1)	2.2 (1.1-3.4) ≥ 15” d.b.h.	Spruce

1. Percentage of the analysis unit that has at least one live ≥ 20” d.b.h. tree present

Table 50 displays current conditions in each potential vegetation type for snags on the Forest in the very large size class. The current proportion from this data set is expressed as an estimated mean percent, with a lower and upper bound estimate provided at a 90 percent confidence interval.

Table 50. Current snag densities on the Forest (snags per acre equal to or greater than 20 inches d.b.h) (Trechsel, 2017b)

Snag Analysis Group (potential vegetation type)	Mean	Lower Bound	Upper Bound
Lodgepole pine	0.4	0.0	0.9
Warm-Dry	1.2	0.2	2.6
Warm-Moist	1.5	0.3	3.1
Cool-Moist	2.1	1.4	3.0
Cold	1.4	0.6	2.5

The numbers above are based upon Forest Inventory and Analysis data, which accounts for snags lost due to natural and human-related disturbances, such as fire, timber harvest, post-fire salvage, and firewood gathering. Due to recent stand-replacing wildfires, snags are currently near the upper end of the natural range of variation (see section 3.3.7 for more details).

Key stressors

Land management

The primary stressors to old-growth forest and associated species and to very large live and dead trees are loss and fragmentation due to timber harvest, road construction, firewood gathering, wildfire, prescribed fire, and insects and disease.

Changing climate

Both drought and wildfire have historically been stressors, but their magnitude and duration are anticipated to increase based upon modeled climate changes (see section 3.1.2 for more details). The time period used for modeling is beyond the anticipated life of the forest plan, but because very large trees take a long time to grow, changing climate is considered for longer time periods. Drought may also lead to decreasing tree growth rates and an increase in insects and/or disease. Forest management actions in portions of the Forest may make trees more resilient when it comes to these changes.

Key indicator for analysis of most species associated with old-growth forest, very large live and dead trees

The following indicators are important for the wide variety of wildlife species associated with old-growth forest and very large live and dead trees.

- Key ecosystem characteristics for species associated with old-growth forest, the very large tree size class, and the distribution of very large live trees, very large snags, and large downed woody material in other forest size classes

In addition, refer to key indicators addressed in sections 3.3.6 through 3.3.9 and section 3.7.4, subsection "Coniferous forest habitat associates."

Environmental consequences

Summary of modeled alternative consequences

Modeling indicates that the very large tree size class trends steadily downward forestwide over the five-decade modeling period under all alternatives. However, the very large tree size class trends upward in the warm-dry and warm-moist potential vegetation types. Much of this decrease is likely attributable to wildfire and/or the high amount of both Douglas-fir and spruce beetle portrayed in the model, both of which would cause widespread mortality of trees in the very large size classes and revert forests back to a smaller size class (see sections 3.3.4 and 3.3.9 and appendix 2 for more details). The warm-dry and warm-moist potential vegetation types are mostly in the wildland-urban interface, where fire suppression efforts may help to protect old-growth forest. As modeled, the warm-dry potential vegetation type shows a distinctly different trend in the very large size class when compared to other settings. Vegetation management treatments likely play a major role in promoting the development of the very large tree size class in this type because it removes the smaller-diameter understory trees (mainly Douglas-fir) and preserves larger-diameter overstory trees (mainly ponderosa pine). Commercial thinning may also be influencing this increase in the very large size class.

Modeling also estimated the future acreage of the Forest with very large snags and the density of very large snags within those areas. For areas with very large snags greater than 20 inches d.b.h., the proportion of the Forest with from 1 to 3.9 snags per acre decreases. However, the proportion of the Forest with more than 3.9 snags per acre increases, which may be beneficial for wildlife. By the fifth decade, modeling suggests that about 9 percent of Forest has at least 4 snags per acre in the 20-inch and larger size class. Essentially, the amount of area with a higher density of snags increases over time to a level that is fairly similar among the alternatives.

All alternatives include a standard to maintain all existing old-growth forest, meeting Green et al. (2011) definitions, and to set limitations on vegetation treatments within old-growth forest, retaining as much old-growth forest as possible in all alternatives (see section 3.3.6 for more details).

Alternative A

Amendment 21 of the 1986 forest plan provides direction to (1) protect all existing old growth as defined by Green et al. (2011). In this amendment, timber harvest areas are required to (2) retain an average of 1 snag per acre greater than 20 inches d.b.h. in the dry potential vegetation group and an average of 1 snags per acre greater than 20 inches d.b.h. in the dry and cold potential vegetation groups and an average of 2 snags per acre of this size in the cool potential vegetation group, (3) retain an average of 10 pieces of down woody material greater than 20 inches diameter in harvest unit in the dry potential vegetation groups and 15 pieces of this size in the cool and cold potential vegetation groups; and (4) provide habitat connectivity and patch sizes on NFS lands similar to historical levels (see section 3.3.6 and 3.3.7 for more details). This management direction provides benefits to species associated with old growth, very large snags, and downed woody material.

A key difference of this alternative when compared to the action alternatives is related to the forest plan direction associated with both forest size class and the very large live tree component. The 1986 forest plan does not explicitly describe desired conditions for forest size class and includes very little if any specific direction related to the very large live tree component outside of old-growth forest. It does incorporate an ecologically based approach to the management of vegetation, including managing for vegetation composition, structures, and patterns that would be expected to occur under natural succession and disturbance regimes; reducing the risk of undesirable fire and insect and pathogen disturbances; and providing for long-term recruitment of forest structural elements such as snags and downed wood. Most of this direction is located in the 1986 forest plan under forestwide objectives in section A(6)-Vegetation (p. II-8) and forestwide standards under (H)-Vegetation (p. II-47).

Alternatives B modified, C, and D

The standards in alternative A have been in effect since 1999, but monitoring indicates old-growth forest has continued to decline, primarily due to the effects of stand-replacing wildfire. This trend is anticipated to continue with projected future climate and associated levels of stand-replacing wildfire, insects, and disease. As a result, the action alternatives include additional plan components to increase the patch size of existing old-growth forest, to retain very large live trees and snags in forest stands of smaller size classes, and to retain larger snags and downed woody material in harvest units, particularly those species that are able to survive fire and/or drought.

Plan components include desired conditions to increase the amount, patch size, and connectivity of old-growth forest in the future in order to create habitat for old-growth-associated wildlife species, especially in the warm-dry and warm-moist potential vegetation types where it is currently lowest (see FW-DC-TE&V-11 and 12). Desired conditions recognize that forestwide and within individual watersheds, the distribution, patch size, and amount of the very large size class and very large individual trees varies over time, depending upon the forest’s development stage and the influence of climate and natural disturbances. For all forest size classes, there is an expectation that there will be wide fluctuation over the short and long terms because of the complex interrelationships between ecological processes (such as succession) and disturbances (such as fire, insects, and disease) and the influence of other desired conditions and objectives in different management areas of the Forest. As a result, desired conditions are most appropriately assessed at the project level, where forestwide standards will apply.

Forestwide standard FW-STD-TE&V-01 protects old-growth forest and associated species:

> In old-growth forest, vegetation management activities must not modify the characteristics of the stand to the extent that stand density (basal area) and trees per acre above a specific size and age class are reduced to below the minimum criteria in Green et al. [2011]. Vegetation management within old-growth forest (see glossary) shall be limited to actions that

- maintain or promote old-growth forest characteristics and ecosystem processes;
- increase resistance and resilience of old-growth forest to disturbances or stressors that may have negative impacts on old-growth characteristics (such as severe drought, high-severity fire, or epidemic bark beetle infestations);
- reduce fuel hazards in the wildland-urban interface; or
- address human safety.

At the site-specific level, other associated characteristics important to old-growth-associated species would be maintained or promoted under these alternatives, such as the amount of dead or broken tops and decayed trees, amount and size of downed wood, and number of canopy layers (canopy layer diversity). Green et al. (2011) provide direction on the use and application of the old-growth forest definitions at the project level, including the associated characteristics (see pp. 11-12).

Standard FW-STD-TE&V-03 states the following:

> Within timber harvest areas, snags and/or live snag replacement trees shall be retained at minimum levels that vary depending upon the geographic area and whether the harvest is within a riparian management zone. Refer to snag retention standards located under each geographic area in chapter 4 of the plan. Refer to FW-GDL-RMZ-10 for additional snag management direction for harvest areas within riparian management zones.

Standards for each geographic area specify the total minimum number of snags or live replacement trees greater than or equal to 20 inches d.b.h. and greater than 10 feet tall that must be retained in timber harvest areas, as well as desirable species (see geographic area standards in the forest plan and sections 3.3.6 and 3.3.7 in the final EIS for more details). These standards also state that all snags of western larch, ponderosa pine, and black cottonwood trees greater than 20 inches shall be retained. Standards for snags greater than or equal to 20 inches d.b.h. are provided forestwide because these are the larger snags with the highest longevity and are the most valued for their contribution to snag habitat by adding to present and future forest structural diversity (including old-growth forest while they stand and after they fall). The minimum numbers are greater than or equal to those specified for alternative A.

Guideline FW-GDL-TE&V-06 would help to increase the future patch size of old growth in areas where timber harvest and other vegetation treatments occur. It states:

> To increase the patch size of old-growth forest in the future, if managing vegetation within 300 feet of existing old-growth forest, treatment prescriptions that would promote the development of old-growth forest in the future should be considered. At a minimum, the following structural and composition components associated with old-growth forest should be retained if present within at least 300 feet of the old-growth forest patch:
>
> - larger live trees (e.g., greater than 17 inches d.b.h.) of species and condition that will persist over time (such as western larch, ponderosa pine, Douglas-fir) and not cause unacceptable impacts to future stand conditions (e.g., dwarf mistletoe infection or potential dysgenic seed source);
> - large downed wood (greater than 9 inches diameter); and/or
> - snags and decayed, decadent trees greater than 15 inches d.b.h.

> Exceptions to this guideline may occur to protect human health and safety and within portions of the wildland-urban interface where decreased fuels are determined necessary to protect values at risk.

Retention of snags of all sizes large enough to be used by wildlife for nesting, feeding, and resting is also emphasized in riparian management zones, recognizing that these areas naturally have higher levels of these components and are important areas for wildlife habitat. In riparian management zones, guideline FW-GDL-RMZ-10 would benefit wildlife species associated with old-growth forest and its key ecosystem characteristics.

In summary, plan components for old-growth forest and very large live trees and snags benefits wildlife by retaining old-growth forest, increasing its patch size and distribution, retaining very large snags with high wildlife value wherever present, and, if snags are not available, leaving replacement trees at levels that would have the potential to provide for snags in the future, after existing snags have fallen. For additional information on existing conditions and effects related to old-growth forest, snags, and downed wood, refer to sections 3.3.6 and 3.3.7 as well as Trechsel (2017b).

Cumulative effects

This section summarizes activities and effects that are common to most species associated with old-growth forest and very large live and dead trees. See also the individual cumulative consequences sections for specific species.

On all managed lands within the cumulative effects analysis area, past management actions, particularly timber harvest and fire suppression, have altered stand structure, composition, function, and connectivity, particularly in valley-bottom areas that were readily accessible, historically had low- and moderate-severity fire regimes, and are now in the wildland-urban interface (see figure 1-13). Prior to the 1986 forest plan, contract utilization standards required many dead trees to be removed in harvest units, resulting in a lack of snags and downed wood. Timber harvest prescriptions and timber sale contracts now include direction to retain snags in harvest units and also require the retention of large downed wood.

On all lands, fire suppression is likely to be most successful in the valley bottoms where people live (primarily the warm-dry and warm-moist potential vegetation types). This could result in better retention of the very large tree size class and very large trees. In the wildland-urban interface, precommercial thinning, timber harvest, and prescribed burning would reduce stand densities, would increase survival of retained trees, and could increase the rate at which very large trees develop. On managed lands, active vegetation restoration actions could mimic natural disturbances in areas where natural disturbances are not compatible with multiple-use objectives of the forest plan or the objectives of other landowners. In these areas, a century of fire exclusion, coupled with timber harvest, has changed historically open forests into more closed, dense forests that are often dominated by smaller Douglas-fir. In western forests where fire is a dominant disturbance process, restoring a more open understory while maintaining a cohort of trees of large and very large diameter in perpetuity may be an appropriate method for achieving objectives related to wildlife and fire resiliency (J. R. Franklin et al., 1997; Habeck, 1990).

Outside the wildland-urban interface, particularly in the cool-moist or cold potential vegetation types, vegetation management standards promote the development of forests in the large and vary large size classes containing spruce and subalpine fir in multistoried stands with a dense understory. These forests would be more susceptible to wildfire and would be likely to have higher levels of mortality due to insects and disease (especially for very large Douglas-fir and spruce). The trend of loss of old-growth forest and the very large size class due to wildfire is likely to continue on all lands in these forest types in the future.

In the future, drought may also affect very large trees on all lands. Douglas-fir and ponderosa pine tolerate drought better than nearly all other species and so may be favored by expected changes in climate, whereas western larch is a species that is highly susceptible to climate warming. Western larch and ponderosa pine have the ability to survive fire, provided they can get large enough between fires and the fuel loading is not too great (Robert E. Keane et al., in press). Most climate change studies predict major losses of live western larch throughout the northern Rockies, which could create an abundance of habitat for cavity-nesting species but would also reduce canopy cover. Where accessible on State and private timber lands, many dead trees are likely to be salvaged.

Because response to anticipated changes in climate will vary by tree species and structure, responses by associated wildlife species will also vary. The most important tree species for a variety of wildlife species associated with old-growth habitats on the Forest are western larch, ponderosa pine, and black cottonwood because these species are key for primary cavity excavators that make nesting and denning cavities required by many other wildlife species. Large Douglas-fir provide important feeding habitat and also provide cavity nesting and denning habitat for a variety of wildlife species, but these snags do not persist as long as western larch or ponderosa pine.

When very large live trees are killed, the number of very large dead trees (snags and downed woody material) goes up. This would be beneficial to wildlife species that depend upon very large snags and downed wood provided that reductions in canopy cover created by the loss of live trees do not become limiting. On NFS lands, modeled trends in very large snag numbers increase over the next five decades under all alternatives. The increase in very large snags (greater than or equal to 20 inches d.b.h.), especially in the “4+ snags per acre” density category, corresponds to the decrease in the very large live tree component. The analysis displayed in table 51 shows very large snags across the Western Montana Zone of the Northern Region, which includes the Flathead, Kootenai, and Lolo National Forests. The numbers are based upon Forest Inventory and Analysis data, which accounts for the cumulative effects of snags lost due to timber harvest, post-fire salvage, and firewood gathering. If the current trend in wildfires continues, snag numbers would be anticipated to remain within the natural range of variation in the future. These snags would provide abundant downed wood in the future, providing feeding, denning, and resting habitat for wildlife as well as deep duff and litter as trees decompose.

Table 51. Snag densities (snags per acre equal to or greater than 20 inches d.b.h) for the Western Montana Zone, which is comprised of the Flathead, Kootenai, and Lolo National Forests combined (Trechsel, 2017b)

Snag Analysis Group (potential vegetation type)	Mean	Lower Bound	Upper Bound
Lodgepole pine	0.6	0.3	0.9
Warm-Dry	1.6	1.1	2.0
Warm-Moist	1.3	0.8	1.7
Cool-Moist	1.8	1.3	2.3
Cold	1.7	1.1	2.3

Within the boundaries of the Forest are three state forests as well as scattered parcels managed by Montana Department of Natural Resources and Conservation. This agency manages old growth according to the administrative rules of Montana for forest management (36.11.418 biodiversity—old-growth management), which directs the department to manage old growth to meet biodiversity and fiduciary objectives. The department considers the role of all stand age classes, consistent with the range of natural disturbances, when designing harvests and other activities to maintain biodiversity. Old growth is constrained in Montana Department of Natural Resources and Conservation’s 2015 sustainable yield calculation; 8 percent of forest stands on lands managed by their Northwestern and Southwestern land offices are to meet the minimum quantifiable definitions of old growth by Green et al. (2011). The project-level considerations of Montana Department of Natural Resources and Conservation complement those of the Forest.

On all lands, if the size, severity, and/or frequency of wildfires increases in the future it could cause widespread declines in the availability of late-successional or old-growth forests because it can take 100 years or more for trees to reach diameters of 20 inches. If species that are adapted to surviving wildfire (such as western larch, ponderosa pine, and Douglas-fir) reach a large enough size between wildfires, the value of these trees for providing wildlife habitat would be retained. However, if they do not grow large enough between wildfires, forest dominance types could be changed to species such as lodgepole pine, which rarely reaches diameters of 20 inches d.b.h. and which is easily killed by fire but is able to regenerate from seed earlier than other species. This would be detrimental to most species associated with old-growth forest.

An increase in private residences or an increase in people who burn firewood can result in the loss of very large snags on all lands, particularly the largest, most desirable wildlife snags such as very large western larch. This effect is most likely to occur within 200 feet of open roads. Past road building on Federal, State, and private lands has likely impacted the number and distribution of very large snags, but road influences have decreased over time. Access management has resulted in fewer routes open to motor vehicle use on Federal, State, and private lands, helping to protect very large snags from removal for firewood.

In summary, proposed management direction on the Forest, in the context of all lands of the larger landscape, would contribute to old-growth forest and habitat and to very large live and dead trees. This would be accomplished by plan components to maintain all existing old-growth forest, retain very large live, decayed, and dead trees, and promote development of very large trees. Although the Forest Service does not have authority over all the stressors, the ecological conditions of old-growth forest and habitat and very large live and dead tree communities and the processes that maintain them would be provided on NFS lands. Coarse-filter plan components provide for biodiversity and the ecological conditions that support the long-term persistence of the majority of species associated with these habitats. Old-growth forest, habitat, and very large live and dead trees are distributed across all Forest geographic areas.

In addition to effects on most species associated with old-growth forest and very large live and dead trees, the following sections describe species-specific effects.

Fisher

Because translocated fisher were known to occur on the Forest in the past and because the Forest contains potential habitat modeled by Olson and others (2014), this final EIS analyzes effects to fisher. On January 13, 2017, the USFWS initiated a status review for the distinct population segment of Northern Rocky Mountain fisher to determine whether this population meets the definition of an endangered or threatened species under the Endangered Species Act. In October 2017, the USFWS found that the fisher in the northern Rocky Mountains is not warranted for listing under the Endangered Species Act (USFWS, 2017a).

Affected environment

Fisher are distributed across portions of Canada, the Rocky Mountains, the Cascade Mountains, the Great Lakes region, and portions of the Pacific Coast region. Fishers are patchily distributed in the northern Rockies. Some of the lands of eight national forests are within the expected range of fisher in the

Northern Region (Cushman, McKelvey, Flather, & McGarigal, 2008; L. E. Olson et al., 2014; Sauder & Rachlow, 2014; M. K. Schwartz, 2007; Michael K. Schwartz, DeCesare, Jimenez, Copeland, & Melquist, 2013). Fisher are found almost exclusively in the inland maritime ecosystem in Idaho and in areas where that ecosystem extends eastward into western Montana (McKelvey & Buotte, in press). The historical distribution of fisher and fisher habitat in Montana is uncertain, but Weckwerth and Wright (1968) reported that the fisher once occurred in western Montana; a few animals were trapped in what is now Glacier National Park prior to 1911. Due to a lack of trapping records in Montana from 1929-1959, many biologists believed the fisher had been extirpated (Ray S. Vinkey, 2003). Trapping, as well as large regional fire events in 1910 and 1934, likely contributed to regional fisher population declines in the early 1900s (J. L. Jones, 1991).

Fisher occur at extremely low densities and are difficult to detect. Vinkey (2003) reviewed historical records as well as carnivore research in Montana and concluded that the fisher is one of the lowest-density carnivores in the State. In high-quality habitats in British Columbia, fisher densities were between 0.03 and 0.04 per square mile or approximately 1 per 21,000 acres (USFWS, 2010). Information is lacking on the survival rates and reproductive success of fisher in the northern Rockies (Sauder, 2014; Sauder & Rachlow, 2014).

Fisher were not known to occur in the plan area until they were translocated from Minnesota and British Columbia to the Forest and nearby portions of the northern Rocky Mountains beginning in 1959 (R. S. Vinkey et al., 2006; Weckwerth & Wright, 1968). Translocations placed 78 British Columbia fishers into various portions of the Rocky Mountains of Montana and Idaho between 1959 and 1963, and another 110 fishers from Minnesota and Wisconsin were translocated into the Cabinet Range in northwestern Montana between 1989 and 1991. Vinkey and others (2006) concluded that the Selway–Bitterroot Mountains of Montana and Idaho likely functioned as a refuge for native fishers in west-central Montana. In northwestern Montana), however, current evidence suggests the translocations resulted in the establishment of fisher populations with non-native genetic haplotypes consistent with British Columbia and Midwestern source populations; to date, no individuals with the native haplotype have been discovered on the Forest. Vinkey and others (2006) stated their belief that fishers in northwestern Montana are descended from both the 1959 and 1989-1991 translocations rather than from a relic fisher population (p. 270).

The sole translocation site on the Forest was near Holland Lake, where 15 fishers were marked and released in 1959 and 1960. Nine fishers were marked and translocated to the Kootenai National Forest, adjacent to the Forest, also in 1959 and 1960. From 1960-1968, 11 of the fishers translocated to the Flathead or Kootenai National Forests were subsequently recaptured (eight were killed by trapping, one was shot, one was found dead, and one was released alive). Four fishers that were released on the Kootenai National Forest dispersed to the Forest and were later retrapped and released (Weckwerth & Wright, 1968, figure 1, tables 1 and 2). From 1982-1993, a minimum of 12 fishers were trapped on the Forest (Giddings, 2012). Most of the trapped animals were listed as animals translocated in 1959 or 1960 (Weckwerth & Wright, 1968, figure 1, tables 1 and 2) or were animals believed to be their offspring. In Montana, the fisher is legally trapped under a limited quota system. In 2015, regulations allowed for the take of two individuals in trapping district 1, located in northwest Montana (MTFWP, 2017).

Fishers are not currently known to occur on the Forest. Detections have been reported based upon tracks or visual sightings but are not considered reliable because marten can be mistaken for fisher. The Montana Natural Heritage Program database (MNHP-MTFWP, 2013) includes observations of fisher that have not been verified with DNA evidence (Kuennen, 2013c). DNA has been collected during noninvasive surveys for mesocarnivores on the Forest from 2006-2014 and also in Glacier National Park. The DNA collection methods (hair snares and bait stations) were developed by researchers with the

Rocky Mountain Research Station. These methods established a 5-by-5-mile systematic survey grid overlaid on the entire Southwest Crown of the Continent landscape (including the southern portion of the Forest). From 2012-2014, 82 of 129 grid cells were surveyed and no fishers were detected on the Forest (SWCC, 2014). Some uncertainty remains because grid cells in the remote Bob Marshall, Great Bear, and Scapegoat Wildernesses have not been surveyed, however, there is little modeled habitat there. Surveys in Glacier National Park have also been unsuccessful in detecting fisher (Curry et al., 2016; Pilgrim & Schwartz, 2015; Swanson, 2017; SWCC, 2014, 2015) (J. Waller, Glacier National Park Supervisory Wildlife Biologist, personal communication, 2015; K. Pilgrim, USFS Rocky Mountain Research Station, personal communication, 2016).

Many factors likely contribute to the current distribution of fishers. Interactions with other species in diverse ecosystems (e.g., mountain lions, wolves, coyotes, wolverines, and lynx) may affect fisher distribution and competition for prey, or these species may prey upon fishers (Fisher, Anholt, Bradbury, Wheatley, & Volpe, 2013). In the Cabinet Mountains of the Kootenai National Forest, at least 9 of 32 fishers transplanted from Wisconsin were known to have been killed by other predators (Roy, 1991). Fishers also appear to be restricted to areas with relatively low snow accumulation (J. L. Jones, 1991). According to Raine (1983) and Krohn et al. in 1994, Aubry and Houston in 1992, Arthur et al. in 1989, and Heinemeyer in 1993 (as cited in Ruggiero et al., 1994), deep, fluffy snow (which occurs on much of the Forest) negatively affects habitat use by fishers and may affect fisher distribution, population expansion, and colonization of unoccupied habitat. Powell and Zielinski note that if trapping seasons are regulated carefully in Montana to prevent overtrapping, fisher populations may slowly expand, but if fisher populations are limited by deep snow, fishers may never reach high densities (as cited in Ruggiero et al., 1994). It is possible that differences in habitat, topography, prey, and predators made transplanted fishers vulnerable (Roy, 1991). Olson and others (2014) stated that fishers were more likely to occur in areas with wetter, milder climates characterized by higher mean annual precipitation, mid-range winter temperatures, and topography in the form of drainages or valleys. Raine (1983) found that movements of fisher were restricted by the soft, thick snow cover that is present during midwinter, whereas marten did not appear to be hindered by soft snow cover to the degree that fisher are. Marten are known to be distributed across most of the Forest, so deep, fluffy snow conditions may be a factor in limiting the distribution of fisher and their potential habitat. Additionally, the northern Rocky Mountain region has a history of periodic regional wildfires, and habitat in the northern Rockies is likely suboptimal for fishers (Lofroth et al., 2011; Michael K. Schwartz et al., 2013). A period of fewer fires occurred from the 1940s to the 1980s, at the same time that fisher were being reintroduced in parts of Idaho and Montana, and more fisher were detected during this time period. Since the late 1980s, the northern Rockies has experienced more frequent fires (Westerling, Hidalgo, Cayan, & Swetnam, 2006). Stand-replacing wildfires have increased substantially on the Forest since 1988 (see section 3.8 for more details).

Olson and others (2014) modeled fisher habitat for an area in the northern Rockies spanning western and northern Idaho. This model was used by the USFWS in their species status assessment (USFWS, 2017d). On the Forest, there are few patches of modeled fisher habitat large enough to support a home range, and most of the habitat modeled by Olson and others (2014) occurs as riparian stringers rather than the large home range-sized patches that occurs in areas with current reproductive populations of fisher (USDA, 2014b, figure 64; USFWS, 2017d). The distribution of modeled fisher habitat on the Forest is likely due to natural environmental conditions accounted for in the modeling. The Forest is at the eastern edge of the range for the western red cedar and hemlock forest types that are characteristic of the moist, maritime-influenced ecosystems. Habitat types in areas of the northern Rockies known to be used by fisher, including all western red cedar and western hemlock habitat types, are within this setting. These potential vegetation types are the least common on the Forest. The warm-moist potential vegetation type that provides larger blocks of potential fisher habitat on the Forest includes moist sites that are largely limited to lower elevations and relatively productive, deep ash-capped soils. The Forest does not support a broad distribution of very large western red cedar, a species that is thought to provide (through heart rot) large enough cavities for fisher denning and resting.

Recent efforts by Olson et al. (2014) to model the expected future distribution of fisher suggests that habitat distribution will change. Conditions that support fisher habitat in the U.S. northern Rocky Mountains are expected to slowly shift north and east toward mountainous areas near Glacier National Park and south of Kalispell in response to a warmer, winter climate with more precipitation (and more that may fall as rain at lower elevations) over the next 70 years.

Schwartz and others (2013) reported on habitat characteristics of fisher in the northern Rockies at multiple, nested scales. They described the landscape scale as features within a 0.62 mile radius surrounding known fisher locations. At a landscape scale, they found that fisher use was highest where large trees (greater than about 15 inches d.b.h.) made up about 50 percent of the landscape but began to decline when the proportion was higher. Sauder and Rachlow (2014) reported that fisher select landscapes managed for multiple use. They modeled fisher habitat selection at the landscape scale and reported that both forest configuration and forest composition were important. Fishers selected landscapes for home ranges with larger, more contiguous, patches of mature forest (defined as trees exceeding about 80 feet canopy height) and reduced amounts of open areas (defined as the 0–9.9% canopy cover class). They found that the percentage of mature forest was not the best supported variable for predicting fisher occupancy, nor was the percentage of high canopy cover. These authors characterized fisher habitat as a variety of habitat patches that support prey species within a matrix of mature forest arranged in connected, complex shapes and with few isolated patches (Sauder & Rachlow, 2014).

In the Rocky Mountains, there are times of the year when fishers prefer young to medium-age conifer forests (J. L. Jones, 1991; Roy, 1991), but they avoid large open areas with very low canopy closure, which may limit their population expansion (Ruggiero et al., 1994). Sauder (2014) found that at the home range scale of about 12,355-24,710 acres in size, fishers select areas for core use zones that have relatively high fine-scale habitat heterogeneity, supporting the hypothesis that fishers establish home ranges that provide access to a greater diversity and abundance of prey species as well as access to habitat features that are important for reproduction and thermoregulation.

At a stand scale, Schwartz and others (2013) suggested that mature forest stands most used by fisher have both large and smaller trees, consistent with evidence that fishers need cover for hunting efficiency or predator escape purposes. Schwartz and others (2013) found that locations used by fisher at the stand scale were closely correlated with the maximum d.b.h. of trees. There is no known threshold for minimum number and size of trees needed by fisher, but they are known to use the largest trees available for denning. In a northern Idaho study, fisher selected for stands containing western red cedar and grand fir and avoided ponderosa pine and lodgepole pine stands (Michael K. Schwartz et al., 2013). On the Forest, western red cedar and most grand fir habitat types are included in the warm-moist potential vegetation type and can be found at suitable elevations for use by fisher, so this forest type is considered potential fisher habitat.

Schwartz and others (2013) stated that managers can maintain fisher resting habitat by retaining large trees and using forest management practices that aid in the recruitment of trees that achieve the largest sizes. They also recommend increasing structural diversity at these sites. Components of structural diversity needed by fisher include very large trees, snags, fallen logs, and stumps, as well as seedlings, shrubs, and herbaceous cover (Meyer, 2011; Ruggiero et al., 1994). According to Roy (1991), snowshoe hares are the most common prey for fishers. For fishers in the Cabinet Mountains of Montana, 50 percent of the prey remains found in 80 scats were from snowshoe hares. Mice and other small rodents constituted the next most common prey (Ruggiero et al., 1994).

In north-central Idaho and west-central Montana, preferred resting habitat and prey were likely more available along drainage courses, which were the most commonly traveled by fishers, based on observations. The importance of riparian areas for fisher has been shown in studies conducted in British Columbia, the southern Sierra Nevada in California, and northwest Montana (Raley, Lofroth, Truex, Yaeger, & Higley, 2012; Weir, Lofroth, & Phinney, 2011; Zielinski, Thompson, Purcell, & Garner, 2013; Zielinski et al., 2004a, 2004b). While riparian corridors have been identified as being important for connectivity (J. L. Jones, 1991), the minimum width is unknown. As summarized by the USFWS, "Though capable of long-distance movements, fisher generally have small dispersal distances. Small dispersal distances may be a factor of fishers' reluctance to move through areas with no cover (Buskirk and Powell 1994, p. 286). Thus, where habitat is fragmented it is more difficult to locate and occupy distant yet suitable habitat, and fishers may be aggregated into smaller interrelated groups on the landscape (Carroll et al. 2001, p. 974)" (USFWS, 2011a). In a review of key findings from fisher habitat studies in the western U.S. and Canada, Lofroth and others (2011) stated that the presence of human activity appears to have little influence on fisher movements.

Key stressors

Land management

On all land ownerships, fisher habitat quantity and quality can be reduced by activities that reduce habitat structural diversity, (e.g., very large live trees, snags, or downed logs) or eliminate connectivity of forests with at least 40 percent canopy cover. Timber harvest can temporarily remove elements of old-growth habitat that are important for fisher (J. F. Franklin et al., 2002; Green et al., 2011; Hann et al., 1997; Wisdom & Bate, 2008). This can have negative effects on fisher through displacement, change in behavioral patterns, or decreased reproductive rates. Timber harvest may mimic natural disturbance if it maintains sufficient canopy cover, creates heterogeneous habitat and edges, and snags are retained. Fisher do not avoid areas adjacent to state highways, and road density is not a significant variable in describing suitable fisher habitat in the northern Rocky Mountains (USFWS, 2017d). Motorized access can indirectly affect accessibility for trapping or firewood gathering.

Changing climate

Some climate models project that the lower elevations of northwest Montana will have less snowfall in the future, with more precipitation falling as rain. This could be beneficial to fisher, but downscaled model projections for winter precipitation are uncertain. Extensive stand-replacing wildfires can temporarily reduce fisher habitat by decreasing cover over large areas but can have positive effects by increasing prey (USFWS, 2017d).

Key indicator for analysis

The following indicator applies:

- Key ecosystem characteristics for fisher habitat

In addition, refer to the indicators and effects described in sections 3.3.6, through 3.3.9 and section 3.7.4, subsections "Old-growth forest, very large live tree habitat, and very large dead tree habitat," "Aquatic, wetland, and riparian habitats," and "Coniferous forest habitats."

Environmental consequences

Alternative A

The 1986 forest plan does not have management direction specific to fisher but does provide for fisher habitat because it has direction for management of old-growth, snags, and downed wood, as described above. Riparian habitat conservation areas also have management direction that promotes habitat conditions that would support fisher and provide connectivity. Routes or areas open to motorized over-snow vehicle use during the winter trapping season may indirectly affect accessibility for trapping, but there are limitations in areas where motorized over-snow vehicle use is allowed (see figure 1-42) that reduce this risk. Alternative A would further reduce public access firewood gathering.

Alternatives B modified, C, and D

Coarse-filter plan components for coniferous forests included in all action alternatives, as detailed in section 3.7.4, subsection "Old-growth habitat, very large live tree habitat, and very large dead tree habitat," and in section 3.3, would provide for the key ecosystem characteristics for fisher described in the "Affected environment" section. Desired condition FW-DC-WL DIV-01 specifically addresses key ecosystem characteristics for fisher in potential habitats, including mixed coniferous forests of the warm-moist potential vegetation type that have the potential to grow very large western red cedar, western larch, and western white pine, and in riparian areas of the cool-moist potential vegetation type. Vegetation standards for the Canada lynx would also benefit fisher by retaining multistoried forest with a dense understory providing hare habitat. Other plan components for vegetation would promote a landscape mosaic of different size classes and successional stages, providing habitat diversity and fisher prey species. Other key plan components for riparian management zones would provide for fisher habitat connectivity (see also section 3.7.4, subsection "Aquatic, wetland, and riparian habitats," and section 3.7.6)

Forestwide standard FW-STD-TE&V-01 protects old-growth forest and associated species by stating that vegetation management activities must not modify the characteristics of the stand to the extent that stand density (basal area) and trees per acre above a specific size and age class are reduced to below the minimum criteria in Green et al. (2011). Guideline FW-GDL-TE&V-06 provides direction for vegetation treatments in stands within 300 feet of existing old-growth forest with the intent of promoting development of old-growth forest in larger patch sizes over time, which would be beneficial to fisher habitat.

In the cool-moist potential vegetation type, modeled fisher habitat is primarily associated with riparian areas. Riparian management zones are abundant and interconnected on the Forest (see figure 1-07). Desired conditions for fisher are integrated with forestwide desired conditions FW-DC-RMZ-01 through 06 for riparian management zones. These desired conditions would provide for ecological conditions that support fisher because they emphasize the natural composition of flora and fauna, natural processes, and relatively more diverse structure and composition than areas outside riparian management zones. Some standards and guidelines apply to the entire riparian management zone and some apply only to the inner riparian management zone, as defined in FW-STD-RMZ-01. Forestwide standards FW-STD-RMZ-02 through 05 and guidelines FW-GDL-RMZ-01 through 13 apply to the entire riparian management zone. These guidelines benefit fisher habitat diversity because they state that the clearcut harvest method should not be used, and they emphasize retention of downed trees and live reserve trees. Forestwide standard FW-STD-RMZ-06 states that vegetation management shall only occur in the inner riparian management zone to restore or enhance aquatic and riparian-associated resources, but exceptions for prescribed fire, sapling thinning, and fuels reduction treatments, as well as for human safety considerations, may occur after site-specific analysis as long as these resources are maintained. Standard FW-STD-RMZ-06 would benefit fisher habitat because it would allow activities such as noncommercial thinning to stimulate the diameter growth of conifers and the removal of ladder-fuels to reduce the risk of mortality of large, live trees, as long as fish and wildlife habitat is maintained. Forestwide guidelines FW-GDL-RMZ-12, 14, and 15 benefit habitat connectivity by promoting the retention of understory vegetation and limiting the construction of new roads, temporary roads, and landings in riparian management zones. Forestwide guideline FW-GDL-RMZ-09, which applies to the entire riparian management zone defined by FW-STD-

RMZ-01, provides for habitat connectivity by stating that the distance to cover for created openings should not exceed 350 feet.

Routes or areas open to motorized over-snow use during the winter trapping season may indirectly affect accessibility for trapping, but there are limitations in areas suitable for motorized over-snow vehicle use (figures 1-42 through 1-45) that reduce this risk. Road access standards and objectives (FW-STD-IFS-02, GA-SM-STD-01, GA-SV-OBJ-04) would limit accessibility for firewood gathering. Motorized access by the public would not increase, but some roads outside of grizzly bear secure core areas could be opened temporarily for public firewood gathering (see “Grizzly bear” subsection of section 3.7.5 for more details). Public motorized road access could indirectly affect retention of very large snags and down trees in areas where firewood removal is allowed.

Summary of modeled alternative consequences

Ecosystem Research Group modeled the effects of the alternatives (appendix 3). The natural range of variation was modeled going back about 1,000 years, and the effects of alternatives were projected for the next 50 years, including anticipated changes in climate. Ecosystem Research Group modeled fisher habitat based on Olson’s characteristics (L. E. Olson et al., 2014). Fisher denning and resting habitat was modeled as forests with an average d.b.h. class greater than 10 inches, since trees in this class on the mesic habitats of the Forest generally have an average height greater than 65 feet tall (consistent with the Olson models). Cover types in the moist habitat type groups with presence of western larch, Douglas-fir, western hemlock, western red cedar, and cottonwood, which may provide cavities used for resting and denning, were included (see appendix 3).

The Ecosystem Research Group model indicates that historically there was a wide range of natural variation of modeled fisher habitat of about 350,000 acres (resulting largely from wildfire). The results show that the number of acres of modeled fisher habitat initially increases by the end of the first decade and then declines back to near current levels by decade 5 under all alternatives. Vegetation modeling results show that the acreage in this size class is likely to increase in the warm-moist potential vegetation type but not in the cool-moist. Model results indicate that natural disturbances have a substantially greater impact on reducing this size class than timber harvest amounts, with fire, insects, and disease the primary disturbances. Very large trees killed by insects or disease would provide potential resting habitat and increase the diverse structure that fisher are associated with, increasing fisher habitat quality, provided that the canopy cover provided by live trees does not decrease too much. Stand-replacing wildfires are likely to reduce canopy cover to levels below that which fishers require, but stand-replacing wildfires are not as likely to occur in the warm-moist potential vegetation type that provides potential fisher habitat as they are in the cool-moist potential vegetation types. Large regional fires dramatically change the landscape but for short periods of time until 10 percent canopy cover is reestablished. Female fisher used high-severity fire areas just as much as adjacent unburned areas 10-11 years post burn (USFWS, 2017d).

Under alternative B modified, modeled fisher habitat declines a little more than under the other alternatives, likely because modeled outputs for this alternative regenerate more acres during the first decade to reduce stand densities in the wildland-urban interface portions of the warm-moist potential vegetation type. The model predicts that all alternatives would stay within the minimum and maximum range of variation over the five-decade time period. None of the alternatives model timber harvest in riparian habitat conservation areas or riparian management zones, where much of the modeled fisher habitat in the cool-moist potential vegetation type occurs, so these portions of the Forest would be likely to continue to contribute to connectivity. Under all the alternatives, access management for no net increase in open roads would help to maintain habitat connectivity, large snags, and downed wood and would reduce trapping access. Patch size, patch distribution, and distance between patches would be analyzed at the project level, as would the presence of very large snags, live trees with heart rot, and downed woody material.

Cumulative effects

In the past, timber harvest removed very large trees in portions of the warm-moist potential vegetation type that provides fisher habitat. According to the preliminary Northern Region Adaptation Partnership risk assessment for fisher (NRAP, 2015), fisher habitat is anticipated to shift in the future. “Fishers are found in the relatively warm and wet conditions associated with the inland maritime ecosystem. Fisher habitat quality is projected to decline in virtually all areas where fishers currently exist, coupled with increased habitat quality in areas to the east and south. However, the old forest structures that fishers are currently associated with require significant time to form; it is unknown whether similar climate will equate to similar habitats in the short term” (p. 62). This risk assessment for fisher (NRAP, 2015) estimated that the magnitude of effects would be low in 2030 and moderate in 2050 (consistent with Ecosystem Research Group’s modeling results), with a high likelihood of effects across all time periods. This may mean that climatic conditions on portions of the Forest may become more suitable for fisher towards the middle or end of the century. Under Olson’s various models of future fisher habitat with respect to climate change, there is a gain of suitable habitat in the mountainous areas of Glacier National Park and areas south of Kalispell. However, there are uncertainties associated with these models because fisher must also be able to disperse if their habitat shifts. If fishers are unable to achieve regular dispersal distances greater than about a mile through unsuitable farmland or developed valley habitat, Olson and others predict that the total area of available habitat would actually decline over time (L. E. Olson et al., 2014). Riparian areas on all lands may help to provide dispersal routes.

Most of the current modeled fisher habitat is in portions of the warm-moist potential vegetation type at low elevations capable of growing mixed species forest, including very large western red cedar, very large western larch, and very large white pine. These forest types are located in the Swan Valley geographic area, along the reservoir in the Hungry Horse geographic area, in portions of the Salish Mountains geographic area, and in the southern portion of the North Fork geographic area (USDA, 2014b). Some areas that provide potential fisher habitat have private and/or State lands intermingled with Forest lands. Montana Department of Natural Resources and Conservation manages old growth according to the administrative rules of Montana for forest management (biodiversity—old-growth management), which direct the department to manage old growth to meet biodiversity and fiduciary objectives. The department considers the role of all stand age classes, consistent with the range of natural disturbances, when designing harvests and other activities to maintain biodiversity. Old growth is constrained in Montana Department of Natural Resources and Conservation’s 2015 sustainable yield calculation such that 8 percent of forest stands on lands managed by their Northwestern and Southwestern land offices are to meet the minimum quantifiable definitions of old growth by Green et al. (2011). The project-level considerations of Montana Department of Natural Resources and Conservation complement those of the Forest with respect to maintenance of old-growth habitat and very large live and dead trees to support wildlife. Whether patch size and connectivity of fisher habitat would increase depends upon specific locations of existing old growth as well as locations of future treatments, which is difficult to predict. How changing climate and stand-replacing wildfires will affect fisher habitat in the future is also difficult to predict (see also cumulative consequences on old-growth forest and very large live and dead trees on all lands, discussed above).

Timber harvest does not occur in Glacier National Park, but extensive wildfires have occurred there since the 1980s. Fisher have not been detected in the Park during non-invasive sampling efforts in in recent years (John Waller, personal communication, 2016), indicating that factors other than timber harvest or trapping may be primarily responsible for low fisher numbers or the absence of fisher on all lands. Glacier National Park, encompassing about a million acres adjacent to the Forest, is closed to trapping.

Montana Fish, Wildlife and Parks adopts trapping regulations, adjusting regulations to meet population and harvest objectives for fisher. In Montana the potential for over-trapping of female fisher appears to be negligible based upon current trapping regulations (USFWS, 2017d).

Pileated woodpecker

Affected environment

The pileated woodpecker is distributed across portions of southern Canada, most of the eastern United States, the northern Rocky Mountains, and the West Coast. The pileated is the largest woodpecker in northwest Montana and is easy to detect. Pileated woodpeckers are regularly detected on annual surveys of the Forest for “integrated monitoring in bird conservation regions,” but they have large home ranges and occur in relatively low numbers and density compared to many other bird species (Kuennen, 2013n; C. M. White et al., 2015), so there are no statistically reliable trends available. There have been numerous observations of this species across all geographic areas on the Forest in the last decade (MNHP, 2013b).

Pileated woodpeckers are primary excavators, drilling large cavities in very large snags or live trees with heart rot for nesting and creating cavities that are used as habitat by numerous other species for nesting, denning, roosting, and resting once they are abandoned by the pileated woodpecker. Pileated woodpecker habitat occurs at a wide range of elevations, and they occur in all forested potential vegetation types of the Forest except cold. Pileated woodpeckers have a relatively large home range of 100-1,000 acres, incorporating diverse forest structure and composition. In Montana, pileated woodpeckers select larch for nesting more frequently than other tree species, followed by ponderosa pine, black cottonwood, aspen, western white pine, grand fir, and ,lastly, Douglas-fir (McClelland and McClelland 1999). Snags selected for nesting are very large diameter (≥ 20 inches d.b.h.) and ≥ 40 feet tall (Bull 1987; McClelland 1977). Bull and Holthausen (1993) found that pileated woodpecker abundance increased as the amount of forest with > 60 percent canopy closure and large old trees increased. Nest trees averaged 28.7 inches d.b.h. and often had broken tops. Large trees, logs, snags, carpenter ants, and heartwood decay (which may enter the tree through deep fire scars) are components of forests that sustain pileated woodpeckers. Thomas (1979) estimated a maximum pair density of 0.3 pairs per 100 acres with a requirement for 14 snags greater than 20 inches d.b.h. per 100 acres for the Blue Mountains of Oregon and Washington.

In recent decades, many forests inhabited by pileated woodpeckers have changed considerably from large continuous areas of mature and old forests with dense canopy cover (Bull & Holthausen, 1993) to relatively open canopies (< 30 percent closure) and an increasing number of snags and logs as a result of increased levels of insect infestation (Bull, Nielsen-Pincus, Wales, & Hayes, 2007). Bull and others (2007) studied the density of nesting pairs and traditional home ranges of pileated woodpeckers in two study areas over a 30-year period and in five additional study areas over 15 years after extensive insect-caused tree mortality and timber harvest during the 1990s. Although canopy closure declined due to tree mortality in five of the seven areas they studied and some of the forests were no longer classified as old growth, they continued to function as habitat for woodpeckers because of the nesting, roosting, and foraging habitat provided.

Key stressors

Key stressors are the same as those listed under section 3.7.4, subsection “Old-growth forest, very large live tree habitat, and very large dead tree habitat,” because pileated woodpeckers occur across the full range of these habitats on the Forest.

Key indicator for analysis

There are no species-specific plan components for pileated woodpeckers because key ecosystem characteristics described in the “Affected environment” section would be provided by the implementation of coarse-filter plan components discussed in sections 3.3.3 through 3.3.8 and in section 3.7.4, subsections "Coniferous forest habitats," "Old-growth forest, very large live tree habitat, and very large dead tree habitat," and "Burned forest and dead tree habitats." The following section discusses how these plan components support key ecosystem characteristics for the pileated woodpecker

Environmental consequences

Summary of modeled alternative consequences

In order to assess key aspects of pileated woodpecker habitat, the Ecosystem Research Group modeled the effects of alternatives on the natural range of variation, current conditions, and effects of alternatives (appendix 3). The natural range of variation was modeled going back about 1,000 years, and the effects of the alternatives were projected for the next 50 years, including anticipated changes in climate and the fire suppression logic of the model. Modeled habitat included forests with average VMap diameter classes greater than 15 inches d.b.h. and greater than 15 percent canopy cover, with species mixes including western larch, ponderosa pine, black cottonwood, and Douglas-fir for nesting. Forests with an average diameter of 15 inches d.b.h. may have very large trees. Although pileated woodpeckers use very large-diameter snags and live trees with heart rot for nesting, the SIMPPLLE model is dependent upon R1 VMap and did not allow the incorporation of very large snag densities. The Forest used Forest Inventory and Analysis summary data to determine the number of acres with at least 8 or 10 large (15-19.9-inch d.b.h.) and very large (greater than or equal to 20 inches d.b.h.) trees per acre (depending on habitat type group). A VMap texture file was then used to spatially map those acres. Forest Inventory and Analysis data were also evaluated to ensure that sufficient large snags exist at the forest scale to provide nesting habitat, assuming random distribution. Forest Inventory and Analysis summary data suggests that snags 15-20 inches d.b.h. (used primarily for feeding) occur at approximately four per acre, and snags greater than or equal to 20 inches d.b.h. (used primarily for nesting) occur at approximately one per acre.

The model predicts that all alternatives would stay within the minimum and maximum range of the natural range of variation over the five-decade time period. Future acres of modeled habitat vary little between alternatives and remain close to current levels, which are at the middle of the range of the natural range of variation. The combined modeled acreage of large trees used for feeding and very large trees used for nesting increases slightly through the five-decade period, likely because forest succession outpaces stand-replacing wildfire in modeled pileated woodpecker habitat. Since pileated woodpeckers can utilize forests that are relatively open, fires, insects, and disease have little negative effect as long as stands retain large and a few very large trees. Changes in the distribution of cover types for suitable nest trees, which include western larch, ponderosa pine, Douglas-fir and western red cedar, suggest those preferred nest trees will also increase slightly through the period (for black cottonwood, see the section on hardwood trees above). The amount of modeled fire, insects, and disease contributes to both nesting snags and foraging snags that would increase habitat suitability for pileated woodpeckers by the end of decade 5, regardless of alternative selected.

Alternative A

The 1986 forest plan does not have management direction specific to pileated woodpecker but does provide direction for management of old growth, snags, and downed wood, as described in section 3.7.4, subsection "Old-growth habitat, very large live tree habitat, and very large dead tree habitat."

Alternatives B modified, C, and D

Coarse-filter plan components for coniferous forests included in all action alternatives, as detailed in section 3.7.4, subsection "Old-growth habitat, very large live tree habitat, and very large dead tree habitat," provide for key ecosystem characteristics for pileated woodpeckers described in the "Affected environment" section. Forestwide standard FW-STD-TE&V-03 requires retention of a minimum of two or three very large snags or live replacement trees per acre in timber harvest areas in the warm-dry, warm-moist, and cool-moist potential vegetation types (which provide pileated woodpecker habitat). These numbers exceed the minimum of 14 per 100 acres (1.4/acre) discussed in the "Affected environment" section. The standards for each geographic area state that all snags of western larch, ponderosa pine, and black cottonwood trees greater than 20 inches shall be retained, and these are the species of highest value for the pileated woodpecker. Nest holes excavated by the pileated woodpecker would provide habitat for many other species that use them for nesting, denning, and resting. The snag analysis shows that the percentage of the Forest with at least one snag per acre greater than 20 inches d.b.h. increases by the fifth decade under all the alternatives (see section 3.3.7 for more details).

Cumulative effects

In the past, very large snags and defective live trees providing pileated woodpecker habitat were removed by timber harvest on all managed lands. In the future, all alternatives have plan components that would provide for key ecosystem characteristics for the pileated woodpecker because of forestwide standards to retain all existing old growth and provide the very large snags and live trees with the heart rot that pileated woodpeckers need for nesting. In addition, other successional stages may provide lower densities of very large trees, snags, and downed woody material over time. Alternatives vary with respect to plan components to increase future old growth and its patch size and the resilience of very large trees. See cumulative effects in section 3.7.4, subsection "Old-growth habitat, very large live tree habitat, and very large dead tree habitat," for more details.

Burned forest and dead tree habitats

Introduction

This section discusses habitat for species associated with burned forests and dead trees (snags, downed wood) less than 20 inches d.b.h. Species that require snags 20 inches or more are discussed in section 3.7.4, "Old-growth forest; very large live habitat; and very large dead tree habitat." Many animal species have evolved with and use burned forests, and some have close association with those that burn with high intensity or severity (R. L. Hutto et al., 2016) (see appendix 6). This section assesses effects to most species associated with burned forest habitat and snags. Following the general discussion, two species are discussed as examples in order to help display differences in effects of alternatives. The two species are the black-backed woodpecker and olive-sided flycatcher.

Examples of key ecosystem characteristics of burned forests are very high densities of dead trees for nesting, an enhanced insect prey base following fire-induced tree mortality, and open canopy and understory conditions when compared to unburned coniferous forests. The black-backed woodpecker, American three-toed woodpecker, hairy woodpecker, northern flicker, and olive-sided flycatcher are all more abundant in intensively burned than in unburned mixed-conifer forest because of an abundance of food (beetle larvae and ants) and potential nest sites associated with large numbers of standing dead trees (Richard L. Hutto, Bond, & DellaSala, 2015; Richard L. Hutto & Young, 1999). A reduction of nest predators after high-severity fire is also a plausible and likely reason for high survival of cavity nesters and other wildlife species in burns (Saab, Dudley, & Thompson, 2004; Saab, Russell, & Dudley, 2007), especially small mammals (Fisher & Wilkinson, 2005). Desired vegetation characteristics of recently burned forest are discussed in sections 3.3.6 and 3.3.7.

In burned conifer forests, the most valuable wildlife snags are more likely to be thick-barked species such as ponderosa pine, western larch, and Douglas-fir rather than thin-barked Engelmann spruce, true firs, and lodgepole pine tree species (Richard L. Hutto, 1995; Saab & Dudley, 1998). Thick-barked snags in burned forests provide feeding opportunities as well as nesting opportunities for birds. Woodpeckers feed extensively on wood-boring beetle larvae in the snags (Richard L. Hutto & Gallo, 2006). Some seed-eating bird species also increase after fires due to the increased availability of seed resources. Species such as the Cassin’s finch, red crossbill, and pine siskin take advantage of seeds that are released or made available in cones that open after severe fires. Cassin’s finches are one of the more abundant birds in early post-fire conifer forests (Kuennen, 2013g), where their numbers can increase significantly regardless of fire severity (Dan Casey, Altman, & Stringer, 2013).

Secondary cavity-nesting species such as the northern hawk owl, mountain bluebird, western bluebird, house wren, and tree swallow benefit from new forest openings in a complex of snags of many diameters within burned forest (Richard L. Hutto et al., 2015). Insects and disease can also create high densities of snags used by cavity-nesting species. About 25 percent of all bird species nesting in the northern Rocky Mountains are cavity nesters and are dependent upon disturbances such as fire, insects, and disease to create habitat (McClelland, Frissell, Fischer, & Halvorson, 1979).

As described in the old-growth section, snag densities used for standards or guidelines in the forest plan are based upon information used in the development of amendment 21, which came from a comprehensive publication on managed forests (Thomas, 1979). Table 52 displays the number and preferred species of snags per 100 acres needed to support 100 percent of the maximum population of two example woodpecker species that are found on the Forest, which Thomas based upon their territory size.

Table 52. Snags per hundred acres by d.b.h. class to meet the needs of key primary excavators in the mixed conifer community (Thomas, 1979)

Species	Maximum Pair Density/100 Acres	Preferred Snag Species	Average Number of Snags
Northern flicker	2.5	Aspen, western larch, ponderosa pine	38 per hundred acres > 12” d.b.h. (3.8/acre)
Black-backed woodpecker	1.3	Engelmann spruce, western larch, aspen	59 per hundred acres > 12” d.b.h. in clumps (5.9/acre)

Although the snag numbers listed by Thomas may be adequate for nest sites, subsequent studies have stressed the importance of leaving many more dead trees in burn areas to provide food for species that feed on insects in dead trees in close proximity to nest sites.

Saab and others (2007) studied the effects of salvage logging and time since fire on cavity-nesting birds. For most species, the time since fire and type of postfire treatment (partially logged vs. unlogged) had little influence on nesting survival. However, some species had higher nest densities in unlogged areas, and two species had higher nest densities in logged areas. Nest densities of wood-foraging species and mountain bluebirds were significantly higher in unlogged burn areas, whereas Lewis’s woodpeckers and kestrels had significantly higher nest densities in partially logged burn areas. Western bluebird nest densities were nearly equal in both logged and unlogged burned areas (Saab et al., 2007). In the study by Saab and others, salvage logging was designed to retain more than half of the snags over 9 inches d.b.h., and these remaining trees provided suitable nesting habitat for open-space foragers during the decade following fire. With respect to time since fire, Saab and others (2007) found that nest densities of northern flickers generally increased with time since fire, whereas nest densities of black-backed and hairy woodpeckers peaked four to five years postfire.

Hutto and Gallo (2006) studied the effects of post-fire salvage logging on cavity-nesting birds in northwest Montana. Based upon a study of 563 active nests of 18 cavity-nesting birds, Hutto and Gallo found that all species nested in uncut burned forest plots, but only eight nested in forest plots that were salvage logged after burning. Half of the species studied were significantly more abundant in the unlogged plots, even though salvage-logged plots had more potential nest snags per acre than the minimum number needed to support maximum densities of primary cavity nesters. Based upon these findings, the authors suggested that woodpecker densities in post-fire areas are more related to food availability (wood-boring beetle larvae) than to nest-site availability. Areas that are salvage logged would not be expected to support endemic levels of many cavity-nesting birds unless sufficient snags remain for both nesting and feeding at a home range scale. Hutto and Gallo found that there were 8 species that nested in severely burned areas with salvage logging but that there were 10 species where nesting was only detected in areas without salvage harvest (Richard L. Hutto & Gallo, 2006).

Affected environment

On the Forest, snags of all sizes and downed woody material provide essential habitat features for about 60 species of birds, mammals, and amphibians. Of these 60 species, about 15 species on the Forest are strongly associated with a variety of environmental conditions that occur with snags or burned forests (see appendix 6). Research specific to the Forest looked at a stratified random sample of 49 stands and analyzed 10 variables that might be related to snag density and distribution (Wisdom & Bate, 2008). Mean snag density for all species was found to be 19 times higher in unharvested stands compared to clearcuts and 3 times higher than in stands that had undergone partial harvest (Wisdom & Bate, 2008). This study found that factors that significantly affecting snag density included seral stage, timber harvest, distance to the nearest town, proximity to open roads, and whether the stand was uphill or downhill from the nearest road.

The acreage burned by wildfire on the Forest has increased a great deal in recent decades compared to previous decades (table 53) and is now in a pattern similar to that seen from 1890-1930 (see section 3.8.2). Recent wildfires have created abundant habitat for species associated with burned forests (see section 3.8 and USDA, 2014b for more details). Table 53 shows the acres burned on Forest lands from 1980-2015. About 90,000 of these acres burned more than once. In comparison, from 1889-1920, about 1.2 million acres were mapped as being burned (with a huge spike in 1910), but the amount of unburned area within burned perimeters is unknown and mapping at that time was at a much coarser scale.

Table 53. Approximate acres burned by wildfire on the Forest from 1980-2015

1980-1989	1990-1999	2000-2009	2010-2015
16,400 acres	42,450 acres	338,700 acres	146,600 acres

Most of the acreage on the Forest burned at moderate to high severity, but the exact acreage is unknown. Of the total acres burned, about 60 percent was in wilderness and about 40 percent was outside of wilderness. Over 1 million acres of the Forest are within designated wilderness, distributed across the Hungry Horse, Swan Valley, South Fork, and Middle Fork geographic areas. Human influence on vegetation conditions is minimal in wilderness, so the relative abundance and variation in size of snags within this area is very high. In the areas that were burned between 1990 and 2013 on the Flathead National Forest, salvage of burned trees occurred on about 4 percent of the area; considering only the areas outside wilderness that burned during that time period, salvage of burned trees occurred on about 10 percent of this area. Therefore, abundant habitat has been available for use by a wide variety of wildlife species associated with burned forest and dead tree habitats. Refer to section 3.3.7 and to Trechsel (2014) for greater detail on the existing conditions and natural range of variation analysis for snags.

Burned forests provide a very high density of snags, but snags also occur at high density in unburned areas with high levels of insects and disease. Modeling of the natural range of variation across the Forest shows that insect and disease levels have also fluctuated over time and across the landscape (Trechsel, 2017a). The current condition for snags in potential vegetation types on the Forest is summarized in table

54 and table 55 (see forest plan figure B-03). Detailed information on recent past and current snag conditions for the Forest can be found in section 3.3.7. The current proportion from this data set is expressed as an estimated mean percent, with a lower and upper bound estimate provided at a 90 percent confidence interval.

Table 54. Snag densities (snags per acre) for the Flathead National Forest, 2017 (Trechsel, 2017b)

2017 Report	≥ 10" d.b.h.	≥ 10" d.b.h.	≥ 10" d.b.h.	≥ 15" d.b.h.	≥ 15" d.b.h.	≥ 15" d.b.h.
Snag Analysis Group	**Mean**	**Lower Bound**	**Upper Bound**	**Mean**	**Lower Bound**	**Upper Bound**
Lodgepole pine	8.6	4.8	13.0	1.0	0.3	1.9
Warm-Dry	11.0	6.3	16.3	4.2	2.0	6.9
Warm-Moist	11.1	5.2	18.0	5.4	2.5	8.6
Cool-Moist	18.6	15.3	22.3	5.8	4.4	7.3
Cold	17.2	12.2	22.8	4.5	2.6	6.7

Table 55. Snag densities (snags per acre) for the Western Montana Zone, which includes the Flathead, Kootenai, and Lolo National Forests combined, 2017 (Trechsel, 2017b)

2017 Report	≥ 10" d.b.h.	≥ 10" d.b.h.	≥ 10" d.b.h.	≥ 15" d.b.h.	≥ 15" d.b.h.	≥ 15" d.b.h.
Snag Analysis Group	**Mean**	**Lower Bound**	**Upper Bound**	**Mean**	**Lower Bound**	**Upper Bound**
Lodgepole pine	13.0	10.3	15.8	1.9	1.3	2.6
Warm-Dry	10.4	8.9	12.1	4.3	3.6	5.1
Warm-Moist	13.9	11.9	16.1	4.9	3.9	6.0
Cool-Moist	17.7	15.6	19.9	5.2	4.3	6.1
Cold	21.7	17.8	25.8	5.8	4.4	7.4

The analysis shows the Forest is currently at the upper end of the modeled natural range of variation across the Forest and the Western Montana Zone. The numbers above are based upon Forest Inventory and Analysis data, which accounts for snags lost due to fire and other natural disturbances, timber harvest, post-fire salvage, and firewood gathering.

Key stressors

Land management

On all lands, fire policy affects decisions on suppression of wildfires. The availability of firefighters and firefighting equipment has a large impact on fire suppression, especially during years when wildfires are abundant across the nation (see section 3.8 for more details). Vegetation management on NFS lands affects the intensity and extent of insect and disease outbreaks that create snags and downed woody material, the ability to manage wildfire spread, snags remaining in timber harvest areas, and snags remaining in wildfire areas (see section 3.3.7 for more details). Public firewood gathering, indirectly affected by road access, also affects the size and species of snags removed.

Changing climate

A warmer, drier summer climate is expected to increase stand-replacement wildfires and insects and disease.

Key indicator for analysis of most species associated with burned forest habitat and snags

In addition to the key indicators addressed in section 3.3 and section 3.7.4, subsection "Coniferous forest habitats," the following indicator is important for the wide variety of wildlife species associated with burned forests and snags. The indicator was developed after considering key stressors, public comments, and issues identified during scoping.

- Plan components to support key ecosystem characteristics for species associated with burned forest snags < 20 inches d.b.h. and burned forest

Environmental consequences

Summary of modeled alternative consequences

Evidence from fire history studies suggests that a complex mosaic of severely burned conifer patches was common historically in the West (R. L. Hutto et al., 2016). Modeling of the natural range of variation across the Forest shows that stand-replacing wildfire has fluctuated greatly over the last 1,000 years due to cycles of warm, dry climate vs. cool, moist climate (see sections 3.3, 3.8, and appendices 2 and 3 for more details). Because over 60 percent of the Forest is in the cool-moist to cold potential vegetation types, the greatest acreage of stand-replacing wildfires has been in these potential vegetation types. Wildlife species that use burned forest habitats may experience population fluctuations that correspond to habitat fluctuations, but they are adapted to these wide fluctuations in habitat availability.

The effects of the alternatives were modeled using the Spectrum model. Modeling estimated the proportion of the Forest with snags in the 10 to 20-inch d.b.h. size class and the density of snags in this size class. Modeling indicated that all alternatives have a similar trend in the densities of snags over the five-decade future model period. Although the percentage of the Forest with at least 10 snags per acre in the 10 to 20-inch d.b.h. size class would be highest under alternative A in the first decade, this pattern does not continue in later decades. Under all alternatives, the proportion of the Forest with a density of 10 or more snags per acre increases by the fifth decade. By the fifth decade, modeling suggests that the proportion of the Forest with greater than 10 snags per acre in the 10-inch and larger size class would be about 30 percent of the Forest. Refer to Trechsel (2017b, attachment 2) for more details on these results. In summary, model results suggest that snag amounts would increase over time, in response mainly to fire and other natural disturbances, and it does not appear that there would be a decline or a shortage of this ecosystem component under any alternative. Desired conditions for snags and downed wood are expected to be met forestwide under all alternatives, and there would be abundant habitat for cavity-nesting and cavity-denning wildlife species at the forestwide scale. All alternatives have standards and guidelines for snag retention (see section 3.3.7 and section 3.7.4, subsection "Coniferous forest habitats." See also the individual cumulative consequences sections for specific species below.

Alternative A

With alternative A, management direction for snags is provided for potential vegetation groupings that are different than the groupings used for alternatives B modified, C, and D. The plan specifies retention of an average of 2 snags per acre in the 12-20 inch size class in the dry potential vegetation group and an average of 6 per acre of this size in the moist and cold potential vegetation groups (in areas more than 200 feet from open roads). This average number for the moist and cold potential vegetation groups would meet the needs of species such as flickers. In the dry potential vegetation group, the specified number would be lower than the desired average of 3.8 per acre indicated for maximum populations of species such as the flicker. If existing snag densities are below the specified numbers, live trees are to be substituted where available. The forest plan does not have management direction for burned forests, so dead and dying trees could be salvaged if in suitable management areas. Timber harvest would not occur in wilderness or recommended wilderness areas, so snag densities are anticipated to be higher in these management areas. Alternative A has more recommended wilderness than alternative D but less than alternative B modified or C.

The plan also specifies that an average of 15 pieces of down woody material in the 9-20 inch size class be retained per acre in the dry potential vegetation group and 30-32 in the moist or cold potential vegetation groups. This management direction provides habitat to support wildlife species associated with down woody material.

Alternatives B modified, C, and D

Under the action alternatives, there is more flexibility to use fire for habitat restoration and maintenance (see section 3.8 for more details).

The standards and guidelines related to snags or live decayed/decadent tree retention in the forest plan are intended to retain a certain level of snags distributed across the Forest to contribute to wildlife habitat and for other ecosystem benefits—not just within wilderness and inventoried roadless areas but also within areas that are more intensively managed. Allowing for the fact that most snags with high quality for wildlife do not last long, direction is provided in the plan for leaving live trees as well in order to contribute to future snag habitat (Harris, 1999). The forest plan direction sets different minimum levels of snag retention depending on geographic area, recognizing differences in past and future human and natural disturbance patterns and in the current number and distribution of snags (see section 3.3.7 for details). Standard FW-STD-TE&V-03 gives the following direction: “Within timber harvest areas, snags and/or live snag replacement trees shall be retained at minimum levels that vary depending upon the geographic area and whether the harvest is within a riparian management zone.” Standards for each geographic area specify the minimum number of snags or live replacement trees greater than 10 inches d.b.h. or greater than 15 inches d.b.h. The standards also specify that live replacement trees shall be of the largest size present above 10 inches d.b.h., shall be decayed or decadent trees if present, and one of the following species if present: western larch, ponderosa pine, Douglas-fir, cottonwood, aspen, birch, or western red cedar. The minimum numbers specified in the tables associated with the standards exceed the minimum requirements for woodpecker species (primary excavators that make cavities for many other species) given in the introduction to this section.

Snag and downed wood densities are anticipated to be higher in riparian management zones, wilderness, and recommended wilderness areas, which are distributed across the North Fork, South Fork, and Middle Fork, Hungry Horse, and Swan Valley geographic areas. Alternative C has the most acreage in wilderness and recommended wilderness management area allocations and alternative D has the least, with alternative B modified in between. These areas are anticipated to provide high densities of snags and downed wood of all sizes and species, providing nesting and feeding habitat for most species associated with snags, downed wood, and burned forest.

The snag analysis shows that densities are currently lower in the Salish Mountains and Swan Valley geographic areas of the Forest (Trechsel, 2017b). These two geographic areas also have more area suitable for timber production (figures 1-10, 1-11, and 1-12) and more area in the wildland-urban interface (figure 1-13), where vegetation treatments would be more abundant and wildfires would generally be suppressed, resulting in a lower density of snags. With the exception of existing old growth, lands suitable for timber production would generally be managed in a way that improves their growth and vigor and limits losses due to insects and diseases, where possible. As a result, future snag retention numbers are higher and the diameter range of retained snags are lowered to 10 inches d.b.h. for these two geographic areas in order to retain those trees that do die from insects and disease. The specified numbers are based upon updated data about snag distribution across the Forest and would exceed the desired average of 3.8 snags per acre greater than 12 inches d.b.h. indicated for maximum populations of species such as the flicker, except in the lodgepole pine type. Lodgepole pine is not a key species for cavity nesting. If snags are not present, the standards include direction for leaving live replacement trees of at least 10 inches d.b.h. to substitute for each unavailable snag. A forestwide guideline for live tree retention in all regeneration harvest units (FW-GDL-TE&V-09) and within any harvesting that occurs in riparian management zones (FW-GDL-RMZ-08) also serves to contribute to the long-term snag habitat need and biodiversity for species associated with snags and downed wood. The intent of live tree replacements is to extend the period when snags may be available to provide structure and wildlife habitat, after existing snags have fallen (see section 3.3.7 for more details). Because some species associated with snags are territorial, these plan components would help to ensure the distribution of snags and downed wood to provide habitat across the landscape, within Forest Service authority and the capability of the lands.

As snags fall, they would provide abundant downed woody material over time. The distribution of downed woody material would be variable, as it is influenced by the pattern of insects, disease, fire, and harvest. Like snags, the highest amounts are expected to occur in riparian management zones, unroaded areas such as backcountry management areas, and designated and recommended wilderness areas. Lower amounts of downed wood are expected to occur on lands identified as suitable for timber production (see section 3.21 for more details). In combination with the mix of management areas across the Forest, guideline FW-GDL-TE&V-08 for downed wood retention is anticipated to be sufficient to meet desired conditions for wildlife.

Cumulative effects

This section summarizes activities and effects that are common to most species associated with burned forest, dead trees (snags), and downed wood habitats. See also the individual cumulative consequences sections for specific species.

Past management actions on all lands, particularly timber harvest and fuels reduction, have altered coniferous forest stand structure and reduced the density of dead trees, removing trees killed by insects, disease, or fire and decreasing forest diversity (see section 3.3 for more details). Within the boundaries of the plan area, there are three state forests, as well as scattered parcels, managed by Montana Department of Natural Resources and Conservation. This agency manages snags according to the administrative rules of Montana for forest management (36.11.411 biodiversity—snags and snag recruits). This management direction specifies the number of snags per acre that are to be retained in harvest units, by habitat type group and in consideration of the wildland-urban interface (see figure 1-13). On State lands, administrative regulations require retention of a minimum of two snags per acre on wet habitat types and one snag per acre on dry habitat types ≥ 21 inches d.b.h. or the next largest size class available. If snags are lacking, large live trees can be substituted. The project-level considerations of the Montana Department of Natural Resources and Conservation complement those of the Forest with respect to retention of snags in harvest units to support wildlife.

Past fire suppression (followed by salvage logging when fires or insect and disease outbreaks did occur) altered the availability and pattern of habitat for species that nest, roost, and/or den in cavities in snags and feed on snags or downed logs. Continued fire suppression is anticipated in the wildland-urban interface on all lands. On Montana Department of Natural Resources and Conservation forest trust lands in the Swan Valley geographic area, the Stillwater State Forest in the Salish Mountains geographic area, and Coal Creek State Forest lands in the North Fork geographic area, wildfires are likely to be suppressed. Stand-replacing wildfires, high snag densities, and widespread or high levels of insects and disease are likely to be much lower in much of the warm-dry and warm-moist potential vegetation types (which has the most area of overlap with the wildland-urban interface) than in the cool-moist and cold potential vegetation types that are dominant outside the wildland-urban interface. Timber harvest, prescribed burning, and precommercial thinning would restore or maintain stand density conditions closer to historic conditions and would make forests more sustainable and resilient to large-scale disturbance, but these activities might not restore snag levels to historic conditions. On State and private timber lands managed for timber production, many of the dead trees are likely to be salvaged if they have economic value. On all lands, forest restoration actions can mimic natural disturbances in areas where natural disturbances are not compatible with objectives.

Past road building on Federal, State, and private lands likely impacted the distribution and number of snags, especially within 200 feet of open roads, but road influences have decreased over time. Access management has resulted in fewer roads open to motor vehicle use on Federal, State, and private lands, helping to protect snags and burned forest.

Increases in insects, disease, and wildfire are likely to affect all lands if the climate becomes warmer and drier in the future. On the Flathead National Forest and in Glacier National Park, the number of snags and acreage of forest burned with stand-replacing wildfire has increased since 1988, and this trend is likely to continue. On the Forest's wilderness lands and in Glacier National Park, there is virtually no salvage of burned forest or snags killed by insects and disease and no public firewood gathering on a combined area of over 2 million acres, so diverse forests with a large number of snags will continue to provide high-quality habitat for species associated with these key ecosystem characteristics.

In summary, proposed management direction on the Forest, in the context of all lands of the larger landscape, contributes to burned forest and snag habitat. This would be accomplished by plan components to use prescribed fire as a management tool and to allow wildfire as a natural ecosystem process where and when it contributes to desired conditions (see sections 3.3 and 3.8 for more details). Although the Forest does not have authority over all the stressors, the ecological conditions of burned forest/snag communities and the processes that maintain them would be provided on NFS lands. Snag habitats (including but not limited to those that burn periodically) are distributed across all Forest geographic areas. Coarse-filter plan components provide for biodiversity and the ecological conditions that support the long-term persistence of the majority of species associated with these habitats.

Black-backed woodpecker

Affected environment

The black-backed woodpecker is distributed across most of Alaska, southern Canada, the Great Lakes region, and the mountain ranges of the northwest United States and California. Black-backed woodpeckers are associated with boreal and montane coniferous forests that have experienced recent burns or large-scale bark beetle outbreaks. Black-backed woodpeckers are distributed across the Forest (Kuennen, 2013b) in three types of forested habitat: (1) post-fire areas that have burned within the past one to six years, (2) areas with extensive bark beetle outbreaks causing widespread tree mortality, and (3) areas of smaller disturbances scattered throughout the Forest caused by windthrow, ice damage, or other occurrences that produce small patches of dead trees.

Successful breeding is known to be closely tied to fires that kill large numbers of trees to provide nest sites for this cavity-nesting species and the subsequent presence of wood-boring beetles for feeding (Dixon & Saab, 2000; Richard L. Hutto & Gallo, 2006). In an Oregon study, Goggans and others found that black-backed woodpeckers had an eighteenfold increase in breeding density in burned forest relative to densities in forests with an epidemic mountain pine beetle outbreak (Fayt, Machmer, & Steeger, 2005). In the forests with a bark beetle epidemic, overall nesting success averaged 68.5 percent. In contrast, nest success was 100 percent and 78.6 percent for nests monitored in burned forests of western Idaho and central Oregon, respectively (Forristal, 2009; Saab & Dudley, 1998). Populations of this species are known to increase for up to a decade following stand-replacing fires and to decrease but persist during periods with fewer stand-replacing fires (Nappi & Drapeau, 2009).

At the landscape scale, moderate to intensively burned forest patches that have trees at least 9 inches d.b.h. and at least 50 percent crown closure prior to burning provide key nesting habitat for black-backed woodpeckers (Forristal, 2009). Following wildfires, some trees are instantly killed, others die slowly over a decade or so, and others are able to survive fire. Similarly, the use of burned areas by black-backed woodpeckers changes over time (Forristal, 2009). Forristal found that black-backed woodpecker populations peaked two to three years following wildfire. Hutto (personal communication, 2012) stated that burned forest habitat is valuable for black-backed woodpeckers for up to a 10-year period following stand-replacing wildfires if trees continue to die over time.

In northwest Montana, it is likely that black-backed woodpecker populations have increased since 2003 due to the large number of acres that experienced high-intensity burns during this period. Black-backed woodpeckers are highly mobile and appear to migrate at least 30 miles to recent burns (Hoyt, 2000), so they are able to locate suitable habitat as burned areas change over time. Dudley and Saab (2007) estimated an average home range size of about 511 acres of high-quality habitat per nesting pair.

Key stressors

Key stressors are the same as those listed in section 3.7.4, subsection "Burned forest and dead tree habitats," because black-backed woodpeckers occur across the full range of these habitats on the Forest.

Key indicator for analysis

The habitat needs of black-backed woodpeckers are largely addressed by coarse-filter plan components for vegetation. In addition to the plan components, indicators, and effects described in section 3.7.4., subsections "Old-growth habitat, very large live tree habitat, and very large dead tree habitat," "Coniferous forest habitats," and "Burned forest and snag habitats," described above, a key indicator is

- Key ecosystem characteristics for the black-backed woodpecker

Environmental consequences

Alternative A

The 1986 forest plan does not have management direction specific to black-backed woodpeckers but does provide direction for management of old growth, snags, and downed wood, discussed in section 3.7.4, subsection "Burned forest and dead tree habitats." On the Forest, there are over 1 million acres of existing wilderness where natural ecosystem processes will prevail, including wildfire. Within wilderness, about 835,000 acres are in potential vegetation types capable of providing black-backed woodpecker habitat. There would be no salvage harvest in wilderness, so abundant high-quality habitat would be available following wildfires.

Alternatives B modified, C, and D

Desired conditions for black-backed woodpeckers are described in FW-DC-WL DIV-01. Key ecosystem characteristics described in the "Affected environment" section would be supported by implementation of coarse-filter plan components. Within wilderness, about 835,000 acres are in potential vegetation types capable of providing black-backed woodpecker habitat. There would be no salvage harvest in wilderness, so abundant high-quality habitat would be available following wildfires under all action alternatives. The alternatives vary with respect to the amount of recommended wilderness, but modeling predicts all alternatives would stay with the natural range of variation.

Outside wilderness, wildfires are likely to be suppressed in the wildland-urban interface, resulting in lower acreages or lower-quality habitat for black-backed woodpeckers on about 400,000 acres of NFS lands. The mix of management areas suitable for salvage harvest varies by alternative, as described below, but all alternatives have plan components to support key ecosystem characteristics for the black-backed woodpecker, including retention of snags, as discussed in section 3.7.4., subsection “Burned forest and dead tree habitats.”

Salvage within burned forests to meet desired conditions may occur in certain circumstances, as described in other sections of this forest plan (see section 3.21, Forest Products—Timber of the final EIS and chapter 3 of the forest plan, suitability for timber production by management area). Generally, as indicated by recent experience, most area burned by wildfire is not salvage harvested, usually because areas are inaccessible (i.e., no roads or too far from existing roads), there is little or no economic value in the burned trees, or harvesting would not meet other forest plan direction (such as protecting soils) (see Trechsel, 2014). FW-GDL-TIMB-02 and 03 would help to retain black-backed woodpecker habitat in salvage harvest areas to achieve distribution across all Forest geographic areas because they specify that clusters of burned trees with a variety of sizes should be retained to provide habitat for wildlife species in areas burned by mixed- or high-severity wildfire and to retain western larch, ponderosa pine, or black cottonwood trees greater than 20 inches d.b.h. in stands that were old-growth forest prior to wildfire. These guidelines would help to provide nesting and feeding habitat for black-backed woodpeckers in areas where timber harvest is suitable or allowable.

Summary of modeled alternative consequences

In order to assess key aspects of black-backed woodpecker habitat, Ecosystem Research Group modeled the effects of the alternatives (appendix 3). The natural range of variation was modeled going back about 1,000 years, and the effects of the alternatives were projected for the next 50 years, including anticipated changes in climate and the fire suppression logic of the model. Modeling of black-backed woodpecker habitat included tree size classes 10 inches d.b.h. or greater for all forested habitat groups and cover types except high-elevation subalpine cover types, including whitebark pine.

The model predicts that all alternatives would stay within the minimum and maximum natural range of variation over the five-decade time period. The natural range of variation of modeled habitat for black-backed woodpeckers historically ranged from about 10,000 to 270,000 acres out of approximately 2.4 million acres on the Forest, a moderate range. High-quality habitat lasts for no more than a decade and this was accounted for in the modeling. The current level of habitat is about 130,000 acres—near the middle of the range.

In the future, modeled acres of habitat increase somewhat and then decline back to current levels by decade 5. Even though the mean number of acres of black-backed woodpecker habitat increases, the level of habitat never reaches the maximum range or even the acres burned in the 2003-2012 time period, due to the modeled effects of fire suppression. However, the fire suppression logic of the model may not be realistic given anticipated future climate conditions; more acres may actually be burned by stand-replacing fire than the model predicts.

Cumulative effects

Black-backed woodpeckers have persisted on the Forest and on other land ownerships within and adjacent to the Forest even though there were very few acres of stand-replacing wildfire from the 1940s to the 1980s. Their populations may occur at low levels during these time periods and increase greatly during periods when the acres burned by wildfire are at a high level. Black-backed woodpeckers readily cross Forest boundaries to exploit burns (Hoyt 2000).

Fires have been active on the Flathead and adjacent lands in the last two decades. Black-backed woodpeckers are likely to find high-quality habitat as they move from place to place to inhabit areas burned with mixed- and high-severity fire on all lands. As stated above in section 3.7.4., subsection "Burned forest and dead tree habitats," some of the areas burned by wildfire are accessible by road on all land ownerships and are likely to continue to have salvage harvest of dead trees, as well as firewood cutting, except within Glacier National Park. Glacier National Park, combined with the Forest's wilderness, inventoried roadless areas (see figure 1-73), and backcountry areas, would continue to provide high-quality habitat for black-backed woodpeckers if these areas burn. Although forests with insect infestations do not provide as high-quality habitat as areas with stand-replacing fires, the acres of forest with high levels of insect infestations are anticipated to increase with a warmer and drier climate, so even if forests do not burn, they are likely to support black-backed woodpecker populations at lower densities.

Olive-sided flycatcher

Affected environment

The breeding range of the olive-sided flycatcher is across most of Alaska, southern Canada, the western and eastern United States, and the Great Lakes region. It is a small neotropical migratory bird that breeds in western Montana (Kuennen, 2013m) and winters in Mexico and South America. Olive-sided flycatchers are generally restricted to coniferous or mixed-coniferous forests that include a juxtaposition of forest openings and mature forest providing edge and snags (although they are not cavity nesters). They can be found in dry to moist sites across a range of elevations. The occurrence of olive-sided flycatchers is influenced by relatively open canopies and the presence of tall trees for aerial flycatching and foraging and perches for singing (Altman and Sallabanks 2012). In mixed conifer forests and in red cedar-western hemlock forests in Idaho, olive-sided flycatchers were found to be significantly more abundant in a matrix of clearcuts than in landscapes of old-growth forest (Evans and Finch 1994; Hejl and Paige 1994). Hutto and Young (1999) found that olive-sided flycatchers were more abundant in early post-fire habitats than in any other major cover type, although they had a similar occurrence in seed tree cover types and were only slightly less common in clearcut and shelterwood cover types, occurring more frequently in disturbed than in undisturbed forest in the northern Rocky Mountains. Intermediate successional stages are generally not suitable (Kotliar, 2007).

Key stressors

These are the same as those listed in section 3.7.4., subsection "Burned forest and dead tree habitats."

Key indicators

In addition to the key indicators addressed in section 3.7.4, subsection "Coniferous forest habitats," the key indicator for species generally associated with burned forests, where openings are created, applies to the olive-sided flycatcher.

- Key ecosystem characteristics for species associated with burned forest conditions

Environmental consequences

Summary of modeled alternative consequences

In order to assess key aspects of olive-sided flycatcher habitat, Ecosystem Research Group modeled the effects of the alternatives on the natural range of variation and effects of alternatives (see appendix 3 for more details). The natural range of variation was modeled going back about 1,000 years, and the effects of the alternatives were projected for the next 50 years, including anticipated changes in climate and the fire suppression logic of the model. Two distinct tree size classes were examined:

- the 0-5-inch d.b.h. size class: all canopy covers 15-100 percent were modeled as openings
- the > 9-inch d.b.h. size class: 15-69.9 percent canopy cover was modeled as mature

Olive-sided flycatchers require edges between openings and stands of mature forest. Modeling of olive-sided flycatcher habitat predicts that all alternatives will stay within the minimum and maximum range of the natural range of vegetation over the five-decade time period and that acreages of modeled habitat will increase continuously through decade 5. The range between maximum and minimum levels of habitat is relatively large, which parallels the maximum levels of modeled fire through the five-decade period. The natural range of variation of modeled habitat ranges from about 450,000 to 1.3 million acres out of approximately 2.4 million acres on the Forest, a large range. There are minor differences in alternatives because wildfire, prescribed fire, commercial thinning, and timber harvest can all create the habitat conditions this species requires. Consequently, even considering some uncertainty in the degree to which forests will burn rather than succumb to insects and disease in the future, modeled habitat for olive-sided flycatchers would be abundant on the Forest (see appendices 2 and 3 for more details).

Effects common to all alternatives

All action alternatives have over 1 million acres of wilderness as well as standards or guidelines for retention of live trees and snags outside of wilderness, which provides habitat quality for olive-sided flycatchers.

Cumulative effects

In the future, areas outside the wildland-urban interface in the cool-moist and cold potential vegetation types are likely to have stand-replacing wildfires that would create high-quality habitat for wildlife such as the olive-sided flycatcher. However, habitat acres are likely to be highly variable from decade to decade because forests in these potential vegetation types have a tendency to burn with high severity on a median fire return interval of 100 years or more (Sneck, 1977). Because olive-sided flycatchers feed on insects in the air, more open canopy conditions after fire or timber harvest could facilitate feeding. Because birds adapted to post-fire conditions are generally mobile species, they are able to move to new locations as vegetation changes with changes in climate and fire (USDA, 2010c).

3.7.5 Threatened, endangered, proposed, and candidate wildlife species

The consequences of alternatives for the wolverine, grizzly bear, Canada lynx, and Canada lynx critical habitat are addressed in this section of the final EIS. On the Forest, federally listed threatened or endangered species and their critical habitat would continue to be managed and protected in accordance with requirements of the Endangered Species Act, Forest Service policy, and all applicable State and Federal laws. Four alternatives, A-D, are analyzed. Alternative A is the 1986 forest plan, as amended, and accounts for current laws, regulations, and nondiscretionary terms and conditions included in programmatic USFWS biological opinions. Consultation with the USFWS on listed species plan components takes place at the programmatic level, whereas consultation on implementation will take place at the project level.

Grizzly bear

Introduction

The grizzly bear was listed as a threatened species under the Endangered Species Act in the lower 48 States in 1975. The Grizzly Bear Recovery Plan (USFWS, 1993) identified recovery goals, objectives, and tasks necessary for recovery of the species. In 2011, USFWS completed a five-year status review and estimated that the overall population size had increased to about 1,500 grizzly bears in the lower 48 States (USFWS, 2011c). Grizzly bears are known to exist in four identified recovery zones: the Northern

Continental Divide, Greater Yellowstone, Cabinet-Yaak, and Selkirk Ecosystems. Of these, the Northern Continental Divide Ecosystem provides for the largest grizzly bear population.

The Grizzly Bear Recovery Plan (USFWS, 1993) specifically called for development of a conservation strategy so that continuity and consistency of management would be provided following delisting. The USFWS began working with multiple agencies in the NCDE in 2009 to develop a habitat management strategy to support a viable population of grizzly bears in the NCDE. Although NFS lands provide a majority of the habitat for grizzly bears in portions of the NCDE area, grizzlies are a wide-ranging species affected by activities on private and other agency lands that can have impacts on their populations. Representatives of MFWP, the Montana Department of Natural Resources and Conservation, the Blackfeet Nation, the Confederated Salish and Kootenai Tribes, Glacier National Park, the USFS, the USFWS, the U.S. Geological Survey, and the Bureau of Land Management were appointed as members of the Interagency Conservation Strategy Team. Their goal was to describe the management and monitoring programs that would maintain a recovered grizzly bear population in the NCDE.

In 2013, USFWS announced the availability of the draft Northern Continental Divide Ecosystem Grizzly Bear Conservation Strategy (hereafter "draft Grizzly Bear Conservation Strategy") for public review and comment. In preparation for delisting, a conservation strategy often is developed to ensure that appropriate protections will be in place to maintain the recovered population into the future. When finalized, the conservation strategy will not change the legal status of grizzly bears in the NCDE. The intent is to support delisting under the Endangered Species Act by demonstrating the agencies' ongoing commitment to conserve the species. The grizzly bear recovery plan acknowledges that maintenance of a healthy, recovered grizzly bear population will depend on effective, coordinated management. Each of the signatories to the final Grizzly Bear Conservation Strategy will contribute to and cooperate as appropriate with its mission and jurisdiction. It is intended to provide a cohesive umbrella for all signatories to operate under, but each signatory has its own legal process and authority to implement the conservation strategy (USFWS, 2013c).

The draft Grizzly Bear Conservation Strategy is intended to provide the regulatory framework for conservation of the grizzly bear and contains habitat-related management direction that pertains to the portions of the Flathead, Helena-Lewis and Clark, Kootenai, and Lolo National Forests that are located within the NCDE (see figures B-10 and 1-74 through 1-78). Alternatives B modified, C, and D of the Flathead's revised forest plan incorporate habitat-related elements of the draft Grizzly Bear Conservation Strategy that are relevant to the management of NFS lands. The USFS coordinated and consulted with the USFWS throughout the process of developing plan alternatives and will continue to do so throughout the NEPA process (USDA, 2014c, 2015a, 2015b, 2016b). The alternatives incorporate a management framework to contributed to recovery of the NCDE grizzly bear population, within the inherent capability of the plan area and USFS authority (36 CFR § 219.1(g)). The Forest Service is using the best available scientific information at this time.

The USFWS gathered public comments on the draft Grizzly Bear Conservation Strategy, with the public comment period beginning on May 2, 2013. In addition, a notice was published in the Federal Register on May 11, 2016 notifying scientists and other interested parties that they would have the opportunity to submit oral or written comments on habitat-based recovery criteria for the NCDE grizzly bear population. On July 7, 2016, the USFWS conducted a workshop with oral presentations by the public and also accepted written comments. The USFWS is currently working on the draft habitat-based recovery criteria and Grizzly Bear Conservation Strategy for the NCDE. When the USFWS finalizes its documents for the NCDE, the Forest Service will assess them to determine whether there are substantive differences from the Flathead's revised forest plan or amended forest plans and, if so, will follow established procedures to make any needed changes.

The grizzly bear is a conservation-reliant species (Scott et al., 2005), and the expectation is that the Grizzly Bear Conservation Strategy would remain in effect beyond recovery, delisting, and the five-year monitoring period required by the Endangered Species Act. The agencies signing the conservation strategy would be committed to be responsive to the needs of the grizzly bear through adaptive management actions based on the results of annual population and habitat monitoring. Forest Service responsibilities for monitoring are specified in chapter 5 of the forest plan for the Flathead National Forest and the monitoring sections for the amendment forests. Monitoring would help to determine whether plans need to be adjusted in the future.

Forest plan components such as standards and guidelines apply only to those lands under Forest Service jurisdiction. USFS plan components are written to conform to requirements of the 2012 planning rule. All alternatives consider Forest ecosystems, key ecosystem characteristics, and ecological conditions to support the NCDE grizzly bear population. All alternatives were developed and analyzed consistent with the NEPA. Alternatives are based upon public and agency comments, differing in the range of future actions that could occur and the extent of their application.

Methodology and analysis process

The diversity of habitats for grizzly bears on the Forest are discussed in sections 3.2, 3.3, and 3.7. In section 3.7.4, plan alternatives are assessed in terms of differences in key terrestrial ecosystem characteristics (vegetation composition, structure, function, pattern, and connectivity) as well as key characteristics of aquatic, wetland, and riparian habitats. Coarse-filter plan components addressed in section 3.7.4 provide for habitat diversity that benefits grizzly bears. Appendix C of the forest plan also includes possible strategies and management approaches to promote grizzly bear foods and other diverse habitat conditions at the project level. Key indicators for analysis specific to the grizzly bear are listed in the section below on consequences of alternatives.

Spatial and temporal analysis

The anticipated life of the forest plan is about 15 years. However, because management actions have the potential to affect wildlife species and their habitats for many decades, the temporal analysis for modeled vegetation change (discussed throughout the final EIS) considers changes that may occur over the next 50 years as environmental conditions change and vegetation moves from one successional stage to another.

The analysis area for indirect effects of the forest plan is the area comprised of the geographic areas of the Flathead National Forest, encompassing the Forest's portions of the grizzly bear management zones identified in the draft Grizzly Bear Conservation Strategy. The Forest includes portions of the recovery zone/primary conservation area and zone 1 (see figure B-10). The recovery zone/primary conservation area and the Forest's portion of zone 1 (including the Salish demographic connectivity area) encompasses the basic area of the current, known grizzly bear population and its distribution on the Forest (Costello, Mace, & Roberts, 2016). Each of the management zones has its own grizzly bear management goals.

Because grizzly bears are wide-ranging and the decision to be made encompasses multiple national forests, the analysis area for grizzly bear cumulative effects encompasses the NCDE management zones for multiple national forests (see figures B-10, 1-74 through 1-78) (USFWS, 2013c). The number of acres in each management zone for each national forest in the NCDE cumulative effects analysis area is displayed in table 56. The cumulative effects analysis can be found in chapter 6 of the final EIS.

Table 56. Acres of NFS land included within the NCDE recovery zone/primary conservation area (PCA); zone 1, including the demographic connectivity areas (DCAs), zone 2, and zone 3. The percent of total acres across all ownerships in each management zone is shown in parentheses.

National Forest	Recovery zone/PCA acres (percent)	Zone 1 including DCAs (percent)	Zone 2 acres (percent)	Zone 3 acres (percent)
Flathead	2,136,536 (37%)	231,548 (5%)	—	—
Helena	183,758 (3%)	149,207 (3%)	642,786 (14%)	5,792 (< 1%)
Kootenai	118,770 (2%)	283,302 (6%)	—	—
Lewis and Clark	777,963 (14%)	6 (< 1%)	2 (< 1%)	972,612 (8%)
Lolo	268,390 (5%)	386,274 (8%)	38 (< 1%)	—

Lands managed by the USFS make up approximately 60.9 percent (3,840,415 acres) of the grizzly bear recovery zone/primary conservation area within the NCDE, which is further divided into areas called bear management units (see figure 1-71) that are in turn divided into bear management subunits (see figures 1-74). Some plan components apply to management zones, some apply to bear management units, and some apply to bear management subunits. Grizzly bear subunits were designated across the national forests in the NCDE to approximate an average female home range size. Bear management subunits are not intended to represent actual female home ranges.

Information sources and incomplete or unavailable information

Since the draft Grizzly Bear Conservation Strategy was published, information on the amount and distribution of secure core habitat, motorized route densities, developed recreation sites, and livestock allotments was updated by the NCDE GIS specialist, based upon input from multiple land managers within the NCDE. Some updated data reflects new on-the-ground conditions, but some data has changed due to factors such as better knowledge or realignment of GIS data layers, even though no actual change has occurred on the ground.

Some members of the public commented on incomplete information about roads, trails, and dispersed recreation sites. The Forest acknowledges that information about roads and trails is incomplete. The Forest is over 2 million acres, and the Forest continues to learn about user-created trails, both motorized and nonmotorized, as well as roads that have not had recent field surveys. Additionally, the Forest does not have complete knowledge of all roads on lands it acquired in the Swan Valley through the Montana Legacy Project. The inventory used for calculations of the Forest road and trail densities is based upon the USFS INFRA database. The USFS periodically updates the INFRA database as new aerial images and field data, such as the type or location of road closures or stream-aligned culverts, become available. The Forest also acknowledges that information on dispersed recreation sites is incomplete. Most of the Forest is open to dispersed recreation, so the sites receiving dispersed use, as well as the amount of use or season of use, are always changing.

Information on the Flathead National Forest (such as potential for mineral and energy development, fire, timber harvest, fuels reduction, thinning, planting), was obtained from a variety of sources, as explained throughout the final EIS. Grizzly bear population ecology, biology, habitat descriptions, and relationships identified by research are described in detail in the biological assessment (Kuennen, Van Eimeren, & Trechsel, 2017) and USFWS biological opinion (USFWS, 2017b), which are available on the Flathead National Forest's forest plan revision website (www.fs.usda.gov/goto/flathead/fpr). The biological assessment, the final EIS and its appendices, the reference sections of the plan's set of documents, and the planning record all document the Forest's consideration of the breadth of relevant scientific information and use of the best available scientific information.

Affected environment

The following description of the affected environment provides a summary of scientific information in the context of the NCDE, focusing on the Flathead National Forest and information needed to respond to public comments and understand the consequences of the alternatives.

NCDE grizzly bear population, distribution, and status

The Grizzly Bear Recovery Plan (USFWS, 1993) established minimum goals for a population of grizzly bears that is (1) adequately distributed throughout the recovery zone, (2) reproducing, and (3) able to sustain existing levels of human-caused mortality (p. 26). To facilitate the assessment of the grizzly bear population recovery goals and objectives, 23 bear management units were delineated in the NCDE, of which 12 are located on or partially on the Flathead National Forest.

The population subgoals for the NCDE grizzly bear recovery zone are listed in the Grizzly Bear Recovery Plan (USFWS, 1993, p. 59) as follows:

10 females with cubs inside Glacier National Park and 12 females with cubs outside Glacier National Park over a 6-year running average both inside the recovery zone and within a 10-mile area immediately surrounding the recovery zone;

21 of 23 bear management units occupied by females with young from a running 6-year sum of observations, with no two adjacent bear management units unoccupied;

Known human-caused mortality not to exceed 4 percent of the population estimates based on the most recent 3-year sum of females with cubs, and no more than 30 percent of the 4 percent mortality limit shall be females;

These mortality limits cannot be exceeded during any 2 consecutive years for recovery to be achieved;

Occupancy in the Mission Mountains portion of the ecosystem.

However, as described in the five-year status review of the grizzly bear (USFWS, 2011c, p. 16), sightability of females with young has always been a challenge in this heavily forested ecosystem. In addition, there was a lack of consistency in data collection and survey effort (Costello et al., 2016). For these reasons, the USFWS discontinued recording the number of females with cubs and their distribution in the NCDE as of 2004. Instead, the USFWS has relied on new science and techniques developed through an extensive DNA-based population estimate (Katherine C. Kendall et al., 2009) and a study of radio-collared bears sampled proportionately to relative population density, enabling calculation of reproductive rates, survival rates, and population trend (R. D. Mace et al., 2012). Subsequent work by Costello et al. (2016) has further refined the methods used for monitoring and reporting population distribution and vital rates, including an estimate of unreported mortalities, and population trend. The following summarizes the findings of these and related studies of population trend, distribution, survival, and mortality in the NCDE.

The Grizzly Bear Recovery Plan identified a minimum NCDE-wide grizzly bear population of 391 bears. In 2004, Kendall and others (2009) conducted a genetic capture/recapture study that encompassed the entire NCDE recovery zone/primary conservation area as well as adjacent areas thought to be inhabited by bears. The mean population estimate was 765 bears (95 percent confidence interval = 715-831), including all age classes. The male population estimate was 295 individuals (95 percent confidence interval = 276-324), and the female population estimate was 471 individuals (95 percent confidence interval = 427-531). The estimated population exceeded the recovery goal. In 2014, the population estimate for the NCDE was 960 grizzly bears (Costello et al., 2016). All population estimates for the

NCDE (Costello et al., 2016; Katherine C. Kendall et al., 2009) indicate the grizzly bear population is above the minimum thresholds needed for population persistence (see Kuennen et al., 2017 for more details).

Multiple methods and estimates indicate that the NCDE grizzly bear population is growing. Costello's analyses resulted in estimates that differ slightly from Mace and others (2012) and led to a slightly lower estimate of the annual rate of population growth (λ = 1.023, or about 2 percent) for the NCDE grizzly bear population than that previously reported (λ = 1.031, or about 3 percent) (R. D. Mace et al., 2012). Costello and others (2016) stated, "We do not believe the observed difference in the two estimates is a result of actual population change. Our current models include a covariate for trend, and no negative trend was observed in any of the vital rates. Rather, we believe that the differences between Mace et al. (2012) and this report can be attributed to: (1) an increase in sample sizes for estimation of all vital rates; (2) better representation of conflict females in the estimation of vital rates; and (3) subtle but significant differences in methods of analysis" (p. 101).

To maintain a healthy grizzly bear population in the NCDE, it is necessary to have a balance between reproduction and mortality (USFWS, 2013c). Grizzly bear reproduction and survival in the NCDE is monitored within the recovery zone/primary conservation area and zone 1. It is influenced by age, sex, reproductive status, and management history (i.e., years since last management action). Costello and others (2016) estimated the number of annual grizzly bear mortalities during 2004-2014 as the sum of (1) management removals, (2) radio-marked losses, and (3) estimated total reported and unreported losses of non-radio-collared bears. Mortalities have a variety of causes and fluctuate from year to year, but despite mortalities, the survival rate for adult females (the most important group affecting population trend) is high, at 0.947 with a 95 percent confidence interval of 0.919-0.972 (Costello et al., 2016). During the 11-year study period, estimated mortality thresholds, consistent with population stability or growth, were not exceeded during any two consecutive years within the Recovery Zone/Principal Conservation Area and Zone 1 (Costello et al., 2016).

The trend in grizzly bear mortalities on NFS lands is downward, but the trend on private lands is upward. Within the Forest's geographic areas, the number of grizzly bear mortalities on NFS lands per decade declined from about 100 in the decade from 1976-1985 to 28 in the most recent decade (2006-2015). Within the Forest's geographic areas, the number of grizzly bear mortalities per decade on lands other than NFS lands has increased from about 20 in the decade from 1976-1985 to 55 in the most recent decade from 2006-2015. These totals do not include bears that were determined to have died of natural causes or those that were counted as mortalities because they were trapped by professional bear managers for purposes such as augmentation of the Cabinet-Yaak grizzly bear ecosystem.

In the NCDE, the most frequent known causes of documented human-caused mortalities of independent-aged grizzly bears during 2004–2014 were listed as management removals, poaching/malicious kills, and defense of life. Accounting for the fact that management removals are documented with 100 percent accuracy whereas other deaths often go unreported, Costello and others (2016) estimated that poaching/malicious kills likely accounted for the highest proportion of total independent-aged bear mortality (27 percent), followed by management removals (16 percent), illegal defense of property (11 percent), and natural causes (9 percent). The majority of management removals result from conflicts at sites associated with frequent or permanent human presence (USFWS, 2013c). Unsecured grizzly bear attractants at sites associated with frequent or permanent human presence include attractants such as chicken coops, garbage, human foods, pet/livestock foods, bird food, livestock carcasses, wildlife carcasses, barbeque grills, compost piles, orchard fruits, or vegetable gardens, found mostly on private lands.

Walters and Holling (1990) stated that managing human-caused mortality, monitoring both population and habitat parameters (e.g., road access), and responding when necessary with adaptive management are the best ways to ensure a healthy grizzly population. Management of human-caused mortality is ongoing, as is population and habitat monitoring (see chapter 5, which includes monitoring of habitat parameters on the Flathead National Forest).

Mace and Roberts (2011) mapped the distribution of grizzly bears in the NCDE. The grizzly bear population has now expanded well beyond the recovery zone/primary conservation area, another indication of population growth (see the biological assessments for the revised Flathead National Forest plan and for the amendment forests for more details: Kuennen, Van Eimeren, and Trechsel (2017) and Warren, Van Eimeren, and Trechsel (2017)). The current distribution is about 21,313 square miles, covering the entire recovery zone/primary conservation area, most of zone 1, and parts of zones 2 and 3 (Costello et al., 2016).The mapped distribution of NCDE grizzly bears now encompasses the Salish demographic connectivity area and about 63 percent of the Ninemile demographic connectivity area. Using all of the verified grizzly bear locations from 2004-2014 (N = 210,126), Costello and others (2016) estimated that the total distribution area for grizzly bears had increased 139 percent from the area of the recovery zone/primary conservation where bear distribution was estimated prior to 1993 (USFWS, 1993). Grizzly bears are also distributed across the NCDE bear management units (Katherine C. Kendall et al., 2009; R. D. Mace & Roberts, 2011). Costello and others evaluated occupancy of the 23 bear management units in the NCDE by females with offspring during 2004-2014. They documented full occupancy of the recovery zone/primary conservation area starting in 2009 (Costello et al., 2016). On the Forest, grizzly bears occupy an area of the recovery zone/primary conservation area totaling over 2.1 million acres and an area outside the recovery zone/primary conservation area totaling about 231,000 acres (see table 56), including the Salish demographic connectivity area in zone 1 (see figure B-10 in the forest plan).

Grizzly bear densities and home range sizes are variable across the NCDE. Grizzly bear home ranges overlap and change seasonally and annually and based on reproductive status. Grizzly bear densities within the NCDE are generally highest in Glacier National Park and on adjacent national forest lands (including the Flathead National Forest) and decrease toward the southern portion of the ecosystem (Katherine C. Kendall et al., 2009). Mace and Roberts (2012) evaluated the home ranges of 34 female grizzly bears that lived in or adjacent to Glacier Park, based upon data collected from 2004-2011. Most home ranges (59 percent) straddled the Park boundary, overlapping lands managed by the Flathead National Forest, the Helena-Lewis and Clark National Forest, and the Blackfeet Tribe. Home ranges were, on average, smallest for bears that lived 100 percent within the Park and larger for females that straddled the Park boundary.

In summary, available information documents increases in grizzly bear distribution and population size. The estimated population size was 765 bears in 2004 (Katherine C. Kendall et al., 2009), nearly double the target of 391 bears that was based on sightings of females with cubs (USFWS, 1993). Mortality has been at an acceptable level based on ongoing research and monitoring, showing that the NCDE grizzly bear population has been stable to increasing and expanding its distribution (Costello et al., 2016). Montana Fish, Wildlife and Parks will monitor grizzly bear populations, including grizzly bear-human conflicts, reproduction, mortality, and population trend. Triggers will be established in the final conservation strategy. As stated in the draft Grizzly Bear Conservation Strategy (USFWS, 2013c):

> Intensive information has been generated in the NCDE about the status of the grizzly bear population. These data indicate that the demographic and distribution criteria, as outlined in the *Revised Grizzly Bear Recovery Plan* (USFWS 1993) have been greatly surpassed. Agencies responsible for management will continue their commitment to careful population monitoring and

> data collection to demonstrate that a healthy and biologically viable population is being maintained. (p. 34).

NCDE—Genetic and demographic connectivity

The draft Grizzly Bear Conservation Strategy includes demographic criteria aimed at maintaining a healthy, widely distributed, and genetically diverse grizzly bear population, with high adult female survival and sustainable mortality limits. The draft Grizzly Bear Conservation Strategy also addresses demographic connectivity between U.S. grizzly bear ecosystems. The Flathead National Forest contains a portion of the Salish demographic connectivity area. The Salish demographic connectivity area has an objective of providing genetic connectivity between the NCDE and the Cabinet-Yaak Grizzly Bear Ecosystem to the west, through occupancy by female grizzly bears, but at a lower bear density than in the primary conservation area. The Salish demographic connectivity area is currently occupied by female grizzly bears (Costello et al., 2016).

Connectivity of grizzly bear populations has been examined at multiple scales. At an international scale, Proctor and others (2015) studied connectivity between the United States and Canada using genetic testing and movement data from radio-collared grizzly bears, with data gathered between 1979 and 2007. Both male and female grizzlies moved freely across the United States/Canada border on the northern edge of the NCDE (including the Forest). The authors concluded there is currently little risk of significant reduction in the present high levels of genetic diversity in the NCDE grizzly bear population. Within the NCDE, few barriers to grizzly bear genetic exchange appear to exist. Both male and female movements have been documented across existing highway corridors. Researchers concluded that habitat connectivity is within levels that ensure both demographic and genetic connectivity (Miller & Waits, 2003; Waller & Servheen, 2005). Well-connected populations improve the probability of persistence for small populations (M. F. Proctor et al., 2015) and also help to mitigate the potential impacts on the grizzly bear from a changing climate, increasing resiliency to demographic and environmental variation (USFWS, 2011c).

Grizzly bear habitat introduction

In order to put the affected environment in context, the grizzly bear management zones in the draft Grizzly Bear Conservation Strategy are used to describe the affected environment. In total, grizzly bear habitat on the Flathead National Forest comprises nearly 40 percent of the NCDE grizzly bear recovery zone/primary conservation area ((USFWS, 2013c), Table 57 displays the approximate acreage in each geographic area on the Flathead National Forest within NCDE grizzly bear management zones, totaling about 2.4 million acres.

Table 57. Grizzly management zones within geographic areas (GAs) on the Flathead National Forest

Grizzly Habitat Classification	North Fork GA	Middle Fork GA	South Fork GA	Hungry Horse GA	Salish Mountains GA	Swan Valley GA	Total Forest
Recovery zone/primary conservation area	319,998	370,156	789,074	286,229	6,781	490,824	2,136,534 (90%)
Zone 1: Salish demographic connectivity area	0	0	0	0	95,840	0	95,840 (4%)
Zone 1 outside Salish demographic connectivity area	43	0	0	5	135,516	143	135,702 (6%)

Grizzly bear habitat on the Flathead National Forest and elsewhere in the NCDE provides a high diversity of habitat, including diverse potential vegetation types distributed across the six geographic areas (see figures B-04 through 09). Grizzly bear habitat includes coniferous forests, deciduous forests, wetland and riparian areas, talus, and grass/forb/shrub patches found in areas such as meadows, avalanche chutes, burned areas, and logged areas. The natural range of variation for grizzly bear habitat has been affected by ecological processes in the past (e.g., fire, floods, avalanches, insects, and disease) and will continue to be affected by these processes in the future. For example, wildfire and avalanches are ecosystem processes that create habitats with abundant bear foods. In northwest Montana, Zager and others (1983) found that grizzly bears foraged in fruit-producing shrubfields in post-fire habitats disproportionately in the summer and autumn. Hamer and Herrero (1987) suggested that forest disturbance created conditions for diverse early-successional plant communities that benefited grizzly bear foraging in Alberta. The quantity and quality of grizzly bear habitat within the Forest and elsewhere in the NCDE consists of a diverse, ever-changing vegetation and landscape mosaic providing a variety of foods, cover conditions, denning habitat, habitat security, habitat connectivity, and vast areas of space for this wide-ranging species.

Grizzly bear habitat—Foods and cover

Grizzly bears are an omnivorous and opportunistic species that has adapted to the natural range of variation in foods, and they are not reliant on any one food (USFWS, 2013c). High-energy food items used by grizzly bears occur across a range of habitats, so if ecosystem processes or changes in climate make one food item less available, other food items are likely to be used. Grizzly bears are known to switch foods according to which foods are available (Aune & Kasworm, 1989, p. in USFWS 2013; Katherine C Kendall, 1986; LeFranc Jr., Moss, Patnode, & Sugg III, 1987; R. D. Mace & Jonkel, 1986; Martinka & Kendall, 1986; Servheen, 1981). Grizzly bears will consume almost any food available, including living or dead mammals or fish, insects, worms, plants, berries, human-related foods, and garbage (Knight, Blanchard, & Mattson, 1988; D. J. Mattson, Blanchard, & Knight, 1991; C. C. Schwartz, Miller, & Haroldson, 2003). The search for energy-rich food appears to be a driving force in grizzly bear behavior and habitat selection. Grizzly bears are large animals with high metabolic demands during the non-denning season. Adequate nutritional quality and quantity are important factors for successful reproduction (USFWS, 1993, as amended). Habitat diversity on the Forest provides a wide variety of vegetation types and bear foods that meet the needs of grizzly bears as the seasons and available foods change.

Food production and grizzly bear use of foods changes seasonally. Upon den emergence in the spring, bears may remain at higher elevations and search avalanche chutes for animal carcasses buried by the snow before descending to lower elevations to seek newly emerging vegetation such as grasses, forbs, and sedges (Aune & Kasworm, 1989; Katherine C Kendall, 1986; LeFranc Jr. et al., 1987; R. D. Mace & Jonkel, 1986; Martinka & Kendall, 1986; Servheen, 1981). As snow melts, grizzly habitat use extends to higher elevations. In the western portion of the NCDE, including the Flathead National Forest, riparian and wetland habitats (Ruby, 2014) and avalanche chutes are important to bears during summer and autumn (R. D. Mace & Waller, 1997). Avalanche chutes are widely distributed and abundant in the NCDE, with the majority of acres occurring in Glacier National Park as well as in the adjacent Flathead and Helena-Lewis and Clark National Forests. During the summer, grizzlies also feed on army cutworm moths and ladybird beetles on the rocky talus areas at high elevations of the Forest, as well as on the adjacent Helena-Lewis and Clark National Forest, tribal lands of the Confederated Salish and Kootenai Tribes, and Glacier National Park lands (Aune & Kasworm, 1989; Craighead & Mitchell, 1982; Klaver et al., 1986; Servheen, 1983; Sumner & Craighead, 1973; J. White, Don, Kendall, & Picton, 1998). Once berries become available in the summer, grizzlies consume a wide variety of berries found on the Forest and elsewhere in the NCDE, including huckleberries, buffaloberries, serviceberries, hawthorn berries, chokecherries, and, to a lesser degree, alderleaf buckthorn berries and mountain ash (Katherine C

Kendall, 1986; LeFranc Jr. et al., 1987; R. D. Mace & Jonkel, 1986; Martinka & Kendall, 1986; Bruce N. McLellan & Hovey, 1995; Servheen, 1981). These diverse berry-producing shrubs provide ripe fruit at various times throughout the summer and fall months, ripening at lower elevations first and progressing upslope. The amount and species of berries in bear diets vary annually based on annual fruit production and distribution (Bruce N. McLellan & Hovey, 1995), which are influenced by environmental variables (Simonin, 2000). In northwest Montana, the production of berries is affected by forest canopy cover, temperature, and soil moisture conditions, which can vary considerably from low to high elevations and from year to year.

Prior to the spread of white pine blister rust, grizzlies in the NCDE fed on whitebark pine seeds from late summer through fall when and where they were available (Aune & Kasworm, 1989; Katherine C. Kendall & Arno, 1990; R. D. Mace & Jonkel, 1986; Shaffer, 1971). However, data on whitebark pine mortality rates from the early to mid-1990s indicated that 42–58 percent of all whitebark pine trees surveyed within the NCDE were dead (Katherine C. Kendall & Keane, 2001) and were no longer producing seeds. Recent remeasurement showed that mortality of whitebark pine trees has more than doubled in the past two decades (Halofsky et al., in press). Despite this loss, the NCDE grizzly bear population is healthy, illustrating the flexibility of grizzly bear diets and high habitat diversity in the NCDE (USFWS, 2013c).

Grizzly bears are also known to feed on animal matter, especially in the fall. Teisberg and others found that fall diets of NCDE grizzly bears consist of higher amounts of meat, such as portions of carcasses left by hunters (32 percent for adult males, 21 percent for adult females) (Teisberg, Madel, Mace, Servheen, & Robbins, 2015). Mace and Roberts (2013) found that grizzly bear diets include more animal matter towards the southern and eastern periphery of the NCDE and more plant matter in the northern and western portions of the NCDE. This pattern is presumed to reflect, at least in part, natural environmental gradients across the NCDE that influence habitat productivity (R. D. Mace & Roberts, 2013).

Because most of the Forest is heavily forested, processes such as wildfire or timber harvest (and other vegetation management activities that affect canopy cover) affect grizzly bear food production over time. Large areas burned by wildfire in recent decades are widely distributed across the NCDE, including the Flathead National Forest, and generally provide high-quality habitat for grizzly bear foraging for a few decades until a coniferous tree canopy reduces light that can, in turn, reduce food production (Kuennen et al., 2017).

Some members of the public have expressed a concern that the amount of high-energy bear foods needed to support a recovered population of grizzly bears in the NCDE has not been quantified. A mosaic of forest successional stages and vegetation providing foods and cover is desirable, but it is difficult to quantify a desired landscape composition. Grizzly bear access to food resources and foraging efficiency is influenced by the ever-changing landscape as well as by increasing bear density, and thus bear populations are likely limited by social factors of the grizzly bear population more than by any limitation of food biomass itself (Bruce N. McLellan, 1994). Available foods, roads, and human activities can also interact in their effects on grizzly bears. McLellan (2015a) studied the interaction of roads, human activities, and food sources for grizzly bears over a 30-year time period in a multiple-use landscape in British Columbia that had high levels of human activity (including logging, gas exploration, and grizzly bear hunting). McClellan stated that a significant implication of his study is that the abundance of a high-energy food source growing in undisturbed portions of his study area enabled the grizzly bear population to increase in spite of intense industrial development and the highest density of hunter-killed grizzly bears in British Columbia. Once the high-energy food source declined, the grizzly bear population declined because of reduced reproduction (either directly or indirectly). He stressed that managers should identify which high-energy foods are important in various ecosystems and try to maintain or enhance these foods while reducing human access into habitats where they are abundant. High-energy foods have been identified for the NCDE, and human access has been reduced in many areas where diverse habitats providing grizzly bear foods are abundant (Kuennen et al., 2017; N. Warren et al., 2017).

To examine grizzly bear abundance in relation to bear foods and other habitat factors (such as mesic habitats), Graves and others (2012) studied an area spanning the NCDE that was centered over Glacier National Park. Bear abundance was determined based upon genetic detection using rub trees and hair traps. Graves and others (2012) found that amounts of mesic habitat, historical presence of bears, and bear management level (as defined by experts) were most closely associated with both male and female grizzly bear abundance. In addition, the amount of meadow and shrub habitat was closely associated with female grizzly bear abundance (see table 3 in T. A. Graves et al., 2012). The analysis by Graves and others indicates that habitat types rich in bear foods are widespread across the NCDE. See the biological assessments for more details (Kuennen et al., 2017; N. Warren et al., 2017).

Because of the complexity of factors influencing grizzly bear use of high-energy foods, the draft Grizzly Bear Conservation Strategy proposes to monitor grizzly bear body condition to assess any changes in the overall assimilated diet of grizzly bears.(USFWS, 2013c, pp. 78-79). Body condition data would be collected by MFWP and would provide insight into possible changes in food availability over time. Teisberg and others studied current grizzly bear population health and body condition, finding that adult females across all ecoregions of the NCDE enter dens at mean fat levels above those thought to be critical for cub production. They stated that there is no evidence to conclude that the widely varying food resources across the NCDE are inadequate to meet the needs of reproductively active adult females. As truly opportunistic omnivores, grizzly bears in all regions of the NCDE exploit diverse combinations of food items to arrive at productive body conditions (Teisberg et al., 2015). Although some bears seek foods associated with humans, monitoring of grizzly bear body condition, reproduction, and mortality indicates that the overall availability of diverse, high-energy bear foods is supportive of grizzly bear population recovery in the NCDE.

Cover is another component of habitat that is important to grizzly bears. Cover provides grizzly bears with shade on hot days, reduces potential disturbance from noise and human activity, and contributes to habitat connectivity (B. N. McLellan & Shackleton, 1989). On the heavily-forested Flathead National Forest, cover is quickly re-established after most disturbances and is generally not limiting. The greatest temporary impact on forest cover and its connectivity in the Flathead National Forest geographic areas, considering all land ownerships, is wildfire (for more details on cover, see USDA, 2014b, figures 34 and 53, pp. 139-143). Beginning in the 1980s, there was an increase in stand-replacing wildfires on the Forest, with sizes ranging up to about 50,000 acres. A high percentage of the South Fork and North Fork geographic areas have been burned by wildfire (about 20 percent of all land ownerships), whereas a low percentage of the Swan Valley and Salish Mountains geographic areas has been burned by wildfire (about 3 percent of all land ownerships). Timber harvest also has temporary impacts on cover but has affected much smaller patches than wildfire. As of 2000, the most recent year for which LANDFIRE data was available, the Salish Mountains geographic area had the highest percentage of area recently harvested (about 9 percent of all land ownerships), the Swan Valley geographic area had a moderate amount (about 6 percent of all land ownerships), and the Middle Fork geographic area had the lowest (less than 1 percent of all land ownerships). On the Hungry Horse and North Fork geographic areas, about 2 percent of all land ownerships had recently been harvested.

Grizzly bear habitat and human developments

Human developments (the developed human footprint) can affect habitat for grizzly bears as well as the risk of human disturbance and/or human-caused mortality. For grizzly bears, areas with higher levels of permanent human development may be associated with avoidance during certain seasons or times of day or higher grizzly bear mortality due to conflicts with humans. Schwartz and others (2010) found that grizzly bear survival in the Greater Yellowstone Ecosystem declined as road density, number of homes, and site developments increased. Habitat connectivity can affect grizzly bears at multiple scales—between grizzly bear ecosystems, within ecosystems, and within a home range.

Permeability refers to the degree to which whole landscapes, encompassing a variety of natural, semi-natural, and developed land cover types, are compatible with wildlife needs and sustain ecological processes. At the landscape scale, effects to grizzly bears occur with respect to permeability and the developed human footprint on other land ownerships, including communities, highways, land converted to agriculture, and other factors (Kuennen, 2017b; TNC, 2016). The Nature Conservancy mapped landscape permeability for the Pacific Northwest (McRae et al., 2016), including the area from the NCDE to the Greater Yellowstone Ecosystem. Overall, the network of Federal lands in northwest Montana provides a moderate to high degree of landscape permeability for grizzly bears (Kuennen, 2015b). See biological assessments for more details (Kuennen et al., 2017; N. Warren et al., 2017).

In the Forest's analysis area, the developed human footprint ranges from less than 1 percent of the South Fork and Middle Fork geographic areas up to about 17 percent of the Salish Mountains geographic area. The Swan Valley geographic area has a moderate but more dispersed human development footprint compared to the Salish Mountains geographic area. In other words, 83-99 percent of each geographic area on the Forest is largely uninhabited by people (for more details on human developments, see USDA, 2014b, pp. 141-143). Grizzly bears generally avoid the developed human footprint in and around the city of Kalispell but may be drawn to residences in smaller rural communities and valley bottoms if attractants are present.

Maintaining large areas of secure habitat is important to the survival and reproductive success of grizzly bears, especially females (R. D. Mace, Waller, Manley, Ake, & Wittinger, 1999; C. C. Schwartz et al., 2010), and is a major goal of the draft NCDE grizzly bear conservation strategy. Throughout the NCDE, large acreages of congressionally designated wilderness provides a high degree of habitat security for grizzly bears. The Wilderness Act of 1964 precludes a variety of activities, including construction of developments such as roads, powerlines, or airstrips; motorized use or mechanized transport; and permanent human habitation (except as specifically allowed by the enabling legislation). New livestock allotments, new mining claims, new oil and gas leases, and other developments that would impair wilderness character are also prohibited (subject to valid existing rights). The NCDE also contains substantial acreage of inventoried roadless areas as well as other lands that have little or no permanent human presence or road development, contributing to secure habitat at a landscape scale. The Mission Mountains Tribal Wilderness is adjacent to the USFS Mission Mountains Wilderness and provides high grizzly bear habitat security and connectivity; Glacier National Park lies in close proximity to the Bob Marshall Wilderness Complex, providing connectivity from Canada to the southern end of the Swan Mountain Range (see figure 1-73). On the Flathead National Forest, a total of about 1.5 million acres inside the recovery zone/primary conservation area is currently designated as wilderness, inventoried roadless area, or other backcountry management area that contributes to high levels of habitat security for grizzly bears (see figures 1-38, 1-01).

Proctor and others (2015) and Weaver (2014) modeled and mapped preferred "linkage habitats" for grizzly bears along highways within the Flathead National Forest and adjacent areas (including Canada) in order to inform management; see also Proctor (2015). Their models and maps were based upon resource selection functions that indicate relative habitat importance. Waller and Servheen studied grizzly bear habitat use along the Highway 2 corridor between Glacier National Park and the Flathead National Forest, evaluating transhighway movements of 42 grizzly bears and relating them to highway and railroad traffic volumes as well as other corridor attributes (Waller & Servheen, 2005). They found that grizzly bears strongly avoided areas within 0.31 mile of the highway and that highway crossing frequency was negatively related to highway traffic volume. Most highway crossings occurred at night when highway traffic volume was lowest (Waller & Servheen, 2005). Waller and Miller also found that traffic volumes had increased when they compared the 1999-2001 study periods and the 2012-2013 periods (Waller & Miller, 2015). Traffic volume increases were most dramatic during the hours in which grizzly bears were most likely to cross the highway; thus, they concluded that suitable highway crossing opportunities have declined along the Highway 2 corridor between Glacier National Park and the Flathead National Forest. Northrup and others studied grizzly bear response to traffic levels in southwestern Alberta. Bears selected areas near roads traveled by fewer than 20 vehicles per day and were more likely to cross these roads. Bears avoided roads receiving moderate traffic (20–100 vehicles per day) and strongly avoided high-use roads (> 100 vehicles per day) at all times (Northrup, Stenhouse, & Boyce, 2012). Similar to Waller and Miller, they also found that traffic patterns caused a behavioral shift in grizzly bears— with increased use of areas near roads and movement across roads during the night when traffic was low. Federal agencies have been cooperating to improve habitat security, connectivity, linkage, and to mitigate impacts of highways and other developments that increase mortality risk and may impede movement by wildlife, including grizzly bears.

Grizzly bear habitat and security

Forest roads can affect grizzly bear habitat security. Grizzly bear habitat security has been modeled and mapped using a variety of methods at a variety of scales (Kuennen & Warren, 2015). Numerous studies using various methods have documented that excessive road density in grizzly bear habitat affects behavior, habitat use, and can lower bears' survival rate during the non-denning season (Boulanger & Stenhouse, 2014; D. J. Mattson, Knight, & Blanchard, 1987; M. Mattson, 1996; Bruce N. McLellan & Shackleton, 1988; Waller & Mace, 1997). Some older studies looked at motorized road use based upon data obtained with weekly telemetry flights, and some newer studies used satellite technology to track a bear's location each half hour or hour. Some studies assessed effects to grizzly bears of all sex, age, and reproductive classes, and others assessed effects on each class. In the Swan Mountain Range on the Forest, Mace and Waller (1996) determined that bears underutilized areas within 500 meters (0.3 mile) of open forest roads with use levels greater than 10 vehicles per day. Based on these findings, security core or secure core habitat in the NCDE is defined as those areas more than 500 meters (0.3 mile) from a motorized access route during the non-denning period and at least 2,500 acres in size. The effects of motorized and nonmotorized trail use on grizzly bears were not part of the Swan Mountain Range study by Mace and others (R. D. Mace, Waller, Manley, Lyon, & Zuuring, 1996) and have not been well studied. Nevertheless, the moving window analysis considers the effects of roads as well as both motorized and high-use nonmotorized trails in the recovery zone/primary conservation area.

Motorized access in the recovery zone/primary conservation area

Research findings from the Swan Mountain Range of the Flathead National Forest have been used to evaluate the effects of motorized access on grizzly bears in the NCDE recovery zone/primary conservation area. In the NCDE recovery zone/primary conservation area, a moving window analysis (see glossary) has been used to assess effects of roads and trails (Kuennen et al., 2017). Mace and others (1996) converted a linear road map to a total road density map using a 1 square kilometer (0.39 square mile) moving window analysis and reported the following relationships to road density:

- road density was lower within the composite of the multi-annual home ranges of 14 adult and subadult female grizzly bears (0.95 mile/square mile) than was road density outside the composite home range (1.7 mile/square mile);
- as total road density increased, the probability of habitat selection by grizzly bears declined;

- 56 percent of the composite female home range was unroaded compared to 30 percent outside the composite home range;
- within seasonal ranges, grizzly bears were more likely to use areas with higher road densities during spring than during other seasons; and
- selection for habitats within a 0.5-kilometer buffer around roads decreased as traffic volume increased.

Based on these and related findings, the Interagency Grizzly Bear Committee established definitions and procedures for analyzing the effects of motorized use, delineating analysis areas that were equivalent to the average size of a female grizzly bear home range. In the NCDE, these were called bear management subunits. The Interagency Grizzly Bear Committee recommended criteria for open and total road densities as well as core habitat within a grizzly bear subunit to support the conservation and recovery of grizzly bears (IGBC, 1998). These recommendations were used as the basis for the percentages for open and total road density and security core for the Flathead forest plan amendment 19, adopted in the 1995 decision notice (USDA, 1995b).

On the Forest, there are 12 bear management units in the recovery zone/primary conservation area that are further subdivided into 73 subunits (see figure 1-31). Of the 73 total grizzly bear subunits on the Forest, 16 are primarily in wilderness, where wheeled motorized vehicle use and mechanized transport are not allowed. The amendment 19 decision applied management direction to 54 of the 73 subunits. Flathead National Forest Plan amendment 19 established a standard for no net increase in total motorized access density or open motorized access density and no net decrease in security core for 54 grizzly bear management subunits. It also established numeric objectives (often referred to as “19-19-68”) to limit high-density (greater than 1 mile/square mile) open motorized access, to limit high-density (greater than 2 miles/square mile) total motorized access, and to provide security core areas that equal or exceed 68 percent of a bear management subunit for subunits with more than 75 percent NFS lands (USDA, 1995b, p. 4). These objectives were to be achieved within ten years. Subsequent consultation with the USFWS identified these objectives as necessary to minimize incidental take, with reasonable and prudent measures to implement a road and motorized trail management program that regulated open and total route density. Incidental take was provided based upon a proposed implementation schedule to achieve the numeric objectives, which was revised in subsequent biological opinions in 2005 and 2014 (USFWS, 2005a, 2014c).

In 1998, after amendment 19 had been adopted for the Flathead National Forest, the NCDE access task group, a group of grizzly bear experts, suggested that (1) the basic premise of managing open and total road densities as well as security core areas during the non-denning period is valid, (2) although amendment 19 is considered effective for managing access in grizzly bear habitat to support recovery of the species, other strategies may also be effective, and (3) seasonal road closures to protect seasonally important grizzly bear habitat can be useful and effective. Since 1998, many other studies of grizzly bear habitat use in relation to roads have been conducted, using a variety of definitions, methods, and statistical techniques.

Between 1995 and 2016, there has been an improved trend in habitat conditions for grizzly bears on the Flathead National Forest. Across the Forest, there are about 3,570 miles of NFS roads. Of this total, the Forest has about 1,580 miles of roads closed with gates (seasonally or yearlong) and about 970 miles of roads closed with barriers. About 730 miles of road have been decommissioned (INFRA database 2016). The availability of secure grizzly bear habitat as well as its connectivity, has greatly increased, benefiting the grizzly bear population. In 1995, 16 of the Forest’s 40 subunits met or exceeded 68 percent security core habitat and by 2016, the number of subunits had greatly increased (USDA, 2016c).

After amendment 19 was adopted, reporting of percentages changed for a variety of reasons. At the time amendment 19 was adopted, 14 subunits had less than 75 percent NFS lands (USDA, 1995a; 1995b, p. 6). These 14 subunits did not have numeric objectives to meet 19 percent open motorized access density, 19 percent total motorized access density, and were not required to meet or exceed 68 percent security core. The number of subunits with greater than or equal to 75 percent NFS lands has now changed because the Forest has acquired more than 45,000 acres of former Plum Creek Timber Company lands through the Montana Legacy Project and other land acquisitions (Kuennen et al., 2017; see figures B-42 and B-43). As a result of land acquisitions and a district court decision related to the Glacier Loon and Buck Holland subunits (USDC-Missoula, 2014), the Forest is now reporting conditions in relation to amendment 19 numeric objectives for 47 rather than 40 subunits (USFWS, 2016b). In these subunits, roads on acquired lands are now classified as NFS roads in the INFRA database, which increases the miles of roads managed by the Flathead National Forest.

The status of these 47 grizzly bear subunits on the Forest which now have at least 75 percent NFS lands is as follows (USDA, 2016c) (see figure 1-37 and table 58; numbers in parentheses are those which would result from decisions that are anticipated to be implemented but have not yet been fully implemented):

> Thirty-seven (37) of 47 subunits meet or are less than 19 percent open motorized route density (32 subunits) or meet site-specifically amended standards (5 subunits),
>
> Thirty-two (32) of 47 subunits meet or are less than 19 percent total motorized route density (31 subunits) or meet site-specifically amended standards (2 subunits),
>
> Thirty-one (31) of 47 subunits meet or are over 68 percent security core (27 subunits) or meet site-specifically amended standards (4 subunits).

Table 58. Access management status of bear management subunits on the Flathead National Forest where NFS lands > 75% (based upon Ake (2017c))

Bear Management Subunit[1]	Percent Open Motorized Access Density—OMAD	Percent Total Motorized Access Density—TMAD	Percent Security Core
Frozen Lake	10	4	80
Ketchikan	14	3	73
Upper Trail	14	4	88
Lower Whale (amended to 37-19-47)	36	17	50
Upper Whale Shorty	12	11	86
Red Meadow Moose	25	17	68
Hay Creek	25	16	55
Coal and South Coal	15	19	73
Werner Creek (amended to 29-19-63)	29	20	63
Lower Big Creek	18	19	71
Canyon McGinnis (amended to 19-33-53)	19	32	50
Peters Ridge	52	25	34
Swan Lake	39	26	45
Lion Creek	18	47	41
Meadow Smith	20 (18)	53	42

Bear Management Subunit[1]	Percent Open Motorized Access Density—OMAD	Percent Total Motorized Access Density—TMAD	Percent Security Core
Buck Holland	24	41	40
Crane Mountain	31	58	25
Piper Creek	19	45 (43)	55
Cold Jim	18	57 (54)	43
Hemlock Elk	6	30 (29)	64
Glacier Loon	22	41	48
Beaver Creek	6	26 (25)	66
Doris Lost Johnny (amended to 57-19-36)	57	19	36
Wounded Buck Clayton (amended to 27-30-65)	27	30	65
Emery Firefighter	19	20 (19)	58 (68)
Riverside Paint	18	16	71
Jewel Basin Graves	19	19	68
Wheeler Quintonkon (amended to 25-19-68)	25	19	68
Logan Dry Park	30	36	51
Lower Twin	9	2	92
Twin Creek	0	0	100
Moccasin Crystal	8	1	81
Stanton Paola	8	3	81
Dickey Java	9	0	81
Long Dirtyface	0	0	100
Tranquil Geifer	0	2	85
Skyland Challenge	20	17	65
Plume Mountain Lodgepole	0	0	97
Flotilla Capitol	0	0	99
Ball Branch	7	12	84
Kah Soldier	19	19	68
Spotted Bear Mountain	19	18	68
Big Bill Shelf	11	6	80
Jungle Addition	19	19	68
Bunker Creek	5	3	92
Gorge Creek	0	0	90
Harrison Mid	1	0	95

[1]There are 16 subunits with > 75 percent NFS lands that are completely within the wilderness and not included in amendment 19. The seven subunits within Montana Legacy Project acquired lands are Buck Holland, Cold Jim, Glacier Loon, Hemlock Elk, Lion Creek, Meadow Smith, and Piper Creek.

Amendment 19 appendix TT defines restricted roads, reclaimed roads, and security core (see glossary) and explains how road status is used in calculating percentages. Some members of the public expressed concern about the Forest's assumptions in calculating the total motorized access density percentages because the Forest does not have complete knowledge of its road system and is uncertain whether stream-aligned culverts remain on some roads. As a result, table 59 shows the total motorized access density for

18 out of 47 amendment 19 subunits where these assumptions could make a difference in the percentages. Although the difference in assumptions makes a difference in the percentages, it does not change the on-the-ground condition with respect to grizzly bear habitat security.

Table 59. Total motorized access route density (TMAD) percentages that change based upon assumptions (Kuennen et al., 2017, table 18)

Subunit Name	TMAD percentage assuming no stream-aligned culverts	TMAD percentage assuming stream-aligned culverts present
Ball Branch	12	14
Buck Holland	41	42
Bunker Creek	3	10
Canyon McGuinness	32	38
Cedar Teakettle (< 75% NFS lands)	27	30
Coal and South Coal	19	27
Cold Jim	55	56
Crane Mountain	58	61
Doris Lost Johnny	20	27
Frozen Lake	4	5
Jewel Basin Graves	19	20
Lower Whale	17	18
Meadow Smith	53	54
Porcupine Woodward (< 75% NFS lands)	73	75
Red Meadow Moose	17	19
South Fork Lost Soup (< 75% NFS lands)	47	50
State Coal Cyclone (< 75% NFS lands)	25	27
Wounded Buck Clayton	30	31

In addition to amendment 19, there is other direction which has contributed to management in portions of the recovery zone/primary conservation area in the Swan Valley, where the acreage of lands with intermingled ownership was high prior to land acquisitions by the Forest Service. The Swan Valley Grizzly Bear Conservation Agreement is a collaborative document that has guided the management of multiple-use lands in the Swan Valley managed by the Forest Service, Montana Department of Natural Resources and Conservation, and lands formerly owned and managed by Plum Creek Timber Company (Plum Creek et al., 1997). At the time the agreement was adopted, it was recognized that Swan Valley subunits with multiple land ownerships and road jurisdictions would require additional coordination to provide habitat security for grizzly bears. The stated purpose of the agreement is to "establish an ecosystem-based management plan throughout the Conservation Area which allows affected Parties to realize economic and recreational benefits of their ownership while helping conserve the bear and other species." The Swan Valley Grizzly Bear Conservation Agreement has provided guidance such as managing activities in linkage areas, maintaining visual screening along open forest roads, maintaining hiding cover in the subunit area, and harvesting timber according to an agreed-upon time schedule, including subunits that can be "active" during specific years. See Plum Creek et al. (1997) for more details.

During the two decades from 1996-2015, Plum Creek Timber Company harvested a large portion of its lands in the agreement area (Ruby, Baty, & Kloetzel, 2016). Table 60 displays the approximate acres of timber harvest in the 11 Swan Valley grizzly bear subunits that have been managed under the Swan Valley Grizzly Bear Conservation Agreement.

Table 60. Acres of timber harvest from 1996 to 2015 in the Swan Valley agreement area by landowner[1]

Swan Valley Grizzly Bear Management Subunit	Timber Harvest DNRC 1996-2005 (acres)	Timber Harvest DNRC 2006-2015 (acres)	Timber Harvest PCTC/TNC 1996-2005 (acres)	Timber Harvest PCTC/TNC 2006-2015 (acres)	Timber Harvest USFS 1996-2005 (acres)	Timber Harvest USFS 2006-2015 (acres)	Total Timber Harvest 1996-2015 (acres)
Beaver Creek			1,044	546	303	5	1,898
Buck Holland			110	984	450	2,247	3,791
Cold Jim			1,045	4,459	149	0	5,653
Glacier Loon			1,543	376	717	104	2,740
Goat Creek	1,345	501	4,369	0	0	10	6,215
Hemlock Elk			1,007	1,843	252	523	3,625
Lion Creek	778		1,249	524	0	796	3,347
Meadow Smith			518	2,631	256	2,262	5,667
Piper Creek		120	2,620	2,141	16	19	4,786
Porcupine Woodward	485	2,000	3,690	0	0	0	6,175
South Fork Lost Soup	1,587	3,097	66	0	0	0	4,750

1. PCTC/TNC = Plum Creek Timber Company/The Nature Conservancy; DNRC = Montana Department of Natural Resources and Conservation.

The Montana Department of Natural Resources and Conservation data has the following important qualifiers:

- Harvested acres were sorted by sale date, not actual harvest date. Harvest dates are unknown.
- DNRC data does not include Plum Creek lands acquired in the Swan Valley through the Montana Legacy Project.
- The data does not include most small-volume timber permits or small-scale thinning/salvage projects.

About 66,000 acres of former Plum Creek Timber Company lands have recently been acquired by State and Federal agencies under the Montana Legacy Project (see figures B-42 and B-43 in Kuennen et al., 2017 for more details). Because there are many acres of young forest in past harvest units that will not be suitable for additional harvest for many decades, the level of harvest and harvest-related activities (including road use) is likely to be much lower in some Swan Valley subunits in the future. Cover is becoming established in the areas that were harvested in the past. Land acquisition has also reduced permanent habitat loss and the risk of grizzly bear food conditioning and habituation associated with private land development (had those lands been sold and subdivided as some other Plum Creek Timber Company lands have been). Both the Montana Department of Natural Resources and Conservation and the Forest Service have closed roads in the Swan Valley grizzly bear subunits to benefit wildlife, including grizzly bears, as displayed in table 61. (Miles of roads closed on former Plum Creek Timber Company lands are unknown. Road inventory is ongoing).

Table 61. Road management on Montana Department of Natural Resources and Conservation (DNRC) and USFS lands located in the Swan Valley

Subunit Name	DNRC Gated	DNRC Physical Barrier	DNRC Historical/ Reclaimed	USFS Gated[1]	USFS Physical Barrier[2]	USFS Historical/ Reclaimed[3]
Beaver Creek	—	—	—	52	5	8
Buck Holland	—	—	—	38	20	1
Cold Jim	—	—	—	81	42	10
Glacier Loon	—	—	—	46	28	6
Goat Creek	86	21	9	0	9	9
Hemlock Elk	—	—	—	54	18	2
Lion Creek	17	7	0	32	18	3
Meadow Smith	—	—	—	63	48	1
Piper Creek	0	0	0	48	30	0
Porcupine Woodward	117	29	13	12	23	32
South Fork Lost Soup	44	28	8	6	4	5

1. Roads are closed by a locked gate and considered available for administrative use; these are considered restricted roads.
2. Roads are closed by various types of physical barriers and generally are not available for motorized administrative use; these are considered restricted roads.
3. Historical or reclaimed roads are not being used by the cooperator, no longer exist, or are not on the cooperator's road system.
Note: approximate mileages as of 2015 excluding public highways, county roads, and roads on small private lands.

The acquisition of the Montana Legacy Project lands has also reduced the need for coordination of timber harvest activities because the only remaining parties to the Swan Valley Grizzly Bear Conservation Agreement are the USFS and the Montana Department of Natural Resources and Conservation. The latter agency manages a large block of lands in four grizzly bear subunits: Goat Creek, Lion Creek, Porcupine Woodward, and South Fork Lost Soup (about 47 percent). The Forest manages less than 75 percent of the acreage in three of these subunits (Goat Creek, Porcupine Woodward, and South Fork Lost Soup), and therefore "no net increase" in open or total motorized route densities and "no net decrease" in security core apply (see table 62).

Table 62. Access management status of bear management subunits included in the Swan Valley Grizzly Bear Conservation Agreement where NFS lands total < 75% (source: Ake (2017c))

Bear Management Subunit	Open Motorized Access Density	Total Motorized Access Density	Security Core
Goat Creek	23	59	39
Porcupine Woodward	28	73	15
South Fork Lost Soup	25	47*	37

In four of the Forest's 73 subunits that are *not* included in the Swan Valley Grizzly Bear Conservation Agreement, the Forest Service manages less than 75 percent of the acreage, and therefore "no net increase" in open or total motorized route densities and "no net decrease" in security core apply (see table 63).

Table 63. Access management status of bear management subunits that are not included in the Swan Valley Grizzly Bear Conservation Agreement where NFS lands total < 75% (source: Ake (2017c)).

Bear Management Subunit	Open Motorized Access Density	Total Motorized Access Density	Security Core
State Coal Cyclone	29	25	58
Cedar Teakettle	25	27	24
Noisy Red Owl	20	17	52
Coram Lake Five	26	46	14

In their biological opinion on the effects of the revised implementation schedule for the Flathead National Forest’s amendment 19 (USFWS, 2014c), the USFWS concluded the existing access management conditions are good to very good for grizzly bears in the NCDE (with a few site-specific exceptions) and that motorized access is managed across the NCDE at levels that are evidently conducive to grizzly bear population growth and conserve grizzly bear habitat.

Amendment 19 of the 1986 forest plan also addresses motorized administrative use of restricted routes (see glossary) in the grizzly bear recovery zone/primary conservation area. Temporary administrative use occurs in the recovery zone/primary conservation area in accordance with the provisions of amendment 19. Motorized administrative use of restricted routes is not limited outside the recovery zone/primary conservation area.

Motorized access in zone 1

Amendment 19 does not apply in zone 1. Zone 1 has been managed in accordance with biological opinions provided by the USFWS once grizzly bears began to occupy the area outside the recovery zone/primary conservation area now called zone 1 (USFWS, 2012c, 2012d). Although a moving-window analysis of motorized access is used in the recovery zone/primary conservation area, a different method based upon the linear density of roads or routes open to public motorized use is applied in zone 1. To put habitat security for grizzly bears in zone 1 in context, research by Boulanger and Stenhouse (2014) is used because it is the best available science on the effects of linear open road density on grizzly bears of different sex and age classes (C. Servheen, USFWS, personal communication to R. Kuennen, 2015).

Boulanger and Stenhouse (2014) studied 142 grizzly bears monitored in Alberta from 1999-2012. The roads in the Alberta study area were almost entirely (96.5 percent) gravel secondary roads associated with settlements and industrial resource-extraction activities, such as oil and gas development and/or timber harvest. In Alberta, for the most part, these roads are open for public use year-round (Stenhouse & Boulanger, 2016). These roads would meet the Forest’s definition of a road open for public use during the non-denning season. More recently, there have been efforts to gate roads in Alberta, but these have not yet formed part of Boulanger and Stenhouse’s ongoing research. They are now looking at how effective these access control measures may be in terms of both human and grizzly bear behavior.

In the Alberta study, modeling found strong spatial gradients in the grizzly bear population trend based upon linear road density. Boulanger and Stenhouse (2014) found that sex and age class survival was related to road density. Threshold values for the road density needed to ensure population stability were estimated in order to refine targets for the population recovery of grizzly bears in Alberta. A summary of the threshold values and how they relate to objectives of the NCDE grizzly bear management zones is shown in table 64.

Table 64. Linear road density threshold values based on Boulanger and Stenhouse (2014).

Objective described in the Alberta study	Maximum reported density in kilometers/square kilometer	Converted to miles per square mile	Where applied in the NCDE analysis
Grizzly bear presence—Distribution of collared bears shows most bears occurred within road densities of 1.5 kilometers/square kilometer or less (p. 10)	1.5 kilometers/square kilometer	2.4 miles/square mile	Used to evaluate zone 1 outside the Salish demographic connectivity area (DCA), where grizzly bear presence during the non-denning season is an objective.
Grizzly bear mortality risk—Most grizzly bear mortalities occurred at road densities greater than 1.0 kilometer/square kilometer, except for adult males where mortalities occurred across all road densities (p. 10)	1.0 kilometer/square kilometer	1.6 miles/square mile	Used to evaluate grizzly bear mortality risk in the Salish demographic connectivity areas. Density calculation included both roads and trails open for public motorized use in the non-denning season on NFS lands.
Occupancy by females—If lower survival rate of females with dependent young is considered, the threshold of road density that can be tolerated is reduced (p. 15)	1.25 kilometers/square kilometer	2.0 miles/square mile	Used to evaluate the portion of zone 1 in the Salish demographic connectivity area, where occupancy by female grizzly bears during the non-denning season is an objective, but at lower density than the core area provided by the recovery zone/ primary conservation area.
Alberta core conservation area—Allows for survival rates of females with dependent offspring high enough to ensure an increasing population (p. 18)	0.75 kilometers/square kilometer	1.2 miles/square mile	Not used to evaluate zone 1. In the NCDE, the core conservation area is the recovery zone/primary conservation area (a moving window analysis method is used in the primary conservation area).

Outside the recovery zone/primary conservation area, the 1986 forest plan identifies geographic units and a range of public open road densities for each geographic unit (see also alternative A discussion of effects) (USDA, 2015e). Table 65 shows the linear density of roads open to public motorized vehicle use (during all or a portion of the non-denning season) within the portions of zone 1 under the management authority of the Flathead National Forest.

Table 65. Density of roads open to public motorized vehicle use by geographic unit

Geographic Unit[1]	Grizzly bear management zone	Density of roads open to public motorized vehicle use (average linear miles/square mile of NFS lands)
Island Geographic Unit	Zone 1	1.7
Olney-Martin Creek Geographic Unit	Salish DCA	1.6
Upper Good Creek Geographic Unit	Salish DCA	1.3
Sylvia Lake Geographic Unit	Zone 1 partially in Salish DCA	1.0
Star Meadow-Logan Creek Geographic Unit	Zone 1 partially in Salish DCA	1.5
Tally Lake-Round Meadow Geographic Unit	Zone 1 partially in Salish DCA	1.7

Geographic Unit[1]	Grizzly bear management zone	Density of roads open to public motorized vehicle use (average linear miles/square mile of NFS lands)
Mountain Meadow-Rhodes Draw Geographic Unit	Zone 1	1.6
Upper Griffin Geographic Unit	Zone 1	0.9
Ashley Lake Geographic Unit	Zone 1	1.9

1. Table is based upon unrestricted road density by geographic unit in the 1986 forest plan, updated as of January 2017. Also see map of Salish demographic connectivity area (USDA, 2015e).

The level of public motorized access shown in table 65 has supported expansion of the grizzly bear population, including females, into zone 1, including the Salish demographic connectivity area (see forest plan figure B-10) (USFWS, 2012a).

In summary, although research, analysis methods and findings have changed over the years, numerous studies have documented that excessive open road densities in grizzly bear habitat during the non-denning season lowers their survival rate (Boulanger & Stenhouse, 2014; D. J. Mattson et al., 1987; M. Mattson, 1996; Bruce N. McLellan & Shackleton, 1988; Waller & Mace, 1997). The density of roads open during the non-denning season has declined substantially across the Forest, including zone 1, since the NCDE grizzly bear population was first listed.

Motorized access during the den emergence time period

Grizzly bears hibernate in dens during the winter months. Both males and females have a tendency to use the same general area to hibernate year after year, but the same den is rarely reused by an individual (Linnell, Swenson, Andersen, & Barnes, 2000). It has been estimated that about 47 percent of NFS lands in the primary conservation area provides potential denning habitat, based upon modeling (R. Mace, 2014). The availability of denning habitat is not likely to be a limiting factor for grizzly bears in this area (USFWS, 2013c).

The 1986 forest plan allows motorized over-snow vehicle use for recreation, as amended by the 2006 record of decision for the Forest’s Winter Motorized Recreation Plan (USDA, 2006; USFWS, 2006b). This decision, known as amendment 24, identified areas and routes suitable and not suitable for motorized over-snow vehicle use. Some routes or areas are open to motorized over-snow vehicle use only during the grizzly bear denning season and some are also open during the non-denning season (snow conditions permitting). The decision also identified three late spring areas (also containing routes) and one route corridor within the recovery zone/primary conservation area where motorized over-snow vehicle use is allowable: Sixmile until April 30, Skyland Challenge until May 15, Lost Johnny until May 31, and Canyon Creek groomed route corridor until April 15 (USDA, 2006, appendix A). Motorized over-snow vehicle routes and areas are displayed in figure B-12 (see the Forest’s over-snow vehicle use maps for more details). During the denning season, about 24 percent of the primary conservation area on the Forest is suitable for motorized over-snow vehicle use.

Mace assessed the distribution of 252 verified grizzly bear dens in the NCDE. The average elevation of 252 grizzly bear dens in the NCDE ranged from 6,427 to 6,906 feet (R. Mace, 2014). Mace found that about 25 percent of the dens are in designated wilderness (19 percent of the 25 percent are female grizzly bears), 15 percent of the dens are in Glacier National Park (13 percent of the 15 percent are female grizzly bears), 31 percent of the dens are in areas open to motorized over-snow vehicle use until April 1 (27 percent of the 31 percent are female grizzly bears), 5 percent of the dens are in areas known as “late spring” areas—open to motorized over-snow vehicle use after April 1 (4 percent of the 5 percent are female grizzly bears), and 24 percent are in other areas closed to motorized over-snow vehicle use on the

Forest (23 percent of the 24 percent are female grizzly bears) (Ake, 2015b; Kuennen, 2015a; R. Mace, 2014). The USFS and MFWP monitor motorized over-snow vehicle use, known den locations, and bears emerging from their dens, and this information is reported to the USFWS (A. H. Jacobs, 2013). The agencies have not detected conflicts due to over-snow vehicle use on the Flathead National Forest. The agencies have not detected grizzly bear avoidance of denning habitat in areas open to motorized over-snow vehicle use.

The impacts of winter recreation activities on denning bears have not been well studied, but there is no evidence to indicate that current levels of nonmotorized or motorized over-snow vehicle use are inhibiting the recovery of the grizzly bear population in the NCDE. In the draft Grizzly Bear Conservation Strategy, the USFWS (2013c) stated that the available data about the potential for grizzly bear disturbance or den abandonment from nearby snowmobile use is extrapolated from studies examining the impacts of other human activities, and it is identified as “anecdotal” in nature (Swenson, Sandegren, Brunberg, & Wabakken, 1997), with sample sizes so small they cannot be legitimately applied to assess population-level impacts (Harding & Nagy, 1980; Hegg, Murphy, & Bjornlie, 2010; P. E. Reynolds, Reynolds, & Follmann, 1986).There are no reports of den abandonment by grizzlies in the lower 48 states due to snowmobiling activity (Hegg et al., 2010; Servheen & Cross, 2010). The draft Grizzly Bear Conservation Strategy stated that current levels of snowmobile use are not appreciably reducing the survival or recovery of grizzly bears, but that monitoring would continue to support adaptive management decisions about denning habitat and snowmobile use (USFWS, 2013c).

Some members of the public have expressed a concern that changes in climate may cause grizzly bears to emerge from their dens earlier, increasing the potential for grizzly bear conflicts with nonmotorized or motorized over-snow vehicle use. Mace collected data on known dens in the NCDE and on the Flathead National Forest through 2014. On the Flathead National Forest, den emergence dates ranged from April 16 to May 29, with the exception of one bear emerging on April 4 of one year. In 2015, a year with lower than average snowfall overall, the earliest known bear emergence date on the Flathead National Forest was April 23 for males and April 28 for females (R. Mace, personal communication, 2015). Mace did not detect shifts in den emergence of the NCDE grizzly bear population associated with changes in climate (Costello et al., 2016). Monitoring would continue to support adaptive management decisions about den emergence dates and snowmobile use (USFWS, 2013c).

Bear research scientists and managers have suggested that in the period shortly before or after spring den emergence (see glossary), a female with cubs may be particularly vulnerable to disturbance by people because cubs have limited mobility after emerging from their dens and females with cubs have high energetic needs (Haroldson, Ternent, Gunther, & Schwartz, 2002; R. D. Mace & Waller, 1997). However, such effects have never been documented, and there are no known scientific papers supporting this potential impact. During the non-denning season, which includes the time period when grizzly bears may be emerging from their dens, motorized over-snow vehicle use is suitable on about 3 percent of the acreage within the primary conservation area (see table 66 and table 67).

Table 66. Miles or acres suitable for motorized over-snow vehicle use within the recovery zone/primary conservation area (PCA)

Area	Motorized Over-Snow Vehicle Routes Open Dec. 1 to March 31[1]	Motorized Over-Snow Vehicle Areas Open Dec. 1 to March 31[1]	Motorized Over-Snow Vehicle Routes Open April 1 to Nov. 30)[2]	Motorized Over-Snow Vehicle Acres Open April 1 to Nov. 30)[2]
PCA	788 miles	513,654 acres	666 miles	57,178 acres

1. This includes routes and areas open during the grizzly bear denning season, snow conditions permitting.
2. This includes routes and areas open during the non-denning season (including den emergence), snow conditions permitting.

Note: numbers may be different than in the amendment 24 decision due to realignment of data layers and GIS updates.

Open and total motorized access route density and security core percentages in the recovery zone/primary conservation area for the two-month season of April-May (late spring, which overlaps with the den emergence time period) are shown in table 67.

Table 67. April-May open and total motorized access route density and security core percentages (USDA, 2016c)

Bear Management Subunit	Area	Open Motorized Access Density Late Spring	Total Motorized Access Density Late Spring	Security Core Late Spring
Werner Creek (as amended)	Canyon Creek	18	23	61
Lower Big Creek	Canyon Creek	15	19	70
Canyon McGinnis (as amended)	Canyon Creek	24	33	41
Cedar Teakettle (< 75% NFS land)	Canyon Creek	15	27	24
Doris Lost Johnny (as amended)	Lost Johnny	79	77	17
Wounded Buck Clayton (as amended)	Lost Johnny	51	62	34
Peters Ridge	Lost Johnny	14	18	66
Swan Lake	Sixmile	27	24	54
Wheeler Quintonkon (as amended)	Sixmile	20	23	64
Noisy Red Owl (< 75% NFS land)	Sixmile	13	15	60
Ball Branch	Sixmile	2	14	89
Skyland Challenge	Challenge/Skyland	51	50	31
Tranquil Geifer	Challenge/Skyland	7	7	81

In table 67, some subunits have open and/or total motorized access route density that are less in late spring than during the non-denning season as a whole. These subunits either have (1) routes closed during April-May that are open in the summer or (2) the assumption is made, based upon knowledge of local conditions, that wheeled motorized traffic does not occur in late spring due to road conditions in most years. Where security core is higher in the non-denning season than it is in late spring, it is because those subunits contain areas or routes that are open to motorized use in late spring and are deducted from security core percentages. Nonmotorized use on the Forest is not restricted during the denning or den emergence time periods.

Nonmotorized trail access

Some members of the public expressed concern about effects of nonmotorized trails on grizzly bears or grizzly bear-human conflicts. Several studies have investigated the behavioral response of bears to nonmotorized trails (Jope, 1985; Kasworm & Manley, 1990; R. D. Mace & Waller, 1996; MacHutchon, 2014; B. N. McLellan & Shackleton, 1989; D. White, Kendall, & Picton, 1999). These studies vary considerably in study design, trail use levels, grizzly bear sample sizes, and conclusions regarding the impacts of nonmotorized trails on bears. Grizzly bear response to human disturbance may differ depending upon the distance between bears and trails or between bears and off-trail foot travel. In Glacier National Park, bears located more than 500 feet away from trails generally did not respond to hikers by fleeing (Jope, 1985, p. 34), and in 45 percent of all cases bears showed no movement in response to hikers. Hiker group size did not significantly affect bear behavior. McLellan and Shackleton (1989) reported that bears showed a stronger response to people on foot than in motor vehicles in “low human-use” areas. However, less than half of bears showed any response (walked or ran away) to stimulus greater than 250 feet away. White and others (1999) documented grizzly bear displacement from feeding sites in Glacier National Park in response to hikers. Kasworm and Manley (1990) reported that grizzly bears used habitats within 100 meters (328 feet) of trails less than expected but used habitats 100-1,000 meters (3,281 feet) from trails in proportion to their availability. On the Forest in the Swan Mountains, Mace and Waller (1996) reported there were no historic or recent records of grizzly bear-human conflict in their study area, which included the heavily used Jewel Basin Hiking Area on the Forest. The authors suggested that avoidance by bears of heavily used human trails may increase grizzly bear survival.

Grizzly bear response to human disturbance may also differ between seasons or habitats. Jope (1985) noted that grizzly bears were more likely to respond to hikers by flight or charges in spring and early summer than later in the year, possibly due to habituation once human use became more common during the summer season. Kasworm and Manley (1990) found that bears used habitat within 400 feet of trails less than expected in spring and fall. Conversely, Mace and Waller (1996) found that distance to trails and/or lakes with campsites were significant variables only in summer and autumn.

Fortin and others (2016) reported that most defensive attacks by grizzly bears result from surprise encounters involving humans hiking off-trail, in the backcountry, and in areas of natural food abundance for grizzly bears. McLellan and Shackleton (1989) also reported that grizzlies fled farther in response to unexpected off-trail foot travel than to motorized use (p. 274). Similarly, Mace and Waller (1996) reported that bear response to off-trail hikers was greater than that observed for other types of disturbances.

Nonmotorized trail uses (hiking, horseback riding, mountain biking) also affect the risk of grizzly bear-human conflicts (J. Herrero & Herrero, 2000; S. Herrero & Higgins, 1999). These conflicts can pose risks to human as well as grizzly bear safety. Herrero (1985) was one of the first researchers to report on the causes of bear attacks and how to avoid them. Based upon his study of bear attacks in Canadian national parks, Herrero reported that in 68 out of 135 grizzly bear incidents in which the party’s activity prior to the bear attack was known, hiking was the most common activity. Herrero reported that 75 percent of encounters he classified as “sudden” were known to involve bear mothers, with females and cubs of the year being most dangerous. Sudden encounters are the most likely situation to result in a grizzly bear-inflicted injury (S. Herrero, 1985). Attacks by bears on humans in North America are disproportionately more frequent in national parks, most being the result of sudden encounters between hikers and grizzly bears that react defensively to protect young or a food source (S. Herrero, 1985; MacHutchon, 2014). Grizzly bear expert Chris Servheen reported that there have been eight fatal grizzly bear attacks on humans in the lower 48 states since 2001 (Servheen, 2017). Of these, six occurred in the Yellowstone Ecosystem and two occurred in the Northern Continental Divide Ecosystem. Human behaviors at the time of the attacks involved hunting, camping, hiking, and mountain biking. Five of the fatalities involved lone individuals, and four of those were lone hikers. Bear spray was not carried or used by any of the people killed in these attacks.

Table 68 shows the different types of allowable trail uses on the Forest by approximate miles and recreation type. Trails can have multiple types of use, so the miles displayed are overlapping, not additive.

Table 68. Allowed nonmotorized summer trail use on the Flathead National Forest in miles

Bicycle	Hiking	Pack and Saddle
806	2,053	2,012

In 1994 and 1998, an Interagency Grizzly Bear Committee task force recommended that the impacts of "high intensity use" *nonmotorized* trails be considered in calculations of "core" habitat in the grizzly bear recovery area (IGBC, 1998, p. 4). Because there were no data or literature available to determine the threshold number of parties defining a high-intensity-use trail or how high-use trails might relate to grizzly bear population parameters, the threshold value to be used to for a trail's influence on security core was determined by a panel of experts. The panel recommended that trails receiving > 20 parties per week for at least one month during the non-denning season be considered high-intensity use and that an influence zone be used that was the same as that for motorized routes for the purpose of estimating the reduced effectiveness of security core habitat. The Forest has about 2,041 miles of NFS trails in the primary conservation area, and about 280 miles of this total were identified as high use based on the Interagency Grizzly Bear Committee task force criteria (Kuennen et al., 2017, figure B-28). The majority of trails that have been modeled as high use in the NCDE are in Glacier National Park, where conflicts and grizzly bear mortalities have been relatively rare and related almost exclusively to campgrounds and other developed human-use areas (D. White et al., 1999).

Because of the lack of studies demonstrating population-level impacts to grizzly bears associated with nonmotorized trails, the subjective method of establishing the threshold value of 20 parties per week and their influence zone, along with the lack of available objective data for quantifying nonmotorized use levels, the NCDE conservation strategy team recommended removing consideration of high-intensity-use nonmotorized trails when defining core habitat effectiveness (USFWS, 2013d).

Although a variety of methods can be used to reduce the risk of grizzly bear-human conflicts due to nonmotorized uses, Herrero and Herrero (2000) emphasized that none of them can entirely remove the risk of hiking or mountain biking in grizzly bear habitat. Strategies recommended to reduce the risk of sudden encounters between grizzly bears and people include (1) visitor education regarding safe practices in bear country (e.g., expect to meet bears, look ahead, slow down, make lots of noise), (2) managing recreation to occur more predictably in space and time, and (3) designing or locating recreation trails to increase the distance at which bears can detect people and to avoid habitats with concentrated bear food resources (Fortin et al., 2016; J. Herrero & Herrero, 2000; Quinn & Chernoff, 2010).

Grizzly bear habitat and developed recreation sites

Conflicts between grizzly bears and people occur at developed recreation sites such as campgrounds, rental cabins, recreation residences, boat launches, picnic areas, and visitor centers. Developed recreation sites include those designed for overnight use and those designed for day use (see glossary). Those that support overnight public use and those with a higher capacity for human occupancy have a higher potential of increasing both the levels of bear attractants and grizzly bear mortality risk (USFWS, 2013c). Summarizing the findings of a number of studies, the draft Grizzly Bear Conservation Strategy stated, "Developed sites are generally associated with frequent, overnight or prolonged human use that may increase both the levels of bear attractants and grizzly bear mortality risk. Developed sites can impact bears through temporary or permanent habitat loss and displacement, but the primary concern regarding developed sites is direct bear mortality or removal from the ecosystem due to bear/human conflicts caused by unsecured bear attractants, habituation, and food conditioning" (USFWS, 2013c, pp. 24-25). The authors concluded that "securing potential attractants is the single most effective way to prevent bears from becoming food conditioned and displaying subsequent unacceptable aggressive behavior" (p. 96). Food storage orders requiring proper storage of attractants are in place on all Forest lands. Because the draft NCDE Grizzly Bear Conservation Strategy focuses on developed recreation sites with frequent, overnight, or prolonged human use, the grizzly bear analysis also focuses on these sites.

Within the recovery zone/ primary conservation area on the Forest, developed sites designed for overnight use on NFS lands are shown in table 69 and their capacity is shown in table 70.

Table 69. Number of developed recreation sites designed for overnight use in the recovery zone/primary conservation area (PCA) on the Forest

Number of developed campgrounds	Number of cabins, lodges, and lookouts with overnight use	Recreation residences
63	20	63

Table 70. Capacity of developed recreation sites designed for overnight use in the recovery zone/primary conservation area (PCA) on the Forest

Capacity of developed campgrounds	Capacity of cabins, lodges, and lookouts with overnight use	Capacity of recreation residences
552	68	63

The Forest also has one developed year-round resort on NFS lands in the recovery zone/primary conservation area—Whitefish Mountain Resort (see Big Mountain, figure B-31). The Forest has consulted with USFWS on the effects of various resort expansion projects since 1989 (USDA-USFWS, 2016; USFWS, 1989, 1995a, 2007a, 2011b, 2012b, 2013b, 2015). The Forest has one developed ski resort in zone 1 (outside the Salish demographic connectivity area) that operates during the grizzly bear denning season (see Blacktail Mountain, figure B-31). The Forest also has an unknown number of dispersed recreation sites. Food storage orders are effective at reducing the risk of grizzly bear-human conflicts at these sites.

When grizzly bear-human conflicts do occur in the NCDE (whether associated with nonmotorized trail use, off-trail backcountry use, developed or dispersed recreation sites, or private or non-Forest Service lands), MFWP, in cooperation with land management agencies and the USFWS, monitors the conflict situation and determines the appropriate conflict response based on the established Interagency Grizzly Bear Guidelines.

Grizzly bear habitat and livestock allotments

Although grizzly bears frequently coexist with large livestock (such as adult cattle) without preying on them, they will often kill smaller animals such as calves, domestic sheep, goats, or chickens (C. R. Anderson, Ternent, & Moody, 2002; Knight & Judd, 1983; Orme & Williams, 1986). Grizzly bear predation on small animals (especially chickens) is a source of grizzly bear-human conflicts on private lands. If repeated depredations occur, managers may relocate bears or remove them from the population (counted as a grizzly bear mortality). Multiple agencies and non-government organizations are making concerted efforts to reduce this source of grizzly bear mortality

Because of the increased risk to grizzly bears posed by actions taken to protect sheep and other small livestock, the 1986 Interagency Grizzly Bear Guidelines emphasized the reduction of livestock allotments on public lands. Between 1980 and 2008, there were three grizzly bear mortalities related to livestock depredations on public land in the NCDE, and none of these occurred on the Flathead National Forest. These accounted for less than 1 percent of all known grizzly bear mortalities in the NCDE during this time period. At current levels, livestock allotments on public land within the NCDE are not a threat to grizzly bears in the lower 48 states. As stated in the draft Grizzly Bear Conservation Strategy, “Current levels of grazing on permitted livestock allotments in forested environments are not displacing grizzly bears in significant ways and are not likely to affect vegetation structure enough to result in direct competition for forage species on public lands within the NCDE, as evidenced by the increasing population trend in the NCDE" (USFWS, 2013c, p. 25). As a result, the draft Grizzly Bear Conservation Strategy included measures to keep livestock grazing at or below the baseline levels.

Authorized grazing on the Flathead National Forest has declined over the last several decades. No sheep grazing and very limited cattle grazing occurs on the Flathead National Forest. The Forest currently has seven active cattle allotments—four in the Salish Mountains geographic area outside the recovery zone/primary conservation area and three in the Swan Valley geographic area inside the recovery zone/primary conservation area (see figure 1-69). Current allotment acreage represents approximately 3 percent of NFS lands, consisting of about 81,500 acres. Current animal unit months authorized for grazing totals about 1,078. Because livestock grazing has been declining, the risk of conflicts on the Forest has also declined. There have been no known livestock-related grizzly bear mortalities on the Flathead National Forest. According to the draft Grizzly Bear Conservation Strategy, "Indirect impacts on grizzly bears due to attractants associated with livestock can be effectively minimized with requirements to securely store and/or promptly remove attractants associated with livestock operations (e.g., livestock carcasses, livestock feed, etc.)" (USFWS, 2013c, p. 25) Livestock carcasses are promptly removed and proper storage of livestock feed is required by the attractant storage orders that are in place on the Forest (USDA, 2010b, 2011a).

There are permitted grazing operations on NFS lands in the NCDE for horses and mules, primarily associated with outfitter and guide operations or Forest Service administrative use. The food storage order(s) address attractants associated with horses or mules, and there is no evidence of conflicts with bears due to depredation, attractants, or forage competition related to horse and mule grazing permits. Honeybees are classified as livestock in Montana (MCA 15-24-921), and their hives can be attractants to grizzly bears. There are no permitted honeybee operations on the Forest.

Grizzly bear habitat and vegetation management

Timber harvest, wildfire, prescribed fire, and other vegetation management activities may alter the amount, quality, and arrangement of cover and forage. Grizzlies in the NCDE occupy numerous types of habitat, including those with forest cover and those without (Aune & Kasworm, 1989; R. D. Mace & Waller, 1997). Vegetation management can increase the quantity and quality of grizzly bear foods through increased growth of grasses, forbs, and berry-producing shrubs (Kerns, Alexander, & Bailey, 2004; Zager et al., 1983). Numerous studies have found that grizzly bear use of habitat is influenced by an interaction of cover, food, and human access. Gibeau and others (2002) concluded that there were significant differences in grizzly bear response to roads, trails, and major development features based upon the bear's sex and age class, the proximity of high-quality habitat, and the time of day. Gibeau and Stevens (2005) reported that bears took advantage of high-quality habitat near development when humans were inactive by using roads, trails, and human facilities at night or when unoccupied. In a recent Alberta study, Stewart and others recommended limiting access to habitat that is heavily selected by bears during the fall ungulate hunting season when human use is extensive and grizzly bear mortality from human self-defense or illegal kills is highest (B. P. Stewart et al., 2013) (see also the "Affected environment" section on grizzly bear habitat security).

Nielsen and others (2004) studied grizzly bear use of habitats in areas with timber harvest compared to uncut forests. These authors reported the average fruit production for six fruit-bearing species used by grizzly bears and stated that there was a nonsignificant difference between clearcut and uncut forests in their study area. Two huckleberry species (*V. caespitosum* and *V. membranaceum*) had higher fruit production in clearcuts, one species had higher fruit production in uncut forests, and the remaining species had no difference in fruit production between clearcuts and uncut forests. Overall, Nielson and others found that clearcuts provided a diverse array of food resources for grizzly bears, particularly roots and tubers, herbaceous materials, and ants. They suggested that the design of timber harvest projects and silviculture prescriptions consider strategies that maximize grizzly bear food abundance while minimizing human access (S. E. Nielsen et al., 2004) (see Kuennen et al., 2017 for more details).

In the dense forests of the Flathead National Forest, the thick growth of conifers provides high levels of cover but may reduce the availability of key bear foods. Mace and Waller (1997) studied grizzly bear habitat use in the Swan Mountain Range of the Forest and found that the highest grizzly bear densities obtained over time were in those locations with ≤ 40 percent overstory tree canopy. They stated that vegetal foods used by grizzly bears (including grasses, forbs, and shrubs) were more common in these habitats (referred to as open or open timber) and that available foods in timber harvest units were used by grizzly bears provided vehicular traffic was restricted. Mace and Waller reported that grizzly bears avoided lower-elevation, more accessible areas where timber had been recently harvested. They found that grizzlies were more likely to use cutting units harvested 30-40 years ago than older or newer cutting units and that these were the most preferred habitats during summer (R. D. Mace & Waller, 1997). Mace and others (1999) also reported that lower-elevation habitats contained most of the human activities and roads, so reductions in habitat use from potential were highest during spring when grizzly bear habitat use is restricted by snow at upper elevations. Areas with a high density of high-traffic roads were strongly avoided, and no bears were observed near high-impact human activity points. These authors suggested that there is value in road closures aimed at minimizing traffic on roads within important seasonal habitats (R. D. Mace et al., 1999).

Ruby (2014) studied grizzly bear habitat use along Montana Highway 83 in the Swan Valley and found that grizzly bears exhibited little negative selection for high open road densities within the Swan Valley study area, but he also found that high open road densities may affect the risk of grizzly bear mortality. Ruby (2014) used location data from 24 grizzly bears instrumented with GPS collars using the Swan Valley of the Forest from 2000 to 2011 to characterize grizzly bear movement and habitat-use patterns. Use of the GPS collars enabled the grizzly bears to be tracked on a 24-hour basis. Ruby found that grizzly bears use high-quality habitats around human development and are not completely displaced. Instead, bears changed their movement patterns when in close proximity to open roads and homes so that they were active during the night when human activity was lowest. Although human activity associated with site development in the rural landscape of the Swan Valley did not affect habitat selection, Ruby (2014) noted that it can result in human encounters resulting in grizzly bear mortality or management-related removals from the population, citing the work of Delibes et al. published in 2001, Mattson et al. in 1990, Neilson et al. in 2004, and C. C. Schwartz et al. in 2010. Where resources are not limiting, grizzly bear movement patterns that avoid periods of human activity may be an important strategy for limiting mortality risk to grizzly bears.

The Interagency Grizzly Bear Guidelines addressed vegetation management activities, and these guidelines were incorporated into the 1986 forest plan for timber management in grizzly bear management situations 1 and 2 (where grizzly bear habitat management is a priority), guiding management for the last 30 years. The draft Grizzly Bear Conservation Strategy (USFWS, 2013c) includes many similar strategies for vegetation management that are designed to increase grizzly bear foods, limit the impacts of road use associated with projects, and protect seasonally important habitats (see additional discussion under consequences of the action alternatives).

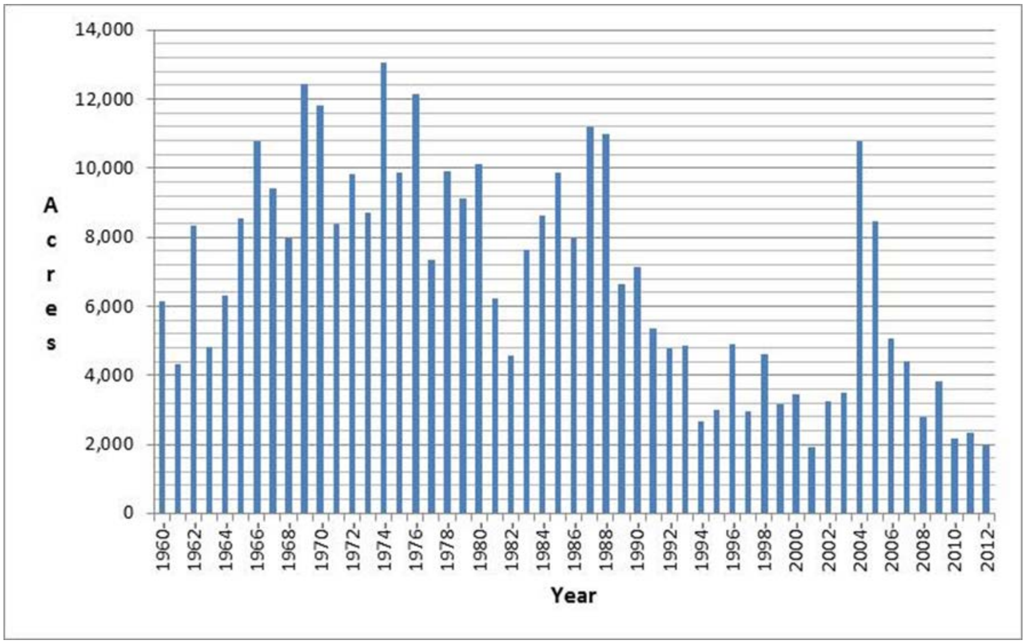


Figure 52. Approximate acres of commercial timber harvest on the Forest from 1960-2012

Figure 52 displays the approximate acres and trend of timber harvest on the Forest from 1960 through 2012 (USDA, 2014b). There were spikes in timber harvest during salvage operations in 2004-2005 after widespread wildfires in 2003, but generally the trend in timber harvest has been downward since the late 1980s. Commercial timber harvest has affected a total of approximately 17 percent of the NFS lands on the Flathead National Forest. Some of the harvested acres subsequently had prescribed burning or thinning, but precommercial thinning has been limited in Canada lynx habitat since 2007, and lynx habitat overlaps with much of the grizzly bear habitat on the Forest. See the biological assessment of the forest plan for more details (Kuennen et al., 2017).

Grizzly bear habitat and leasable, locatable, and salable mineral activities

Mineral and oil and gas development have the potential to increase grizzly bear displacement, mortality risk, habituation, permanent habitat loss, and habitat fragmentation. The management of mineral and energy resources is regulated by Federal laws, regulations, and legal decisions, with certain laws, regulations, and polices pertaining to specific mineral and energy resource types or land allocations.

There are three general types of mineral resources associated with national forests: leasable minerals, locatable minerals, and salable mineral materials. Leasable mineral development includes the production of materials such as oil and natural gas. Locatable mineral development refers to surface and underground hardrock mining of metallic minerals and nonmetallic minerals. Salable minerals include materials such as common varieties of sand, stone, and gravel. The Forest Service has management authority over the surface resource impacts resulting from locatable mineral activity and has full discretionary authority over the disposal of salable mineral material. For leasable commodities on NFS lands, the Bureau of Land Management issues all leases with Forest Service consent.

Leasable minerals

The production of oil and natural gas is conducted through a leasing process. Forest plan standards and guidelines provide guidance for authorizations and stipulations that are determined at the project level. At this time, there is no leasable mineral exploration or development on the Forest. The Bureau of Land

Management suspended existing oil and gas leases in 1985 after the Conner v. Burford district court decision (Conner v. Burford, 605 F. Supp. 107 [D. Mont.1985]) (see figure 1-79). The court found the environmental effects analysis supporting lease issuance to be inadequate and specified that no activity could take place on the leases until an EIS is completed. The 9th Circuit Court of Appeals upheld the district court decision requiring an EIS prior to any post-leasing activities in a January 13, 1988, decision, as amended July 1, 1988.

Locatable minerals

Currently, there are no authorized locatable mineral development operations within the boundaries of the Flathead National Forest planning area. Based on the results of a February 2, 2014, query of the Bureau of Land Management mining claim database, one active mining claim (MMC195448) is located within the planning area. This is the Mary Dee II lode claim, which is located in the Hungry Horse geographic area.

Saleable minerals

The Forest's use of mineral material such as gravel, riprap, and crushed aggregate includes maintenance and/or new construction of roads, recreation sites, and trailheads. Other uses include Forest contract work (i.e., timber sales), culvert replacement, and repair of damage caused by fire, floods, and landslides. The mineral material utilized by the Forest is primarily derived from Forest Service pits and quarries located in the planning area. In addition, free-use permits can be issued to State or Federal agencies, municipalities, county road districts, nonprofit associations, or individuals (36 CFR § 228.57). The type, volume, and source location of saleable mineral material varies year by year according to need.

The Forest has low future potential for locatable minerals and low to high potential for leasable minerals (see figures 1-67 and 1-68). However, many NFS lands on the Forest are withdrawn from mineral entry (see figure B-29 in the forest plan).

Grizzly bears, habitat, and a changing climate

The draft Grizzly Bear Conservation Strategy states,

> Climate change may result in a number of changes to grizzly bear habitat, including a reduction in snowpack levels, shifts in denning times, shifts in the abundance and distribution of some natural food sources, and changes in fire regimes. Most grizzly bear biologists in the U.S. and Canada do not expect habitat changes predicted under climate change scenarios to directly threaten grizzly bears (Servheen and Cross 2010). These changes may even make habitat more suitable and food sources more abundant. However, these ecological changes may also affect the timing and frequency of grizzly bear/human interactions and conflicts (Servheen and Cross 2010). (USFWS, 2013c, p. 31).

With respect to shifts in the denning season, the draft Grizzly Bear Conservation Strategy defined denning season dates and stated that dates would be adjusted if the 10-year average den emergence data for females or females with offspring shows a shift of at least a week. Denning in the NCDE has been monitored. The analysis of the effects of alternatives on denning habitat uses modeled denning habitat provided by Mace (2014), which is currently the best available scientific information for the Forest.

On October 6-7, 2009, the Wildlife Conservation Society and the USFWS held a workshop entitled "Climate Change Impacts on Carnivores in the Northern U.S. Rockies: Strategies for Conservation." Participants included a diverse group of scientists and managers from government agencies, universities, and conservation science non-governmental organizations, including MFWP, Idaho Fish and Game, U.S. Forest Service, U.S. Geological Survey, USFWS, National Park Service, Wildlife Conservation Society, The Nature Conservancy, the National Wildlife Federation, and the University of Montana. Participants discussed the relationship between the rate of climate change, the types of change in bear foods and habitats that might result from these changes, and the ability of bears to adjust their food habits and perhaps seasonal ranges. It was hypothesized that a more rapid rate of change could challenge adaptive success but that this could vary depending on the particular food economies used by individual bears.

The group of workshop participants recommended monitoring potential effects of climate change on grizzly bears and the ever-changing availability of bear foods by monitoring grizzly bear body condition. Teisberg and others (2015) studied grizzly bear population health and body condition and concluded that grizzly bears in all regions of the NCDE exploit diverse combinations of food items to arrive at productive body conditions (Teisberg et al., 2015). The draft Grizzly Bear Conservation Strategy states that monitoring would be conducted to assess the adequacy of food production and the types of foods grizzlies use across the landscape each year by monitoring grizzly bear body condition and food habits using the most appropriate and available technology.

Nielsen and others (2013) evaluated the importance of six different factors on springtime body size patterns in grizzly bears of Alberta, Canada. The six factors they examined were (1) regional habitat productivity, (2) interannual variability in productivity, (3) habitat quality, (4) human footprint and activity, (5) rate of landscape change, and (6) density dependence. The authors stated, “Given the short season associated with high-alpine environments, such as the Rocky Mountains in Alberta, we hypothesize that individuals associated with a limited growing season and temperature-limited ecosystems, such as interior grizzly bears, might actually benefit from increases in season length associated with climate change. This prediction is largely consistent with observed body size and seasonality patterns in grizzly bears across North America, but may be dependent on sufficient snow cover during the denning period” (Scott E. Nielsen et al., 2013).

Fire frequency and severity are predicted to continue to increase in the western United States as a result of a changing climate. Large, stand-replacing wildfires that convert mature forest to an early-successional condition alter the availability of grizzly bear foods and cover, potentially changing how bears use the landscape. Decreases in forest cover associated with wildfires could benefit grizzly bears by increasing the production of shrubs, berries, and root crops in the years following large fires (Blanchard & Knight, 1996). There have been repeated, very large, stand-replacing wildfires in grizzly bear habitat on the Forest since the late 1980s, and multiple bears, including females with cubs, have been observed feeding in these areas by MFWP. As discussed in detail in appendix 2 and in section 3.7.5, subsection “Canada lynx,” modeling indicates that the extent and intensity of wildfires on the Forest is within the natural range of variation.

The extent and rate at which individual plant species or plant communities will be impacted by climate change in the future is difficult to foresee with any level of confidence (Fagre, Peterson, & Hessl, 2003; Walther et al., 2002). In summary, the potential positive and negative effects of climate change would likely be variable across the ecosystem and are difficult to predict. Some climate change projections are for the end of the century (Running, 2016), extending well beyond the anticipated life of the forest plan. The degree of uncertainty associated with specific effects increases as time goes on, emphasizing the importance of monitoring of the grizzly bear population, body condition of individual grizzly bears, and grizzly bear-human conflicts so that any necessary adjustments can be made.

Environmental consequences

Introduction

The previous “Affected environment” section describes key ecosystem characteristics and conditions for the NCDE grizzly bear population. The key indicators for analysis provide a foundation for the alternative effects analysis. Stressors are activities that may impact a species and/or its habitat if not managed or mitigated. They can be activities that have occurred in the past that are not occurring presently or are not necessarily expected to occur in the future. Stressors may include activities or conditions that occur on non-NFS lands or that are not within Forest Service authority or ability to manage. For the grizzly bear, these are considered under the cumulative effects sections in chapter 6 of this final EIS.

The following sections assess the consequences of alternative A, which is continued implementation of the 1986 forest plan, as amended, and the three action alternatives (B modified, C, and D). The action alternatives include a set of plan components for the recovery zone/primary conservation area that are consistent with the amendment Forests (Kootenai, Helena-Lewis and Clark, Lolo), as applicable, but include additional plan components that are specific to the Flathead National Forest's forest plan. This section considers the programmatic effects to the NCDE grizzly bear population and its habitat as guided by plan components, applied forestwide to the recovery zone/primary conservation area, to the Salish Mountains geographic area (grizzly bear management zone 1, including the Forest's portion of the Salish demographic connectivity area) (see figure B-10), and to specific areas such as management areas (see figures 1-01 through 1-04). Monitoring items (detailed in chapter 5 of the forest plan) will help make the plan adaptive. As is typical of forest plans, this forest plan is programmatic and does not provide an analysis of site-specific actions.

Key stressors

Land management

Land management actions on all lands, including management activities related to vegetation, roads, energy and minerals, livestock grazing, and recreation, can affect the grizzly bear in ways that are positive, negative, or neutral. The draft NCDE Grizzly Bear Conservation Strategy (USFWS, 2013c) identified six key habitat features and human activities relevant to the management of NFS lands that have the greatest potential to impact grizzly bears. These are (1) the amount and distribution of secure core, (2) motorized route densities, (3) developed recreation sites, (4) livestock allotments, (5) vegetation management, and (6) mineral and energy development. The Forest Service manages these stressors on lands over which it has authority.

Fragmentation of habitat

Human-caused alterations of natural landscape patterns can reduce the total area of habitat, increase the isolation of habitat patches, and affect movement between those patches of habitat. Habitat fragmentation may be permanent (e.g., converting forest habitat for residential developments) or temporary (e.g., creating a forest opening through timber harvest until trees and shrubs regrow). The Forest Service manages these stressors on lands over which it has authority.

Grizzly bear-human conflicts

Actions on all lands can affect the risk of grizzly bear-human conflicts. When conflicts occur between grizzly bears and people, bear management specialists with MFWP work with agencies and the public to provide education on how to reduce conflicts, remove attractants and/or trap, move, or aversively condition the bear so that it learns to avoid people. People may also illegally kill the bear(s).

Key indicators for analysis

The analysis is focused on six aspects of grizzly bear habitat in the draft NCDE Grizzly Bear Conservation Strategy (USFWS, 2013c). The analysis of effects of the alternatives is presented here for the Flathead National Forest and in chapter 6 for the other four forests. Chapter 6 also includes discussion of the cumulative effects across the NCDE. Additionally, the framework of the grizzly bear management zones is designed to address grizzly bear-human conflicts and connectivity in the NCDE.

The key indicators used to focus the effects analysis are summarized in table 71. These were developed after considering key drivers and stressors, public comments, and issues identified during scoping.

Table 71. Overview of key indicators used to assess effects of alternatives on grizzly bears

Resource Element	Indicator
Grizzly bear habitat security in the primary conservation area	• Public motorized access during the non-denning season, the risk of human disturbance, and grizzly bear-human conflict risk; • Nonmotorized trails; and • Temporary reductions in habitat security to allow for projects, administrative use, or public use.
Risk of disturbance of females with cubs during the den emergence time period	• Areas or routes suitable for motorized over-snow vehicle use during the den emergence time period in the primary conservation area.
Grizzly bear occupancy in zone 1 and the Salish demographic connectivity area	• Density of routes open to public motorized use during the non-denning season on NFS lands in the Salish demographic connectivity area; • Density of roads open to public motorized use during the non-denning season on NFS lands in the rest of zone 1.
Recreation and grizzly bear- human conflict potential	• Number and capacity of developed recreation sites designed and managed for overnight use in the primary conservation area; and • Day-use developed recreation sites in the primary conservation area
Livestock grazing allotments	• Number of cattle allotments and potential for conflicts; and • Risk of grizzly bear-human conflicts due to livestock grazing across the forest.
Vegetation management	• Desired conditions for vegetation and habitat diversity; • Areas suitable or not-suitable for timber production, areas where timber harvest is allowable; and • Wildfire and prescribed fire
Oil, gas, and mineral development	• Areas of mineral withdrawal, mineral potential, no surface occupancy stipulations; and • Risk of habitat loss, disturbance or displacement, grizzly bear-human conflicts.
Habitat connectivity	• Grizzly bear habitat connectivity on all lands within the Flathead National Forest geographic areas.
Demographic connectivity	• Motorized route density in the Salish demographic connectivity area and population connectivity to Cabinet-Yaak grizzly bear ecosystem.
Grizzly bear attractants and mortality risk	• Food/attractant storage orders across the Forest

Effects common to all alternatives

Wilderness

Congressionally designated wilderness (management area 1a) comprises about 50 percent (1,075,376 million acres) of the Flathead National Forest primary conservation area (see figure 1-01). Designated wilderness areas would provide high levels of habitat security for grizzly bears under all alternatives because these areas are not suitable for motorized vehicle use or mechanized transport.

Inventoried roadless areas

Inventoried roadless areas are the same for all alternatives and provide a high level of grizzly bear habitat security. Although alternatives vary with respect to management area allocation of inventoried roadless areas, as discussed below, none of the alternatives may conflict with the Roadless Area Conservation Rule (36 CFR § 294). This rule established prohibitions on road construction and road reconstruction within inventoried roadless areas on NFS lands. Responsible officials do not have the authority to recommend additional designated roadless areas or to modify the boundaries of designated roadless areas covered by the Roadless Area Conservation Rule. Most of the inventoried roadless areas on the Forest are in the recovery zone/primary conservation area (see table 72). Motorized trails may occur in these areas but temporary disturbance due to projects (see glossary) is less likely due to the lack of roads (see figure 1-73).

Table 72. Inventoried roadless areas by NCDE management zone

NCDE Management Zone	Inventoried roadless areas on NFS lands (acres)
Primary conservation area	473,290
Salish demographic connectivity area, zone 1	5,465
Zone 1, outside demographic connectivity area	2
Outside NCDE management zone	< 1

Minerals

Under all alternatives, some lands on the Forest are withdrawn from mineral entry or leasing in the Flathead National Forest plan area (subject to valid existing rights). These include

- administrative sites such as campgrounds;
- Forest lands within the boundaries of a ski area permit;
- the Bob Marshall, Great Bear, and Mission Mountains Wilderness Areas;
- sections of the North, South and Middle Forks of the Flathead River (based upon their wild and scenic river status); and
- portions of the Forest withdrawn from mineral development by the North Fork Watershed Protection Act of 2013 (see figure B-29).

Withdrawal of these large areas reduces the risk of grizzly bear habitat loss, disturbance, displacement, and mortality. All withdrawals are subject to valid existing rights. The Forest Service does not have the discretion to deny the exercise of an outstanding mineral right. However, the developer does not have unrestricted rights because the developer's rights are limited to using only as much of the surface as is reasonably necessary to explore, develop, and transport materials. The developer must provide an operating plan to the Forest, and the Forest has some ability to manage surface resources (for more information, see volume 2 of the Flathead National Forest assessment (USDA, 2014b), as updated by the 2015 leasing withdrawal).

With respect to leasable minerals, over 1,000,000 acres were leased or under lease application in 1984. A Federal court ruling in 1985 caused the BLM to suspend those leases until litigation is completed" (p. VI-18). Some of the current oil and gas leases are suspended because the Conner v. Burford decision requires the Forest Service to complete an oil and gas leasing EIS prior to the leases being activated. There are no plans or funding to pursue an oil and gas leasing EIS on the Flathead National Forest, so any possible affects would be highly speculative and uncertain. No activity can take place on the leases (see figure 1-36) until an EIS is completed. A leasing decision is not a part of this forest plan revision.

Because the Flathead National Forest currently has no active leasable or locatable mineral activity and because over 50 percent of the land area is withdrawn from mineral entry or leasing, the effects of leasable and locatable mineral activity are anticipated to be minor.

Ongoing grizzly bear conservation actions by the Forest Service

The draft Grizzly Bear Conservation Strategy for the NCDE states:

> For grizzly bear conservation to be successful, providing habitat on the landscape is not enough. For grizzly bears to survive, people must accept the grizzly as a cohabitant of the land. Tolerance can be maintained when the public has confidence in management agencies to respond quickly and appropriately to grizzly bear-human conflicts and the public is equipped with the knowledge to understand and avoid grizzly bear-human conflicts. The objective of conflict management is to maximize human safety and minimize property losses while maintaining a viable population of grizzly bears. (USFWS, 2013c, p. iv)

Multiple agencies, including the Forest Service, work with the public towards this end (see also section 6.5). All action alternatives include plan components for attractant storage to reduce the risk of grizzly bear-human conflicts on NFS lands. The Forest's attractant storage orders require that food, garbage, and other attractants are stored properly so that grizzly bears cannot obtain access to them. This prevents the food conditioning of bears, which usually leads to grizzly bear-human conflicts, removal of bears, and possibly human injuries or fatalities. Food storage orders have been issued and implemented in the NCDE since the mid to late 1980s. In 2010, the Flathead (as well as the Helena, Kootenai, Lewis and Clark, and Lolo National Forests) issued a food storage order that covers the portions of the Forest that is within the NCDE recovery zone/primary conservation area (USDA, 2010b). In 2011, the Forest adopted an attractant storage order covering the rest of the Forest. The Forest provides bear-resistant devices at many facilities (such as campgrounds and dispersed campsites) both within and, in some cases, outside of the recovery zone/primary conservation area.

A variety of informational and educational materials (e.g., pamphlets, brochures, signs, videos, etc.) and programs are provided to the public. Signs and brochures about proper behavior and safety procedures in bear country are placed at campgrounds, trailheads, dispersed recreation sites, picnic areas, etc. The Forest Service has cooperated with MFWP and other cooperating institutions and individuals in giving presentations and offering workshops that address bear identification; safe camping, hiking, hunting, and working procedures to use in bear habitat; the use of electric fencing to reduce conflicts between bears and livestock (e.g., chickens, pigs, beehives, sheep, cattle); and the proper use of bear-deterrent pepper spray. Patrols by wilderness rangers and other backcountry patrols have been used to inform and educate the public on food storage orders and to check on compliance with these orders. Field patrols have been used during hunting seasons to reduce hunter-caused conflicts and grizzly bear mortalities.

Many contracts and special-use permits issued on the Forest contain provisions requiring protection of the grizzly bear and its habitat as well as proper storage of food and attractants. Timber sale prescriptions and contracts incorporate provisions to protect grizzly bear habitat. For example, silvicultural prescriptions are designed to maintain or enhance food sources, timing provisions are aimed at reducing the potential for displacement or grizzly bear-human conflicts, and specific contract provisions require proper food storage and temporary or permanent cessation of permitted activities to resolve grizzly bear-human conflicts. Existing livestock grazing permits include special provisions such as proper storage of food and attractants as well as carcass removal. Disposal of animal carcasses has been emphasized to reduce conflicts with grizzly bears.

For many years, the Forest Service has coordinated with transportation agencies and railroad companies to reduce the risk of collisions with grizzly bears. For example, in 1991, the Great Northern Environmental Stewardship Area was formed for the rail line that traverses the Middle Fork Flathead River Corridor. The agreement was signed by the Burlington Northern Santa Fe Railway and multiple State, Federal and tribal partners. The agreement established a conservation trust fund and identified several railroad operation and maintenance procedures that would be followed to minimize train-bear incidents and ensure a rapid response and removal of attractants from the railroad right-of-way.

The Forest Service also maintains the Wildlife Crossings Toolkit website (https://www.fs.fed.us/wildlifecrossings/index.php), which was developed in partnership with the National Park Service, Federal Highway Administration, and American Association of State Highway and Transportation Officials. This website provides state-of-the-art information for biologists, engineers, and transportation professionals to assist in reducing wildlife mortalities and maintaining or restoring habitat connectivity across transportation infrastructure on public lands. Additionally, important grizzly bear habitat has been acquired through land exchanges and acquisitions, such as the Montana Legacy Project land acquisition in the Swan Valley.

Management for habitat connectivity

Under all alternatives, standards for Canada lynx indirectly provide habitat connectivity for grizzly bears. Lynx habitat on the Forest encompasses an area of about 1.8 million acres that is also used by grizzly bears. All alternatives include connectivity standard ALL S1 and vegetation standards VEG S1, VEG S2, VEG S5, and VEG S6 (see appendix A). These standards limit vegetation treatments, indirectly providing cover and connectivity of cover for grizzly bears. Alternatives B modified, C, and D have one additional exception to vegetation standard VEG S6 to protect whitebark pine trees, but this would not affect habitat connectivity due to the very limited amount of cover that would be reduced (see consequences of alternatives for Canada lynx).

Alternative A

The following sections discuss key indicators to display differences in alternatives. Under the 1986 forest plan, as amended, grizzly bear management direction applies only to the NCDE recovery zone, which is further divided into areas mapped as management situations 1, 2, and 3. Management direction for each management situation is specified in the Interagency Grizzly Bear Guidelines (IGBC, 1986; USDA, 1986, p. II-24). Under alternative A, grizzly bear management situations and guidelines applicable to each would continue to be implemented in the recovery zone/primary conservation area. About 99 percent of the acres within the recovery zone/primary conservation area on the Forest is management situation 1 or 2, which has the most stringent protection of grizzly bear habitat. About 1 percent is management situation 3, which gives more consideration to human uses and development (see table 73).

Table 73. Acres of management situations 1, 2, and 3 within and outside the NCDE recovery zones under the 1986 forest plan, as amended.

National Forest	Management Situation (MS) 1 in NCDE recovery zone	MS 2 in NCDE recovery zone	MS 3 in NCDE recovery zone
Flathead	2,022,688	99,418	12,614

As the NCDE grizzly bear population expanded outside the recovery zone/primary conservation area, the Forest consulted with the USFWS to determine appropriate management (discussed in the following sections).

Management direction adopted in the 1986 forest plan also states that management situation stratification would be refined based on current grizzly bear habitat suitability, population, and distribution trends. Changes to the management situation stratifications in the 1986 forest plan are now being proposed by revising the forest plan. The original recovery zone would be the same as the primary conservation area but no longer stratified into management situations. For comparison with the action alternatives, the consequences of alternative A will be discussed relative to the recovery zone/primary conservation area and zone 1 area (outside the recovery zone/primary conservation area).

Consequences of motorized access management direction for alternative A

Recovery zone/primary conservation area

Amendment 19 of the 1986 forest plan has standards and objectives for access management (see the “Grizzly bear, affected environment” section for more details). The terms open motorized access density, total motorized access density, and security core are based upon definitions in amendment 19 (appendix TT) of the 1986 forest plan as amended (see glossary for more on these terms). Alternative A would result in a low risk of grizzly bear disturbance or displacement (especially females with cubs) because of the expectation that additional roads and trails would have motorized use restrictions, additional roads would be reclaimed, and/or additional security core would be created (S. Anderson, 2009; USDA, 1994, 2004; USFWS, 1995b, 1995c, 2005a, 2014c, 2016b). In bear management subunits where the Forest manages more than 75 percent of the land and amendment 19 applies, there would be an expectation to achieve 19 percent or less open motorized access density, 19 percent or less total motorized access density , and 68 percent or more security core unless site-specifically amended. Table 74 and table 75 show the estimated miles of motorized routes that would need to be closed in subunits in the recovery zone/primary conservation area (see figure 1-38) to meet or exceed 68 percent security core, unless site-specifically amended. Under alternative A, the calculation of the percentage of a bear management subunit providing security core includes a deduction due to the influence zone of high-use nonmotorized trails. As explained in the “Affected environment” section, grizzly bear response to nonmotorized trails is highly variable, and the thresholds for disturbance or displacement are unknown. The risk of grizzly bear-human conflicts on nonmotorized trails is also variable depending upon the type of activity.

Table 74. Estimated miles of NFS road that would be closed if 68 percent security core is to be met in subunits where the Forest originally managed more than 75 percent of the lands

Grizzly bear subunit name	Miles of motorized routes to close
Hay Creek	11 miles roads
Canyon McGinnis	2 miles roads
Peters Ridge	27 miles wheeled motorized trails and 10 miles roads
Swan Lake	27 miles wheeled motorized trails and 9 miles roads
Crane Mountain	33 miles roads
Beaver Creek	13 miles roads
Emery Firefighter	9 miles roads
Logan Dry Park	19 miles roads
Skyland Challenge	1 mile wheeled motorized trails and 4 miles roads

Table 75. Estimated miles of NFS road that would be closed if 68 percent security core is to be met in subunits where the Forest has acquired lands

Grizzly bear subunit name	Miles of motorized routes to close
Buck Holland	40 miles roads
Cold Jim	68 miles roads
Glacier Loon	56 miles roads
Hemlock Elk	25 miles roads
Lion	36 miles roads
Meadow Smith	58 miles roads
Piper Creek	43 miles roads

In order to fully meet amendment 19 numeric objectives for all three measures of motorized access density (open motorized access density, total motorized access density, and security core), an additional 518 miles of roads would need to be reclaimed. This total includes up to about 400 miles of roads on lands acquired through the Montana Legacy Project and about 57 miles of trails where wheeled motorized use would no longer be allowed unless site-specifically amended.

The mileages are estimates based upon a programmatic assessment (Ake, 2015a). The actual number may be higher or lower depending upon changing access conditions on adjacent lands and the site-specific factors that must be considered when evaluating access and grizzly bear habitat needs. The Forest would continue to make progress toward implementation as funding allows. This alternative would provide very low risk of individual female grizzly bear displacement on NFS lands because wheeled motorized trails, high-use nonmotorized trails, and/or roads in the grizzly bear recovery zone/primary conservation area would be further restricted. It is uncertain whether additional road or trail restrictions on NFS lands would reduce female grizzly bear mortality or increase the grizzly bear population because grizzly bears are a wide-ranging species and grizzly bear mortality may still occur on private lands, especially if attractants are present, whether public lands are secure or not.

Amendment 19 (appendix TT) of the forest plan also addresses motorized administrative use of restricted routes (see glossary) in the grizzly bear recovery zone/primary conservation area. Appendix TT states that outside of security core areas, motorized administrative use is acceptable at low-intensity levels as defined by either (1) existing cumulative effects analysis models (which defined low-intensity levels as one to six vehicles/week) or (2) minor activities that do not exceed 30 days in duration. Administrative use of reclaimed roads may not occur during the non-denning season unless it is motorized over-snow vehicle use, which can occur during the period of time when public motorized over-snow vehicle use is allowed. Based upon the findings of Northrup and others (Northrup et al., 2012) and of Mace and Waller (1996), the administrative use of roads allowed under amendment 19 would not cause avoidance or underutilization of habitat by grizzly bears.

The existing forest plan and the programmatic biological opinion do not have specific provisions for the amount of temporary decrease in security core and/or temporary increase in total or open motorized access density allowed in the recovery zone/primary conservation area. However, through project-level section 7 consultations, temporary changes have been allowed to accommodate projects such as post-fire timber salvage or culvert removal to benefit bull trout. Some minor effects to individual bears would be anticipated due to temporary increases in open and total motorized access density and temporary decreases in security core for projects.

With alternative A, it is anticipated that motorized access and timber harvest occurring during the non-denning time period would continue to be cooperatively managed in four Swan Valley grizzly bear management subunits where the Forest and the Montana Department of Natural Resources and Conservation continue to share the bulk of lands (Goat Creek, Lion Creek, Porcupine Woodward, and South Fork Lost Soup). Under alternative A, the assumption is that these subunits would be managed according to active periods outlined in the Habitat Conservation Plan adopted by the Montana Department of Natural Resources and Conservation (MTDNRC, 2011). Concentrating commercial timber harvest activities in active subunits and limiting the scope and timing of activities in the inactive subunits would reduce the risk of disturbance of grizzly bears.

Zone 1 outside the grizzly bear recovery zone/primary conservation area

Amendment 19 does not apply outside the grizzly bear recovery zone in zone 1, and therefore open motorized access density and total motorized access density have not been calculated using the moving window analysis method used for amendment 19. Instead, the 1986 forest plan adopted maximum linear road densities that apply to smaller geographic units in areas outside the recovery zone/primary conservation area in the Salish Mountains geographic area. The left column in table 76 shows the maximum linear density of roads open to public use in each geographic unit, as specified in the 1986 forest plan.

After 1986, as grizzly bears began to occupy the Salish Mountains geographic area, subsequent Endangered Species Act section 7 consultation provided direction for management of NFS lands to further reduce grizzly bear mortality risk. The USFWS issued biological opinions, incidental take statements, and terms and conditions for the Salish Mountains geographic area, focusing on access management, livestock grazing, and food/attractant storage. Under alternative A, the assumption is that the Flathead National Forest and it is anticipated that limitations would continue as long as the NCDE grizzly bear population is listed (A. Jacobs, 2005; USDA, 2011c; USFWS, 2006a, 2012a). The right column in table 76 shows the baseline density of roads open to public motorized vehicle use that now occurs as a result of road closures to meet the terms and conditions for grizzly bears and to provide elk habitat security. Current conditions are below maximum linear densities for each geographic unit specified in the 1986 forest plan. (Amendment 19's management direction for OMAD, TMAD, and security core does not apply in the geographic units listed in table 76).

Table 76. Maximum linear density of unrestricted roads by geographic unit

Geographic unit	Grizzly bear management zone	Maximum density requirement (average linear miles/square mile of NFS land[1])	Baseline density(average linear miles/square mile of NFS land)
Island geographic unit	Zone 1	2.2	1.7
Olney-Martin Creek geographic unit	Salish DCA	1.8	1.6
Upper Good Creek geographic unit	Salish DCA	1.8	1.3
Sylvia Lake geographic unit	Zone 1 partially in Salish DCA	1.8	1.0
Star Meadow-Logan Creek geographic unit	Zone 1 partially in Salish DCA	2.2	1.5
Tally Lake-Round Meadow geographic unit	Zone 1 partially in Salish DCA	2.2	1.7
Mountain Meadow-Rhodes Draw geographic unit	Zone 1	2.2	1.6
Upper Griffin geographic unit	Zone 1	3.2	0.9

Geographic unit	Grizzly bear management zone	Maximum density requirement (average linear miles/square mile of NFS land[1])	Baseline density(average linear miles/square mile of NFS land)
Ashley Lake geographic unit	Zone 1	3.2	1.9

1. Source: 1986 forest plan, p. II-37, baseline updated as of January 2017.

Outside the recovery zone/primary conservation area in zone 1, the analysis of the effects of linear open road densities uses the findings of Boulanger and Stenhouse (2014); see also USDA (2015). These authors found that grizzly bear occupancy of habitat occurred where linear open road densities did not exceed 2.4 miles per square mile. In zone 1, linear open road densities are below the threshold of 2.4 miles per square mile that provides for grizzly bear occupancy and below the 2.0 miles per square mile threshold that supports female occupancy (but at a density lower than the core habitat provided by the recovery zone/primary conservation area). The USFWS determined in 2013 that high road densities and lack of security habitat would have impacts on individual bears in some areas outside the recovery zone/primary conservation area but that current management provides for occupancy by female bears (USFWS, 2013c). This conclusion is consistent with research from Boulanger and Stenhouse. If the NCDE grizzly bear population is delisted, incidental take limitations would no longer apply and open road densities in zone 1 would be limited by maximum density requirements of the 1986 forest plan, as displayed in table 76. The maximum open road densities in 2 geographic units are not supportive of grizzly bear occupancy and the maximum road densities in 4 additional geographic units are not supportive of female grizzly bear occupancy.

Motorized access during the den emergence time period

The current forest plan meets the requirements of a settlement agreement resulting from a lawsuit challenging over-snow motorized vehicle use on the Flathead National Forest. In 2006, when the Forest was revising its plan, the intention was stated to carry amendment 24 forward into the forest plan. However, the Forest halted plan revision due to a lawsuit on the proposed planning rule and is now revising its plan again under the 2012 planning rule. Under alternative A, the Forest would continue to implement amendment 24 (USDA, 2006). Based upon new public input on its forest plan, the action alternatives would change some of the areas suitable for motorized and nonmotorized over-snow vehicle use, as described under consequences of alternatives B modified, C and D.

In the recovery zone/primary conservation area, motorized over-snow vehicle use during the den emergence time period (when there is a risk of human disturbance to females with dependent cubs) would be allowed on open roads when snow conditions permit but would otherwise be limited to three late spring areas (also containing routes) and one motorized route corridor. These are Challenge-Skyland, Lost Johnny, and Sixmile late spring areas and Canyon Creek groomed route corridor (see figure B-12). In the recovery zone/primary conservation area, where almost all modeled denning habitat occurs, less than 22 percent of modeled grizzly bear denning habitat on the Forest overlaps with the areas open for motorized over-snow vehicle use during the den emergence time period (see figure 1-32). Given that the number of snowmobilers generally declines during April of each year as the snow starts to melt, the probability of a snowmobiler encountering a female with cubs during this time period is low. The USFWS wrote in their five-year review for grizzly bear, “Our best information suggests that current levels of snowmobile use are not appreciably reducing the survival or recovery of grizzly bears” (USFWS, 2011c, p. 38). Snowmobile use has been monitored by the USFS, and grizzly bears emerging from their dens have been monitored by MFWP; detrimental effects to grizzly bears have not been demonstrated on the Forest (A. H. Jacobs, 2013; USDA, 2012, 2015c, 2016e).

Outside the recovery zone/primary conservation area in zone 1, there is little modeled denning habitat and few restrictions on motorized over-snow vehicle use during the den emergence time period. As of 2015, there has been one known occurrence of a grizzly bear denning outside the recovery zone/ primary conservation area, so the effects of activities in zone 1 during the den emergence time period are expected to be minor.

Consequences of recreation management direction under alternative A

Developed recreation sites

Under the no-action alternative, the forest would continue to follow the Interagency Grizzly Bear Committee recreation management guidelines in management situation 1 and management situation 2 grizzly bear habitat (USDA, 1986, p. II-37). Although there is a potential for developed recreation sites to affect grizzly bears through habituation, food conditioning, or risk of mortality, the likelihood is low because food storage orders are in place across the Forest, greatly reducing grizzly bear-human conflicts on NFS lands across the Forest.

In addition, the 1986 forest plan management direction and anticipated budgets limit increases in developed recreation sites. The 1986 forest plan has a forestwide standard to retain the existing capacity of national forest developed recreation sites and to improve the quality of the developed recreation opportunities through full-service maintenance or the redesign and reconstruction of existing sites to better accommodate present and future needs as funding allows. Some capacity increases are anticipated to occur as a result of these improvements. In the past decade, USFWS consultations for campground and cabin rental projects in the recovery zone/primary conservation area have limited the increase in the number and capacity of developed recreation sites and it is anticipated that limitations would continue as long as the NCDE grizzly bear population is listed. Increased risk of grizzly bear-human conflicts at developed recreation sites on the Forest has been and is anticipated to continue to be minor. Outside the recovery zone/primary conservation area, increases in the number or capacity of developed recreation sites is not limited.

The Whitefish Mountain Resort is in the recovery zone/primary conservation area and has year-round, developed recreation on private lands as well as NFS lands. As explained in the "Affected environment" section, its management has been guided by site-specific consultation. The resort is surrounded by modeled denning habitat, but it is unlikely that grizzly bears would den there due to the high level of human activity. Food and garbage storage requirements, timing constraints on activities during the spring time period, and the requirement to maintain habitat security in the Hellroaring watershed during the non-denning season reduces the risk of grizzly bear-human conflicts.

There is modeled denning habitat in the portion of the Salish Mountains geographic area near the Blacktail Mountain Ski Area west of Kalispell, but it is highly unlikely that grizzly bears would den in the area due to the high level of winter recreational use. Zone 1 has only about 400 acres (a very minor amount) of modeled denning habitat that is not in the Blacktail Mountain Ski Area. Because this potential area of modeled denning habitat is heavily timbered and not accessible by road or trail, it is unlikely to get motorized use during the den emergence time period, so any potential effects are expected to be minor.

Consequences of livestock management direction under alternative A

Over the past several years, more than half of the Forest's 20 allotments were vacated and closed. In 2010, the Flathead National Forest administratively closed five vacant range allotments where use had not occurred for several years (see section 3.23 for more details). Protections and mitigations to reduce livestock-grizzly bear conflicts include (1) deferring livestock grazing in important spring habitat until after July 1 and (2) including permit measures to protect vitally important food sources from conflicting and competing uses by livestock. There are no known livestock conflicts on cattle grazing allotments of the Forest. Based on the lack of history of conflicts, the mortality risk associated with cattle grazing is low and is expected to continue to be low under the no-action alternative.

Consequences of vegetation management direction under alternative A

Alternative A has the highest acreage suitable for timber production of all alternatives—about 526,900 acres (see figure 1-09). Under the no-action alternative, the forest would continue to follow the Interagency Grizzly Bear Committee vegetation management guidelines in management situation 1 and management situation 2 grizzly bear habitat in the recovery zone/primary conservation area. These guidelines state that project design will specify measures to protect, maintain, and/or improve grizzly bear habitat and populations (IGBC, 1986). In the recovery zone/primary conservation area, forest plan guidelines provide limits on distance to cover and limit regeneration harvest until adjacent areas recover. Vegetation management direction would provide for diverse cover and forage conditions that support grizzly bears and would reduce the potential for grizzly bear displacement through the timing of timber sale activities. Riparian areas are managed according to INFISH (USDA, 1995c), which states that treatments in riparian habitat conservation areas cannot retard the attainment of riparian management objectives. This may indirectly benefit the grizzly bear by providing for cover and habitat connectivity in riparian habitat conservation areas. With respect to patch size and landscape pattern, management direction for cover would result in smaller timber harvest openings, more edge, and more fragmented habitat than would have occurred historically due to large stand-replacing wildfires.

Under alternative A, the percentage of the Forest where temporary decreases in security core due to projects are anticipated is difficult to predict at the programmatic level. In general, timber sale projects do not occur in security core, but security core percentages may be reduced due to the influence zone of roads near the edge of security core. These calculations have been made for site-specific projects, in consultation with the USFWS, and it is anticipated that consultation on temporary changes due to vegetation management projects would continue to occur while the grizzly bear is a listed species.

Large stand-replacing wildfires as well as more insect and disease infestation are likely in the future due to warmer, drier summer climate conditions. Wildfires, insect and disease infestations, and timber harvest would reduce cover but would promote grizzly bear foods. The SIMPPLLE and Spectrum models were used to estimate the differences among alternatives with respect to timber harvest and prescribed fire (see section 3.3 and appendix 2 for more details).

Although no management direction specific to grizzly bears is given in the 1986 forest plan for the area outside the recovery zone/primary conservation area, the Forest has consulted on site-specific vegetation management projects as the grizzly bear population has expanded into zone 1. The forest plan contains management direction that indirectly provides benefits to grizzly bears through direction pertaining to other species and their habitats, such as elk. Selected recommendations from the Montana Cooperative Elk-Logging Study (Lyon et al., 1985), which is appendix DD of the 1986 forest plan, would continue to be followed. This direction has the indirect effect of protecting moist sites that may provide grizzly bear foods, as does the management direction for riparian habitat conservation areas. (For a discussion of timber suitability, see the section below titled “Consequences of management area allocations.”)

Consequences of minerals management direction under alternative A

The 1986 forest plan contains management direction to mitigate the effects of mineral development. This direction includes standards and guidelines associated with INFISH and grizzly bear guidelines for minerals and special uses, applicable to all management situations (p. II-42) in the recovery zone/primary conservation area. These mitigation measures are intended to reduce the impacts of mineral activities upon grizzly bears by (1) reducing or eliminating impacts of mineral activities within riparian habitat conservation areas, (2) scheduling activities so as to provide grizzly bear security immediately adjacent to activity areas, (3) requiring restrictions on food storage, garbage disposal, firearms, and domestic pets at approved camps, (4) avoiding adverse effects that reduce habitat effectiveness in seasonally important habitats, and (5) restricting helicopter flight patterns. The Forest has not had to apply this management direction because it has not had mineral activities (except for salable activities such as gravel removal), and there is low probability of any effects to grizzly bears in the future because of the lack of high mineral potential (see figure 1-67).

Regarding leasable mineral activity (e.g., oil and gas), according to the current (1986) forest plan, “Stipulations which are displayed in Appendix O and which are based on the Environmental Assessment of Oil and Gas Leasing of Non-wilderness Lands on Flathead National Forest, 1980, will be recommended in accordance with the management area direction in Chapter III. Before action is recommended on any lease application, additional site-specific analysis of environmental affects will be done” (p. II-55). Each lease, if issued, would include numerous standard and special stipulations to minimize the effects of oil and gas activities on surface resources.

Consequences of habitat connectivity management direction under alternative A

Alternative A does not specifically address connectivity with respect to grizzly bears. The 1986 forest plan contributes to habitat connectivity in terms of cover and areas with low risk of human disturbance (see figure 1-38). Forestwide management direction associated with amendment 21, as well as INFISH, addresses connectivity in old growth and riparian areas, which would benefit grizzly bears. Amendment 19 provides for habitat connectivity with respect to motorized access.

Consequences of demographic connectivity management direction under alternative A

Demographic connectivity considers the genetic interchange between the Forest portion of the NCDE and the Cabinet-Yaak Ecosystem for grizzly bears. The 1986 forest plan does not provide specific management direction to provide for female grizzly bear occupancy in the area outside the recovery zone/primary conservation area and does not address demographic connectivity or genetic interchange with the Cabinet-Yaak Ecosystem. In the last decade, MFWP has translocated grizzly bears from the NCDE to the Cabinet-Yaak Ecosystem in order to facilitate genetic interchange. In recent years, the number of documented grizzly bear reports in the area outside the recovery zone has been increasing as the population in the NCDE increases. More grizzly bears are exploring new territory farther to the west (R. D. Mace & Roberts, 2012).

Consequences common to Alternatives B modified, C, and D

Some plan components apply to the recovery zone/primary conservation area, which totals about 90 percent of the total Forest area. Some plan components apply to areas that were previously outside the recovery zone/primary conservation area, designated as zone 1 (totaling about 10 percent of the total Forest area). Zone 1 includes the Salish demographic connectivity area (see forest plan figure B-10).

Consequences of motorized access management

Under the action alternatives, previous amendments to the forest plan (e.g., amendment 19) would no longer be part of the forest plan, but many of the past actions that have created the current baseline would be retained, such as having standards for motorized use of roads and trails. The moving window analysis method has been used to evaluate the effects of motorized access density on grizzly bears across the NCDE since 1995 and would continue to be used to calculate access percentages. Requirements resulting from consultation on the forest plan would replace requirements of the previous consultations for motorized access in the recovery zone/primary conservation area and zone 1.

Some members of the public expressed concern about methods used to calculate motorized access percentages. Under the action alternatives, the methods for calculating open motorized route density, total motorized route density, and secure core are different than the methods used for calculating percentages for alternative A (Ake, 2017a). The EIS uses different terms (rather than the terms open motorized access density, total motorized access density, and security core) to distinguish between amendment 19 (alternative A) and the action alternatives. For example, the draft Grizzly Bear Conservation Strategy uses the term "secure core" rather than "security core" to refer to the revised definition which does not include deductions due to high-use nonmotorized trails, based upon the best available scientific information. The Forest has adopted the same terminology and definition in developing the action alternatives for the forest plan revision (see glossary). Additionally, under the action alternatives the recovery zone/primary conservation area is no longer stratified into grizzly bear management situations 1, 2, or 3) (see the "Affected environment" section for more details). Management situation 3 is not counted in calculation of percentages for amendment 19, but would be counted for the action alternatives because motorized access standards apply to the whole recovery zone/primary conservation area. In calculating total motorized route density for the action alternatives, roads are not counted if they meet the definition of "impassable" (see glossary). Because the methods for calculating percentages under the action alternatives are different than the methods used for calculating percentages under alternative A, the percentages for some subunits may change even if there have been no changes on the ground. All of the action alternatives would maintain baseline levels (see glossary) of open motorized route density, total motorized route density, and secure core in the recovery zone/primary conservation area, providing on-the-ground levels of security for grizzly bears that have supported the NCDE grizzly bear population.

The action alternatives would maintain baseline levels of the linear density of motorized routes open to public use during the non-denning season in zone 1 inside the Salish demographic connectivity area (see the "Affected environment" section for more details).

Consequences of recreation management

All action alternatives would add plan components in the recovery zone/primary conservation area for developed recreation sites, but the action alternatives differ with respect to recreation plan components for zone 1. Limits on the number and capacity of developed recreation sites in the recovery zone/primary conservation area for alternatives B modified, C, and D (discussed in detail below) is anticipated to be similar to what has resulted through consultation, so increased risk of grizzly bear-human conflicts at developed recreation sites on the Forest would be minor. Most of the grizzly bears killed or removed by management agencies in the NCDE in the past had been involved in conflicts related to unsecured attractants such as garbage, bird feeders, pet/livestock feed, and human food. Although the majority of these mortalities occurred on private lands, the risk of grizzly bear mortality at developed recreation sites on public lands in the recovery zone/primary conservation area remains of concern because grizzly bear-human conflicts have occurred at developed recreation sites on NFS lands in the past. The Forest's food storage orders are highly effective at reducing the risk of grizzly bear-human conflicts. As a result, the draft Grizzly Bear Conservation Strategy includes measures that would allow a slight increase in the number and capacity of overnight developed recreation sites within the recovery zone/primary conservation area, but this increase would be limited to further reduce the risk of conflicts (see the sections on consequences specific to each action alternative for more details).

Consequences of livestock management

Cattle grazing is a relatively minor use of NFS lands on the Forest, and there are no sheep grazing allotments. The existing cattle-grazing allotments have been compatible with an NCDE grizzly bear population that is stable to increasing and expanding in distribution (Costello et al., 2016). Based on the lack of a history of conflict, the risk of grizzly bear mortality associated with livestock grazing is low.

Consequences of vegetation management

Specific reference to the Interagency Grizzly Bear Guidelines (IGBC, 1986), including the delineation of management situations, would no longer be part of the forest plan. However, plan components are very similar to the Interagency Grizzly Bear Guidelines for timber management in terms of managing for a mosaic of successional stages, restricting logging activities in time and space as needed, designing projects to maintain or improve grizzly bear habitat quality or quantity where it would not increase the risk of grizzly bear-human conflicts, and retaining cover as needed in key habitat areas such as grass, forb, and shrub openings and riparian management zones. The vegetation management plan components would provide for diverse cover and forage conditions and would reduce the potential for grizzly bear disturbance through the timing of timber sale activities.

All action alternatives include guidelines FW-GDL-TE&V-01 through 05. These guidelines reduce the risk of grizzly bear-human conflicts, disturbance or displacement in the recovery zone/primary conservation area. All action alternatives allow for temporary increases in the percentage of open and total motorized route density and temporary decreases in the percentage of secure core under standard FW-STD-IFS-03 for projects, but management areas where this could occur and the magnitude of change that could occur are limited. In each bear management subunit within the NCDE primary conservation area, temporary changes in the open motorized route density, total motorized route density, and secure core shall be allowed for roads used for projects (as defined by “project (in grizzly bear habitat in the NCDE)” during the non-denning season; see glossary). Calculations will include estimated changes for each year of the anticipated duration of the project and shall be incorporated into the 10-year running average required by standard FW-STD-IFS-03. As in the past, effects of vegetation management projects would be disclosed in environmental assessments completed at the project level. Although there may be short-term negative impacts to individual bears from vegetation management projects and associated road use, these impacts have been and would continue to be limited by standards and guidelines so that Forest management can contribute to the continued recovery of the NCDE grizzly bear population. (The SIMPPLLE and Spectrum models were used to estimate the differences among the alternatives with respect to timber harvest and prescribed fire (see section 3.3 and appendix 2 for more details). For a discussion of timber suitability by alternative, see section 3.7.7 on consequences of vegetation management.

Consequences of minerals management

Mineral development can affect grizzly bears by causing long-term loss of habitat, increasing vehicle collisions, increasing grizzly bear disturbance or displacement, and increasing grizzly bear-human conflicts. The action alternatives include standards FW-STD-E&M-01 through 09 and guidelines FW-GDL-E&M-01 through 07 that specify minerals mitigation measures related to grizzly bears that reduce the risk of key habitat degradation, grizzly bear-human conflicts, and grizzly bear disturbance or displacement should mineral development occur in the future.

Alternative B modified

Consequences of motorized access management direction for alternative B modified

Recovery zone/primary conservation area

Desired condition NCDE-DC-IFS-01 would establish the intent to manage open motorized route density, total motorized route density, and secure core in a manner that would contribute to sustaining the recovery of the NCDE grizzly bear population. Three key standards and two key guidelines would help to achieve this desired condition: FW-STD-IFS-01 through 03 and FW-GDL-IFS-01 and 02. FW-STD-IFS-02 states, “In each bear management subunit within the NCDE primary conservation area, there shall be no net decrease to the baseline (see glossary) for secure core and no net increase to the baseline for open motorized route density or total motorized route density on NFS lands during the non-denning season (see glossary).” The bulleted items listed under FW-STD-IFS-02 note conditions that are not considered a net increase or decrease from the baseline based upon what has been learned through the application and monitoring of amendment 19. Listing the bulleted items is intended to provide clarity, as are the definitions in the glossary. During the time period that the NCDE grizzly bear population was growing and expanding in distribution, changes to open motorized route density, total motorized route density, and security core percentages occurred due to motorized route closures, but percentages also changed even though there was no change or a very minor change in on-the-ground conditions for grizzly bears (USDA, 2014a, 2016c).

Table 77 and table 78 show the baseline open road motorized density, total motorized route density, and secure core percentages for each bear management subunit under alternative B modified (see figure 1-39). There would be some bear management subunits on the Forest where open road motorized density or total motorized route density exceed 19 percent or where secure core is less than 68 percent. These subunits would not be required to further decrease road densities or increase secure core in the future, so there would be negative effects to individual bears due to disturbance, displacement, and/or mortality risk (Kuennen et al., 2017). However, the best available scientific information documents increases in grizzly bear distribution, population size, and genetic diversity under these conditions. The estimated population size was 765 bears in 2004 (Katherine C. Kendall et al., 2009), more than double the target of 391 bears based on sightings of females with cubs. Distribution has increased, and the occupancy of bear management units has been documented (Costello et al., 2016). Mortality has been at an acceptable level based on ongoing research and monitoring showing that the NCDE grizzly bear population has been stable to increasing (Costello et al., 2016; Mikle, Graves, Kovach, Kendall, & Macleod, 2016). Motorized access conditions are expected to continue to support the recovery of the NCDE grizzly bear population. Habitat security conditions would continue to be monitored by the Forest, and the grizzly bear population would continue to be monitored by MFWP.

Table 77. Open road motorized density (OMRD), total motorized route density (TMRD), and secure core baseline (CORE) for bear management subunits with NFS lands greater than or equal to 75 percent (source: Ake (2017a)

Bear Management Subunit Name	OMRD (%)	TMRD (%)	CORE (%)
Albino Pendant	0	0	100
Big Salmon Holbrook	0	0	100
Black Bear Mud	0	0	100
Brushy Park	0	0	100
Buck Holland	24	41	49
Burnt Bartlett	0	0	100
Hungry Creek	0	0	100
Little Salmon Creek	0	0	100
Meadow Smith	20	54	42
White River	0	0	100
Big Bill Shelf	11	6	87
Bunker Creek	5	3	92
Gorge Creek	0	0	100
Harrison Mid	1	0	99
Jungle Addition	19	19	68

Bear Management Subunit Name	OMRD (%)	TMRD (%)	CORE (%)
Lion Creek	18	47	51
Spotted Bear Mountain	19	18	68
Pentagon	0	0	100
Silvertip Wall	0	0	100
Strawberry Creek	0	0	100
Trilobite Peak	0	0	100
Doris Lost Johnny	57	20	36
Emery Firefighter	19	20	58
Peters Ridge	52	25	34
Riverside Paint	18	16	71
Wounded Buck Clayton	28	30	66
Dickey Java	9	0	85
Moccasin Crystal	8	1	81
Stanton Paola	8	3	83
Canyon McGinnis	18	31	50
Lower Big Creek	18	19	71
Werner Creek	29	20	63
Beaver Creek	6	26	66
Cold Jim	18	57	43
Crane Mountain	28	53	25
Glacier Loon	22	41	52
Hemlock Elk	6	30	64
Piper Creek	19	45	55
Ball Branch	8	12	84
Jewel Basin Graves	20	19	75
Kah Soldier	19	19	68
Logan Dry Park	30	36	51
Lower Twin	9	2	92
Swan Lake	40	23	46
Twin Creek	0	0	100
Wheeler Quintonkon	25	19	68
Flotilla Capitol	0	0	100
Long Dirtyface	0	0	100
Plume Mountain Lodgepole	0	0	100
Skyland Challenge	20	17	65
Tranquil Geifer	0	2	90
Coal & South Coal	15	19	73
Frozen Lake	10	4	86
Hay Creek	25	16	55
Ketchikan	14	3	73
Lower Whale	36	17	50
Red Meadow Moose	25	17	68

Bear Management Subunit Name	OMRD (%)	TMRD (%)	CORE (%)
Upper Trail	14	4	88
Upper Whale Shorty	12	11	86
Basin Trident	0	0	100
Gordon Creek	0	0	100
Jumbo Foolhen	0	0	100
Youngs Creek	0	0	100

Note. OMRD = percentage of subunit with open motorized route density greater than 1.0 mile/square mile, updated baseline; TMRD = percentage of subunit with total motorized route density greater than 2.0 miles/square mile, updated baseline; CORE = percentage secure core in subunit; updated baseline.

Table 78. Open road motorized density (OMRD), total motorized route density (TMRD), and secure core baseline (CORE) for bear management subunits with NFS lands less than 75 percent (source: Ake (2017a)

Bear Management Subunit Name	Principal Land Management Unit (all ranger districts (RD) are on the Flathead National Forest)	OMRD (%)	TMRD (%)	CORE (%)
Goat Creek	Swan Lake RD and Montana Department of Natural Resources and Conservation	23	59	39
South Fork Lost Soup	Swan Lake RD and Montana Department of Natural Resources and Conservation	25	47	37
Coram Lake Five	Hungry Horse RD	30	46	14
Cedar Teakettle	Glacier View RD	35	36	24
Porcupine Woodward	Swan Lake RD and Montana Department of Natural Resources and Conservation	27	74	15
Lazy Creek	Tally Lake RD and Montana Department of Natural Resources and Conservation	68	62	10
Stryker	Tally Lake RD and Montana Department of Natural Resources and Conservation	37	33	50
Upper Whitefish[1]	Tally Lake RD and Montana Department of Natural Resources and Conservation	34	57	54
Noisy Red Owl	Swan Lake RD	20	13	59
State Coal Cyclone	Glacier View RD and Montana Department of Natural Resources and Conservation	29	25	58

Note. OMRD = percentage of subunit with open motorized route density greater than 1.0 mile/square mile, updated baseline; TMRD = percentage of subunit with total motorized route density greater than 2.0 miles/square mile, updated baseline; CORE = percentage secure core in subunit; updated baseline.

Another standard addresses temporary changes in road densities due to projects in the recovery zone/primary conservation area. FW-STD-IFS-03 would allow temporary changes within a bear management subunit for projects (see glossary), up to a limit of 5 percent increase in open motorized route density, 3 percent increase in total motorized route density, and 2 percent decrease in secure core calculated by a 10-year running average. To reduce the risk of grizzly bear disturbance or displacement, each project would be designed so that implementation would not exceed five years (NCDE-GDL-IFS-01) and pre-project motorized route and secure core percentages would be restored within one year of project completion (NCDE-GDL-IFS-02). The temporary changes allowed to open motorized route density, total motorized route density, and secure core under FW-STD-IFS-03 are based on an analysis of six timber sale projects on NFS lands (Ake & Kuennen, 2017). During the life of these six projects, open motorized access density temporarily increased an average of 5.4 percent, total motorized access density temporarily increased an average of 2.9 percent, and security core temporarily decreased by 2 percent.

This includes five projects that occurred on the Flathead National Forest and one on the Lolo National Forest, affecting 18 grizzly bear management subunits. The projects were reviewed and allowed through consultation with the USFWS. They occurred between 2003 and 2010, a period during which the NCDE grizzly bear population is estimated to have been increasing (Costello et al., 2016; Katherine C. Kendall et al., 2009; R. D. Mace et al., 2012). Therefore, the duration of these projects and the associated effects are believed to be compatible with a stable to increasing grizzly bear population in the NCDE.

Although the standards above would allow temporary changes in habitat security due to projects, including some activities in secure core, there would be no temporary decreases in secure core due to vegetation management projects over most of the recovery zone/primary conservation area. The Forest has about 1.7 million acres in secure core habitat, with only about 9 percent of secure core outside of wilderness and inventoried roadless areas, so high levels of habitat security would continue to be maintained (see figure 1-39). In addition, under alternative B modified, some of the inventoried roadless areas would be added as recommended wilderness, where timber harvest would not be allowed (see the discussion in the section below titled “Consequences of management area allocations—All alternatives”).

Table 79. Temporary changes in habitat security due to projects anticipated for alternative B modified

Recovery Zone/Primary Conservation Area	Alternative B Modified
Acres in the recovery zone/primary conservation area on the Forest	2,124,316 acres
Acres in secure core habitat	1,672,877 acres
Acres of existing wilderness	1,075,376 acres
Acres in inventoried roadless areas	478,758 acres
Percentage of secure core habitat where a temporary decrease would be anticipated	9%

Allowances made for project implementation would permit some negative impacts to individual bears as a result of human disturbance in a project area but would establish limits on the amount per subunit as well as on the duration of the disturbance. These impacts have been and would continue to be managed to provide for the needs of the NCDE grizzly bear population. Implementation of these standards and guidelines would be monitored and reported (see monitoring items in chapter 5 of the forest plan).

Standard FW-STD-IFS-01 addresses administrative use in the recovery zone/primary conservation area that do not meet the definition of a project. During the time period that the NCDE grizzly bear population was growing and expanding in distribution, administrative use was allowed on restricted roads if it met the criteria listed under standard FW-STD-IFS-01. Mace and others (1996) studied grizzly bear use of areas within a 0.5 kilometer (about 0.31 mile) influence zone of roads in the Swan Mountains of the Forest. Most grizzly bears exhibited either neutral or positive selection for this zone if it surrounded closed roads or roads receiving less than 10 vehicles per day, but avoided this influence zone if it surrounded roads having use by more than 10 vehicles per day. Based upon these findings, the administrative use of six trips per week on closed roads that would be allowed under alternative B modified would not be anticipated to cause grizzly bear avoidance. Unlimited use for one 30-day time period allowed by standard FW-STD-IFS-01 could cause bear avoidance in the affected area if it exceeded 10 vehicles per day, but this level of administrative use would be restricted to a short period of time to minimize adverse impacts to grizzly bears. This allowance provides for short-duration activities which must be accomplished during the non-denning season, such as culvert and road best management practice work on roads in secure core. Due to the short duration and low level of temporary administrative use, negative impacts to the grizzly bear resulting from disturbance are anticipated to be minor.

FW-STD-IFS-04 applies to temporary use of roads by the public. This standard states, “within the NCDE primary conservation area, a restricted road may be temporarily opened for public motorized use to allow authorized uses (such as firewood gathering), provided the period of use does not exceed 30 consecutive days during one non-denning season and occurs outside of spring and fall bear hunting seasons. However, temporary public use of a restricted road shall not be authorized in secure core (see glossary).” There would be some increase in disturbance and the risk of grizzly bear mortality in areas outside of secure core, but the risk is minimized by limiting the duration and season when temporary use by the public could occur. Gated roads on the Forest have been temporarily opened for periods of up to 30 days to allow firewood gathering during the time period when the NCDE grizzly bear population was growing and expanding, with no apparent population-level effects.

Overall, the set of plan components discussed above is intended to limit open motorized route density and total motorized route density and to maintain sufficient secure core in the recovery zone/primary conservation area to support the NCDE grizzly bear population. In addition, open motorized route density, total motorized route density, secure core, administrative use, and temporary changes due to projects would be monitored by the USFS (see the forest plan, chapter 5), and the plan could be modified in the future if monitoring indicates that changes are needed.

Zone 1

For zone 1, the draft Grizzly Bear Conservation Strategy establishes a goal to provide for grizzly bear occupancy. In the Salish demographic connectivity area within zone 1, the goal is to provide for female grizzly bear occupancy to provide for genetic interchange with the Cabinet-Yaak Grizzly Bear Ecosystem, but at a lower density than in the recovery zone/primary conservation area. Zone 1 is not intended to provide core habitat for the NCDE grizzly bear population. This goal is addressed by desired condition GA-SM-DC-01 for the demographic connectivity area. Desired conditions FW-DC-LSU-01 and GA-SM-DC-03 also address connectivity, including consolidation of NFS lands and conservation easements with willing landowners to provide habitat connectivity and facilitate movement of wildlife, including but not limited to the grizzly bear. In the last decade, MFWP has also translocated grizzly bears from the NCDE to the Cabinet-Yaak Ecosystem in order to facilitate genetic interchange between grizzly bear ecosystems.

Baseline densities of motorized routes in the Salish demographic connectivity area (table 80) would be sufficient to support occupancy by female grizzly bears, according to findings of Boulanger and Stenhouse (2014). In the rest of zone 1, baseline levels of the linear density of roads open to motorized public use during the non-denning season would be maintained at baseline levels, but the density of motorized trails could increase. As displayed in table 80, the density of motorized roads and trails outside the Salish demographic connectivity area provides for grizzly bear occupancy and would continue to do so even if motorized trails increased slightly, based upon findings by Boulanger and Stenhouse (see table 62 in the “Affected environment” section).

Table 80. Public open motorized access for all roads/trails on NFS lands (includes highways and county/city and private roads/trails) (source: Ake (2017b); USDA (2016a, Dec. 28, 2015, roads/trails data set))

NCDE Management Zone	Open Roads (Miles)	Motorized Trails (Miles)	Total (Miles)	NFS Lands (Square Miles)	Public Open Motorized Roads Only (Miles/Square Mile)	Public Open Motorized Roads and Trails Miles/Square Mile
Zone 1, Salish demographic connectivity area	217	14	231	150	1.4	1.5

NCDE Management Zone	Open Roads (Miles)	Motorized Trails (Miles)	Total (Miles)	NFS Lands (Square Miles)	Public Open Motorized Roads Only (Miles/Square Mile)	Public Open Motorized Roads and Trails Miles/Square Mile
Zone 1, outside Salish demographic connectivity area	338	64	402	212	1.6	1.9

In recent years, the number of documented grizzly bear reports in the area outside the recovery zone/primary conservation area has been increasing as the population in the NCDE has increased. More grizzly bears are exploring new territory farther to the west (R. D. Mace & Roberts, 2012). Alternative B modified would maintain the baseline linear density of roads open to motorized vehicle use by the public that has supported the expansion of the grizzly bear population into areas outside the recovery zone/primary conservation area (see figure B-17 in Kuennen et al., 2017 for more details). Guideline GA-SM-GDL-01 for elk habitat security also provides indirect benefits to grizzly bears in zone 1 in terms of limiting the distribution of roads open to motorized vehicle use by the public during the non-denning season and providing for a mosaic of cover and forage in elk security habitat.

Motorized over-snow vehicle use

Under alternative B modified, about 60 percent of modeled grizzly bear denning habitat occurs within existing wilderness areas where motorized use is prohibited. About 13 percent of modeled denning habitat is within recommended wilderness areas, and about 13 percent of modeled denning habitat is in other areas that are not suitable for motorized over-snow vehicle use (see figure 1-33). In these areas, individual grizzly bears may be disturbed by nonmotorized uses, such as backcountry skiing or snowboarding, during the den emergence time period, but there would generally be a low risk of human disturbance, and population-level effects are not anticipated. The USFWS wrote in their five-year review for grizzly bear, “Our best information suggests that current levels of snowmobile use are not appreciably reducing the survival or recovery of grizzly bears” (USFWS, 2011c, p. 38).

The discussion of motorized over-snow vehicle use is focused on the den emergence time period due to concerns about the risk of disturbance to female grizzly bears with dependent cubs emerging from their dens (see the “Affected environment” section for more details). With this alternative, areas that are open to motorized over-snow vehicle use during the den emergence time period occur in about 3 percent of modeled grizzly bear denning habitat in the recovery zone/primary conservation area, a minor amount. In the recovery zone/primary conservation area there are about 19 miles of routes open to motorized over-snow vehicle use in modeled grizzly bear denning habitat after April 1; these routes could be open during the den emergence time period, depending upon annual snow conditions.

Because there is uncertainty regarding the potential effects of motorized over-snow vehicle use on females with cubs during the den-emergence time period and because this use could increase in the future, alternative B modified adopts standard FW-STD-REC-05, which states “Within grizzly bear denning habitat modeled by MTFWP in the NCDE primary conservation area, there shall be no net increase in percentage of area or miles of routes designated for motorized over-snow vehicle use on NFS lands during the den emergence time period (see glossary)” (see forest plan figure B-12; Skyland Challenge, Lost Johnny, and Sixmile areas and Canyon Creek groomed route corridor). Because very little modeled denning habitat is open when den emergence may be occurring and because many females with cubs are known to exit their dens during the latter part of the time period when these areas may be open to motorized over-snow vehicle use, the risk of disturbance is anticipated to be minor. Standard FW-STD-REC-05 would provide assurance that potential impacts to bears, particularly females with cubs, would not increase over time in the recovery zone/primary conservation area. Much of the area outside the recovery zone/primary conservation area is suitable for motorized over-snow vehicle use. There is a minimal amount of modeled grizzly bear denning habitat in zone 1 outside the primary conservation area, so the risk of disturbance or displacement to grizzly bears (including females with cubs) is very low.

Consequences of recreation management direction under alternative B modified

Developed recreation sites

Developed recreation sites with frequent or prolonged human occupancy may result in increased bear attractants, increasing the risk of grizzly bear-human conflicts or grizzly bear mortality. The draft Grizzly Bear Conservation Strategy stated that the main concern with developed recreation sites has to do with overnight use. Under alternative B modified, two desired conditions and one standard address developed recreation sites designed and managed for overnight use. Within the recovery zone/primary conservation area, the number, capacity, and improvements of developed recreation sites would provide for user comfort and safety while minimizing the risk of grizzly bear–human conflicts on NFS lands (FW-DC-REC-01 and FW-DC-REC-02). Standard NCDE-STD-REC-01 would set a limit of one increase in the number or the overnight capacity of developed recreation sites designed and managed for overnight use per bear management unit per decade on NFS lands in the recovery zone/primary conservation area. There are 11 bear management units within the recovery zone/primary conservation area on the Flathead National Forest, not counting the Stillwater bear management unit (where NFS lands are minimal). Out of these 11, 6 are shared with other Forests or agencies (e.g., the National Park Service). Therefore, in a 10-year time period, the Flathead National Forest has the ability to add a maximum of 5 to 11 overnight developed recreation sites in the recovery zone/primary conservation area (6 to 12 counting the Stillwater bear management unit). Outside of the recovery zone/primary conservation area, the limitation on overnight developed recreation sites is not applied.

The draft Grizzly Bear Conservation Strategy states, “The intent of the developed recreation site standard is to not increase the number of developed sites or capacity at most overnight developed sites on public Federal lands within each bear management unit above levels known to have occurred at a time when there was a stable to increasing grizzly bear population” (USFWS, 2013c, p. 59); planning record #00671. Although the NCDE grizzly bear population was listed as threatened under the Endangered Species Act, there were occasional increases in developed sites that were approved through consultation with the USFWS. To allow a similar level of increase in developed site numbers or capacity that has occurred under listed status, one increase in the capacity or number of developed sites would be allowed per bear management unit per 10 years. The set of plan components for developed recreation sites is consistent with what has occurred on the Forest through consultation during the time period when the NCDE grizzly bear population was stable to increasing and expanding in distribution (Costello et al., 2016).

Although there may be an increased risk of grizzly bear-human conflicts as a result of some increase in developed recreation sites with overnight use in the future, the risk of grizzly bear-human conflicts or mortality for grizzly bears would be limited. The action alternatives include standard FW-STD-WL-02, which states that within the NCDE primary conservation area and zone 1 (including the Salish demographic connectivity area), food/wildlife attractant storage special order(s) shall apply to all NFS lands. Food storage orders are in effect across the Forest and are very effective in reducing grizzly bear-human conflicts or mortality on NFS lands. The orders are updated over time as new information and new technologies become available but would continue to be guided by the Interagency Grizzly Bear Committee or a similar group of experts. Concerted efforts by MFWP to respond to grizzly bear-human conflicts, both on and off NFS lands, have greatly reduced the risks to both bears and people. Additionally, guideline FW-GDL-REC-01 specifies that additional measures should be used to reduce the risk of grizzly bear-human conflicts if the number or capacity of day-use or overnight developed recreation sites is increased.

There is one developed year-round resort in the recovery zone/primary conservation area, Whitefish Mountain Resort. It has operated as a ski area since the 1940s and has operated during the non-denning season since the 1980s. This resort does not have overnight use on NFS lands. As discussed in previous biological assessments, the Whitefish Mountain Resort likely causes disturbance and/or displacement of grizzly bears, but there have been no known grizzly bear mortalities. The Whitefish Mountain Resort has had mitigation measures in place for decades to reduce grizzly bear-human conflicts during the non-denning season. The following standards and guidelines would apply under alternative B modified. Standard FW-STD-REC-04 requires that new or reauthorized ski area permits on NFS lands that operate during the non-denning season shall include measures to limit the risk of grizzly bear-human conflicts, and this would continue to decrease the potential for detrimental effects to the NCDE grizzly bear population. Additionally, guideline GA-SM-MA7-Big Mtn-GDL-01 and desired condition GA-SM-MA7-Big Mtn-DC-04 would benefit the grizzly bear by limiting the risk of grizzly bear disturbance or displacement or grizzly bear-human conflicts at the resort.

No limits on developed recreation sites would occur in zone 1 under alternative B modified. There is one developed ski area in Zone 1, the Blacktail Ski Area. This ski area is not currently operated during the non-denning season, but forestwide standard FW-STD-REC-04 would apply to this area as well.

Other recreation activities

As stated in the “Affected environment” section, individual grizzly bears may avoid nonmotorized trails and thus reduce the risk of grizzly bear human conflicts or they may have conflict with people on nonmotorized trails; the effects of nonmotorized trails are highly variable. There are no demonstrated population-level effects to the NCDE grizzly bear as a result of nonmotorized trail use, so deductions to secure core percentages for high-use nonmotorized trails are eliminated under this alternative. As stated in the draft Grizzly Bear Conservation Strategy, “If research demonstrates that high intensity use non-motorized trails do significantly impact grizzly bear populations or that there are areas of significantly higher mortality risk near high intensity use nonmotorized trails (as opposed to other trails or roads), this new information will be appropriately considered and incorporated through an adaptive management approach” (USFWS, 2013c, p. 23). In the future, grizzly bear population monitoring would be conducted by MFWP to determine whether any population-level effects of human uses are occurring. Alternative B modified also has recreation plan components that are Forest specific. For example, desired conditions MA7-DC-01 and 02 are applicable to management area 7 (focused recreation areas; see figure 1-02). The proposed action includes plan components to reduce the risk of bear-human conflicts, benefiting grizzly bears.

To reduce the risk grizzly bear-human conflicts, alternative B modified includes the following guidelines:

FW-GDL-IFS-15. When developing, constructing, or reconstructing system trails, pertinent public information on how to avoid and respond to bear-human encounters should be posted at trailheads. In addition, site-specific trail design should include one or more methods to limit the risk of bear-human conflicts such as, but not limited to:

- locating trails outside of riparian management zones or avalanche chutes, unless it is necessary to cross or to access an existing developed recreation site,
- designing and maintaining trails to increase sight distance and/or to address speed of travel consistent with site-specific conditions for the managed use of the trail.

- FW-GDL-REC-05. To reduce the risk of conflicts between wildlife and event participants as well as with other recreationists, authorizations for recreation events, group use, and commercial activities should include permit measures that address potential conflicts such as, but not limited to, location of the event, timing of the event, party size, and education on reduction of wildlife-human conflicts.

Grizzly bear-human conflicts are monitored by MFWP and would continue to be monitored in the future so that adaptive changes could be made, if warranted.

Consequences of livestock management direction under alternative B modified

Desired condition FW-DC-GR-01 for grazing provides for ecological conditions for the grizzly bear. To incorporate livestock allotment standards in the draft NCDE Grizzly Bear Conservation Strategy, alternative B modified includes standards FW-STD-GR-01 through 06 and guideline FW-GDL-GR-01 for the recovery zone/primary conservation area. Standards FW-STD-GR-01 through 04 and 06 also apply to zone 1 to reduce the future risk, in response to public comments. In addition, in order to reduce the cost of administering very small livestock allotments, the forest plan includes a Forest-specific guideline for the Swan Valley geographic area (GA-SV-GDL-04) that would reduce cattle-grazing allotments in the recovery zone/primary conservation area if opportunities arise with a willing permittee. The additional management direction for grazing included in alternative B modified is not associated with the draft Grizzly Bear Conservation Strategy. Although the Flathead National Forest has not had conflicts between cattle and grizzly bears in the past, the set of plan components for livestock grazing would reduce the risk conflicts with grizzly bears in the future.

Additionally, attractant storage orders required by FW-STD-WL-02 reduce the risk of grizzly bear-human conflicts associated with livestock. According to the draft Grizzly Bear Conservation Strategy (2013c), “Impacts on grizzly bears due to attractants associated with livestock can be effectively minimized with requirements to securely store and/or promptly remove attractants associated with livestock operations (e.g., livestock carcasses, livestock feed, etc.)” (p. 25). Continued implementation of the Forest’s attractant storage orders is expected to result in minimal risk of grizzly bear-livestock conflicts.

As stated in the draft Grizzly Bear Conservation Strategy, “Current levels of grazing intensity [on permitted livestock allotments] in forested environments are not displacing grizzly bears in significant ways and are not likely to affect vegetation structure enough to result in direct competition for forage species on public lands within the NCDE, as evidenced by the increasing population trend in the NCDE” (USFWS, 2013c, p. 25). As a result, the draft Grizzly Bear Conservation Strategy included measures to keep livestock grazing at or below the baseline levels in the recovery zone/primary conservation area. The 2011 baseline was selected because available information documents increases in grizzly bear distribution and population size. The estimated population size was 765 bears in 2004 (Katherine C. Kendall et al., 2009), more than double the target of 391 bears based on sightings of females with cubs. Occupancy of bear management units has been documented (Costello et al., 2016). Mortality has been at an acceptable level based on ongoing research and monitoring showing that the NCDE grizzly bear population has been stable to increasing and expanding its distribution (Costello et al., 2016).

Consequences of vegetation management direction under alternative B modified

As stated in the “Affected environment” section, the grizzly bear is a habitat generalist that is adaptable to changing vegetative conditions. Alternative B modified provides for habitat diversity, taking into account the modeled effects of climate change that are anticipated to occur over the next 50 years. Because the grizzly bear uses a wide variety of habitats across the Forest, a specific model was not developed for this species. Instead, the discussion below is a summary of modeled vegetation changes on the Forest. Grizzly bear habitat and its use by grizzly bears would vary across time and space due to natural processes (e.g., succession, wildfires, insects and disease) and vegetation management activities (e.g., timber harvest, prescribed fire, thinning, planting). On the heavily forested Flathead National Forest, changes in successional stages and other vegetation characteristics are one indicator of the potential availability of bear foods, cover, and connectivity.

SIMPPLE modeling for alternative B modified shows that grass/forb/shrub communities would be likely to increase by the fifth decade, corresponding to the amount of high- and moderate-severity wildfire as well as prescribed fire and timber harvest. These increases are likely to result in more bear foods, such as berry-producing shrubs and grasses that need more light, but would result in temporary decreases in cover. The model predicts there would be a forestwide increase in the amount of area in the large tree size class by the fifth decade. This size class provides cover and forested connectivity, as well as some forage. Because the SIMPPLE model is probabilistic, it is not possible to predict the connectivity of forest cover with certainty, but this would be assessed at the project level. Vegetative succession is responsible for the majority of changes in the size classes because trees that are not killed by fire grow and advance into larger forest size classes. In contrast, the model predicts a downward trend in the very large forest size class in the cool-moist and cold potential vegetation types. Although forestwide standards protect old-growth forest and very large trees, stand-replacing wildfire and Douglas-fir and spruce bark beetle can result in the loss of the very large forest size class and likely affect far more area than timber harvest in the cool-moist and cold potential vegetation types.

Inside the recovery zone/primary conservation area, desired conditions for the grizzly bear include FW-DC-TE&V-01 and 02 and guidelines FW-GDL-TE&V-01 through 05, similar to the Interagency Grizzly Bear Committee vegetation guidelines. These guidelines would benefit the grizzly bear because they promote a mosaic of successional stages; restrict logging activities in time and space as needed; encourage project designs that maintain or improve grizzly bear habitat quality or quantity where it would not increase the risk of grizzly bear-human conflicts; and retain cover as needed along grass, forb, and shrub openings. Appendix C also includes possible strategies for vegetation management related to grizzly bear habitat.

In addition to vegetation guidelines for the recovery zone/primary conservation area that are specific to the grizzly bear, other standards and forestwide plan components would indirectly benefit the grizzly bear. Desired condition FW-DC-TE&V-02 would promote a variety of grass/forb/shrub species, including berry-producing species that provide forage for grizzly bears and other wildlife species (e.g., huckleberries (*Vaccinium globulare*, *Vaccinium membranaceum*), serviceberries (*Amalanchier alnifolia*), mountain ash (*Sorbus scopulina*), and buffaloberry (*Shepherdia canadensis*). This desired condition may be met in wildfire areas, prescribed burn areas, and areas managed to produce timber. Lynx management standards VEG S1, VEG S2, VEG S5, and VEG S6 (see the forest plan, appendix A) apply across about 1.8 million acres of the Forest and would limit vegetation treatments in lynx habitat on the Forest. Because the Forest's lynx habitat also provides grizzly bear habitat and many analysis units overlap with grizzly bear management subunits, these limitations on vegetation management would also provide for distribution of cover for grizzly bears. Forestwide, riparian management zones total about 427,320 acres and are not suitable for timber production, although timber harvest may occur under specific conditions (see FW-SUIT-RMZ-01, section 3.21, and the bull trout section of the biological assessment (Kuennen et al., 2017) for more details). Plan components for riparian management zones, including forestwide standards FW-STD-RMZ-01, 05, and 06 and forestwide guidelines FW-GDL-RMZ-08 through 15, provide for ecological conditions of key wetland and riparian habitats used by grizzly bears. Forestwide guideline FW-GDL-RMZ-09, which applies to the entire riparian management zone defined by FW-STD-RMZ-01, states that the distance to cover for created openings should not exceed 350 feet. These plan components indirectly benefit the grizzly bear by providing for cover and habitat connectivity (see section 3.74, subsection "Aquatic, wetland, and riparian habitats," for more details).

Although there are known, usually short-term impacts to individual bears from vegetation management activities and associated road use, these impacts have been and would continue to be managed to support the NCDE grizzly bear population. In summary, available information documents increases in grizzly bear distribution and population size. The estimated population size was 765 bears in 2004 (Katherine C. Kendall et al., 2009), more than double the target of 391 bears based on sightings of females with cubs. Occupancy of bear management units has been documented (Costello et al., 2016). Mortality has been at an acceptable level based on ongoing research and monitoring showing that the NCDE grizzly bear population has been stable to increasing and expanding its distribution (Costello et al., 2016). Under this alternative, the NCDE grizzly bear population would continue to be monitored by MFWP, including grizzly bear population trend, body condition (an indicator of food availability), survival, mortality, and grizzly bear-human conflicts. The Forest would monitor vegetation conditions using analysis tools such as VMap and Forest Inventory and Analysis data that classify all lands (see chapter 5 in the forest plan for more details). Vegetation management activities would also continue to be assessed through project-specific NEPA analysis so site-specific effects would be determined as vegetation conditions change.

Consequences of minerals management direction for alternative B modified

As discussed in the section on consequences common to all alternatives, the Forest has low potential for locatable mineral activity. Adverse impacts on the NCDE grizzly bear population from saleable mineral activity that occurs on the Forest would be very minor. Forestwide guideline FW-GDL-E&M-05 would reduce the risk of grizzly bear-human conflicts and grizzly bear disturbance or displacement. Although the Forest has very low potential for oil and gas leasing, alternative B modified would lower the risk of grizzly bear habitat loss and mortality even further because NCDE-STD-MIN-08 would require that no surface occupancy stipulations be applied to any new oil and gas leases in the recovery zone/primary conservation area.

Consequences of habitat connectivity management direction for alternative B modified

Alternative B modified provides for habitat connectivity during the non-denning season, both in terms of cover and in terms of areas with low risk of human disturbance. Alternative B modified includes the following plan components related to habitat connectivity:

- appendix A: ALL 01, ALL S1, ALL G1, LINK 01, LINK S1, LINK G1, G2 for Canada lynx;
- plan components that provide for riparian connectivity (FW-DC-WTR-02; FW-STD-RMZ-01, 05, and 06; FW-GDL-RMZ-09 and 12);
- plan components for forest vegetation connectivity (FW-DC-TE&V-14 and 19; FW-GDL-TE&V-03, 06, and 07; MA6a-DC-02, MA6b-DC-02, and MA6c-DC-02);
- plan component FW-GDL-IFS-12 which states that within areas specifically identified as important for wildlife connectivity across highways, the USFS should cooperate with highway managers and other landowners to implement crossing designs that contribute to wildlife and public safety.
- plan components for connectivity in areas that have been modeled as important for several wide-ranging carnivores or big game species, including Canada lynx, wolverines, grizzly bears, and elk (GA-HH-DC-03, GA-MF-DC-04, GA-NF-DC-06, and 07, GA-SM-DC-03, and GA-SV-DC-09).
- plan components to retain NFS lands in public ownership or acquired lands by purchase, donation, exchange, or other authority as opportunities arise to improve national forest management (FW-DC-LSU-01).

These desired conditions, standards, and guidelines would contribute to habitat connectivity and linkage areas for grizzly bears.

Alternative C

Alternative C has the most extensive protections of grizzly bear habitat and exceeds the requirements of the draft Grizzly Bear Conservation Strategy, in response to public comments. Under alternative C, numerous plan components that apply to the recovery zone/primary conservation area in alternative B modified would also apply to zone 1. These include vegetation management guidelines for grizzly bears (FW-GDL-TE&V-01 through 05), grazing standards FW-STD-GR-01 through 04 and 06, and guideline FW-GDL-GR-01. Similarly, FW-STD-MIN-08, requiring that no surface occupancy stipulations be applied to any new oil and gas leases, would also apply to zone 1. These plan components have not been applied under the 1986 forest plan nor have they been required as a result of consultation.

This alternative has the lowest percentage of area suitable for timber production, about 317,300 acres. (For a discussion of timber suitability, see the section on consequences of management area plan components below and section 3.21for more details). As a result, the percentage of the recovery zone/primary conservation area that could be anticipated to have a temporary decrease in secure core due to projects (see glossary) is the lowest of all the action alternatives, about 3 percent.

Similar to alternative B modified, alternative C limits motorized access, including wheeled motorized trails on NFS lands in the Salish demographic connectivity area, to baseline densities (see discussion above under alternative B modified for more details). Similar to alternative B modified, FW-STD-IFS-04 states that roads within secure core shall not be opened for temporary motorized use by the public, e.g., firewood cutting.

Alternative C has the greatest acreage of recommended wilderness (MA 1b). Similar to alternative B modified, alternative C states that mechanized transport and motorized travel are not suitable in recommended wilderness areas. When site-specific decisions are implemented, three of the areas open to motorized over-snow vehicle use during the den emergence time period would be virtually eliminated due to changes in suitability for management area 1b and its associated management direction (see figure 1-34). Areas of modeled denning habitat that would remain suitable for over-snow motorized vehicle use during the den emergence time period include the groomed route corridor in Canyon Creek and areas near Whitefish Mountain Resort. These two areas currently receive very high levels of public recreational use. In zone 1, suitability for motorized over-snow vehicle use generally would not change. Most areas in zone 1 would not have restrictions on motorized over-snow vehicle use during the den emergence time period.

Taken together, these additional programmatic plan components would further reduce the risk of future grizzly bear disturbance or displacement as well as the risk of grizzly bear-human conflicts. As explained in the “Affected environment” section, it is unknown whether additional habitat protections on NFS lands would have population-level effects because grizzly bear social characteristics influence their populations, as do the availability of attractants and mortality on private lands.

Alternative D

As under the other action alternatives, the forest plan would incorporate standards and guidelines relative to motorized access, developed recreation sites, and livestock allotments in the recovery zone/primary conservation area. Standards would maintain baseline levels of open and total motorized route density and secure core in the primary conservation area (see glossary). In zone 1, there would be no net increase in the density of roads open to public motorized use.

In contrast to alternatives B modified and C, the density of motorized trails in zone 1 would not be limited. In contrast to alternatives B modified and C, roads within secure core could be opened for motorized use by the public for up to 30 days (e.g., for purposes such as firewood cutting) outside the spring and fall bear hunting seasons. Alternative D would slightly increase areas that are suitable for motorized over-snow vehicle use during the den emergence time period. Areas of modeled denning habitat that would remain suitable for over-snow motorized vehicle use during the den emergence time period include designated routes and areas in Canyon Creek and near Whitefish Mountain Resort, the Challenge-Skyland, Lost Johnny, and Sixmile areas (see figure 1-35). In zone 1, suitability for motorized over-snow vehicle use would not change. Most areas in zone 1 would not have restrictions on motorized over-snow vehicle use. Taken together, programmatic plan components would slightly increase the risk of future grizzly bear disturbance or displacement as well as the risk of grizzly bear-human conflicts.

Consequences of geographic area plan components for alternative B modified

Swan Valley

As detailed in the "Affected environment" section, land ownership in the Swan Valley geographic area has changed substantially since the 1986 forest plan and the Swan Valley Grizzly Bear Conservation Agreement were adopted. Alternative B modified would manage all of the Forest's bear management subunits using the same forestwide set of management direction and would terminate the previous agreement. As stated in desired condition FW-DC-P&C 03, "Recovery of threatened and endangered species is accomplished through cooperation with USFWS (including section 7 consultation, as required), State agencies, other Federal agencies, tribes, counties, interested groups, and interested private landowners." The Forest would continue to coordinate with the other land managers that share bear management subunits with the Forest.

Additional plan components would provide benefits for the grizzly bear in the Swan Valley. Alternative B modified includes desired conditions GA-SV-DC-06 through 09 and objective GA-SV-OBJ-04 that would have the indirect effect of continuing to improve habitat quality for grizzly bears. As explained in the "Affected environment" section, most of the Montana Legacy Project land acreage had regeneration harvest prior to being acquired by the Forest, so the trees on these acres will not be large enough to be merchantable for many decades. As a result, the level of timber harvest and associated road use that occurred on these lands over the last decade would not be likely to occur in the near future. The Forest has made its best programmatic estimate of the range of miles of road that could be decommissioned or placed into intermittent stored service for objective GA-SV-OBJ-04, but specific roads would be assessed during site-specific project planning. Guideline FW-GDL-IFS-12 also applies to the Swan Valley. These plan components would benefit grizzly bears in the Swan Valley by contributing to habitat connectivity, linkage, and improving habitat quality on lands acquired through the Montana Legacy Project.

Salish Mountains

The Salish Mountains geographic area has specific grizzly bear management direction that applies to zone 1, including the Salish demographic connectivity area, as discussed throughout this grizzly bear section. Additional plan components such as GA-SM-DC-04 and 05, GA-SM-OBJ-04, GA-SM-GDL-01, and FW-GDL-IFS-12 would indirectly provide benefits for the grizzly bear. These plan components would benefit grizzly bears in the Salish Mountains by emphasizing linkage of habitat in the Salish demographic connectivity area and providing elk habitat security in zone 1, which would also benefit the grizzly bear population.

Consequences of management area allocations

Forestwide plan components are followed regardless of management area, as applicable. The management areas, their acreage, suitability, and their distribution may differ among the alternatives. The management areas under the no-action alternative (alternative A) are different than those under the action alternatives (alternatives B modified, C, and D), so a cross-reference of management areas was prepared for comparison purposes (see final EIS, volume 1, table 3, proposed management areas and equivalent 1986 forest plan management acres). The management areas for each alternative are displayed in figures 1-01 to 1-04 and are displayed by geographic areas for alternative B modified in the forest plan in figures B-19 through B-24. The Canada lynx section of (see section 3.7.5) describes the effects of specific management areas in detail; the effects to grizzly bears would be similar. The following sections discuss key management area differences related to grizzly bear habitat and management zones by alternative (see table 81 through table 84).

Alternative A

Table 81. Distribution of alternative A management areas in grizzly bear management zones

Management area	Recovery zone/primary conservation area	Zone 1, Salish demographic connectivity area	Zone 1, outside demographic connectivity area
1a Designated wilderness	50%		< 1%
1b Recommended wilderness	5%		
2a Designated wild and scenic rivers	1%		
2b Eligible wild and scenic rivers	1%		
3a Administrative areas	< 1%		< 1%
3b Special areas	< 1%		
4a Research natural areas	< 1%	6%	
4b Experimental and demonstration forests	< 1%		
5a, 5b, 5c, 5d Backcountry	17%	4%	8%
6a General forest low-intensity vegetation management	3%	10%	7%
6b, 6c General forest medium- and high-intensity vegetation management	23%	80%	84%
7 Focused recreation areas	< 1%	1%	1%

Under the 1986 forest plan, one management area (management area 11) specifically emphasizes management for grizzly bears in the Trail Creek, Bunker Creek, and Swan/Clearwater Divide areas. This management area has a goal to maintain or enhance grizzly bear habitat by implementing appropriate management and investment activities and controlling public access. This management area also has a goal to have about 60 percent open and 40 percent security cover, with good geographic distribution of burns, meadows, riparian areas, ridgetops, shrubfields, sidehill parks, scree and talus, and timber. This alternative has less recommended wilderness (management area 1b) than alternatives B modified or C but more than alternative D. Wilderness (management area 1a) and recommended wilderness (management area 1b) would provide the highest levels of habitat security (see figure 1-38; sections 3.14 and 3.15 for more details). There would be no commercial timber harvest in wilderness or recommended wilderness. These areas currently have and are anticipated to continue to have high levels of successional stage and habitat diversity, primarily provided by natural ecosystem processes.

This alternative has the highest amount of medium- to high-intensity general forest vegetation management in the primary conservation area. In zone 1, the majority of lands is also in general forest management area 6b or 6c. These management areas currently have and would continue to have high levels of successional stage diversity, primarily provided by timber harvest, fuels reduction, and thinning. Under alternative A, management area 7 (focused recreation areas) includes areas such as Whitefish

Mountain Resort, Blacktail Mountain Ski Area, three groomed Nordic ski areas, the Blacktail Wild Bill motorized trail system, the Cedar Flats and Hungry Horse off-highway vehicle areas, and several developed campgrounds. Since 1986, many of these areas have been managed as grizzly bear management situation 3 (where grizzly bear habitat maintenance and improvement are not management considerations) or they are outside the recovery zone/primary conservation area.

Alternative B modified

Table 82. Distribution of alternative B modified management areas in grizzly bear management zones

Management area	Recovery zone/primary conservation area	Zone 1, Salish demographic connectivity area	Zone 1, outside demographic connectivity area
1a Designated wilderness	50%		< 1%
1b Recommended wilderness	9%		
2a Designated wild and scenic rivers	1%		
2b Eligible wild and scenic rivers	1%	< 1%	1%
3a Administrative areas	< 1%		< 1%
3b Special areas	< 1%	< 1%	< 1%
4a Research natural areas	< 1%	6%	
4b Experimental and demonstration forests	< 1%	5%	
5 a, 5b, 5c, 5d Backcountry	14%		< 1%
6a General forest low-intensity vegetation management	6%	1%	3%
6b, 6c General forest medium- and high-intensity vegetation management	17%	86%	84%
7 Focused recreation areas	2%	1%	12%

Under alternative B modified, much of the acreage that is grizzly bear habitat management area 11 in Trail Creek and Bunker Creek (under the 1986 forest plan) is included in recommended wilderness (management area 1b). Management of wilderness (management area 1a) and recommended wilderness (management area 1b) would provide the highest levels of habitat security for grizzly bears (see figure 1-39 and sections 3.14 and 3.15 for more details). There would be no commercial timber harvest in wilderness or recommended wilderness. These areas currently have and are anticipated to continue to have high levels of successional stage and habitat diversity, primarily provided by natural ecosystem processes. Prescribed fire may also be used to achieve desired conditions, such as restoration of whitebark pine. Under this alternative, the area along the Swan-Clearwater divide that is in management area 11C under the 1986 forest plan is in management area 6a or 6b. Similar to management area 11C, vegetative manipulation including timber harvest and prescribed burning would occur in this area (and GA-SV-DC-09 emphasizes habitat connectivity in this area).

In zone 1, the majority of lands are in management area 6b or 6c (general forest medium- or high-intensity vegetation management). These areas currently have and are anticipated to continue to have high levels of successional stage diversity, primarily provided by timber harvest, fuels reduction, and commercial thinning. In order to place more emphasis on demographic connectivity than for alternatives A or D, a continuous area of management area 6b is designated in the Salish demographic connectivity area along the north and west boundary of the Tally Lake Ranger District, contiguous with a research natural area that is unroaded (management area 3b).

Focused recreation areas (management area 7) are more extensive in alternatives B modified and D than the other alternatives (see section 3.10 for more details). A variety of recreation activities are discussed for this management area, as specified in the geographic area sections of the plan (chapter 4). Recreational uses may be more concentrated in management area 7, so there would be a greater risk of grizzly bear disturbance or displacement than under alternatives A or C, but it is also likely that that human activities would be more predictable, which could allow grizzly bears to avoid people (see the “Affected environment” section for more details). Recreation uses and grizzly bear habitat in management area 7 areas are highly variable, so it is difficult to anticipate effects at the programmatic level. Projects would continue to be evaluated during site-specific NEPA analysis.

Alternative C

Table 83. Distribution of alternative C management areas in grizzly bear management zones

Management area	Recovery zone/primary conservation area	Zone 1, Salish demographic connectivity area	Zone 1, outside demographic connectivity area
1a Designated wilderness	50%		< 1%
1b Recommended wilderness	23%	6%	< 1%
2a Designated wild and scenic rivers	1%		
2b Eligible wild and scenic rivers	1%	< 1%	1%
3a Administrative areas	< 1%		< 1%
3b Special areas	< 1%	< 1%	< 1%
4a Research natural areas	< 1%		
4b Experimental and demonstration forests	< 1%	5%	
5a, 5b, 5c, 5d Backcountry	6%		< 1%
6a General forest low-intensity vegetation management	9%	22%	4%
6b,c General forest medium- and high-intensity vegetation management	9%	66%	89%
7 Focused recreation areas	1%	1%	6%

Under alternative C, the highest amount of acreage of the grizzly bear habitat management areas (management area 11 in the 1986 forest plan) in Trail Creek and Bunker Creek would be included in recommended wilderness (management area 1b). The Le Beau Research Natural Area in the Salish demographic connectivity area would also be recommended wilderness. Wilderness (management area 1a) and recommended wilderness (management area 1b) would provide the highest level of habitat security. This alternative has the largest amount of recommended wilderness, which would not be suitable for motorized use or mechanized transport (see figure 1-40 and section 3.15 for more details). These areas currently have and are anticipated to continue to have high levels of successional stage and habitat diversity, primarily provided by natural ecosystem processes.

This alternative has the lowest amount of medium- or high-intensity vegetation management (management areas 6b and 6c). In order to place more emphasis on demographic connectivity, a continuous area of management area 6a is designated in the Salish demographic connectivity area along the north and west boundary of the Tally Lake Ranger District, contiguous with a research natural area that is unroaded (management area 3b) and the area along the Swan-Clearwater divide that is in management area 11C under the 1986 forest plan is in management area 6a or 5.

In comparison to alternatives B modified and D, alternative C would have less focused recreation area (management area 7), particularly along the southern end of the Whitefish Range. Compared to alternatives B modified and D, there would also be less management area 7 across the Forest (see section 3.10 for more details). Nonmotorized recreational uses would continue to occur across the Forest as these uses are generally not restricted, but there would likely be less emphasis on increasing recreation opportunities in frontcountry areas. Recreation uses and grizzly bear habitat in management area 7 areas are highly variable, so it is difficult to anticipate effects at the programmatic level. Projects would continue to be evaluated during site-specific NEPA analysis.

Alternative D

Table 84. Distribution of alternative D management areas in grizzly bear management zones

Management area	Recovery zone/primary conservation area	Zone 1, Salish demographic connectivity area	Zone 1, outside demographic connectivity area
1a Designated wilderness	50%		< 1%
1b Recommended wilderness			
2a Designated wild and scenic rivers	1%		
2b Eligible wild and scenic rivers	1%	< 1%	1%
3a Administrative areas	< 1%		< 1%
3b Special areas	1%	< 1%	< 1%
4a Research natural areas	< 1%	6%	
4b Experimental and demonstration forests	< 1%	5%	
5a, 5b, 5c, 5d Backcountry	22%		< 1%
6a General forest low-intensity vegetation management	5%	1%	3%
6b, 6c General forest medium- and high-intensity vegetation management	17%	86%	84%
7 Focused recreation areas	2%	1%	12%

Alternative D has no recommended wilderness (management area 1b) and more inventoried roadless acres in a variety of backcountry management areas (management area 5) (see figure 1-41 and sections 3.14 and 3.15 for more details). Under alternative D, much of the grizzly bear habitat in Trail Creek and Bunker Creek that is designated as management area 11 in the 1986 forest plan is in management area 5a, backcountry nonmotorized year-round. Mechanized transport would be the least limited under alternative D because there would be no recommended wilderness. These management areas currently have and are anticipated to continue to have high levels of successional stage diversity, primarily provided by natural ecosystem processes.

This alternative has about the same amount of general forest medium- and high-intensity vegetation management areas (management areas 6b and 6c) as alternative B modified. These areas currently have and are anticipated to continue to have high levels of successional stage diversity, primarily provided by timber harvest, fuels reduction, and commercial thinning.

Under alternative D, focused recreation areas (management area 7), are similar to those in B modified (see section 3.10 for more details). A variety of recreational activities are discussed for this management area, as specified in the geographic area sections of the plan (chapter 4). Recreational uses may be more concentrated in management area 7, so there would be a greater risk of grizzly bear disturbance or displacement than under alternatives A or D, but it is also likely that human activities would be more predictable. Recreation uses and grizzly bear habitat in management area 7 areas are highly variable, so it is difficult to anticipate effects at the programmatic level. Projects would continue to be evaluated during site-specific NEPA analysis.

Adequacy of plan components for the grizzly bear

The 2012 planning rule requires the Forest to determine whether or not the plan components provide the ecological conditions necessary to contribute to the recovery of federally listed threatened and endangered species that occur within the plan area (36 CFR 219.9(b)(1)). Key ecosystem characteristics for the grizzly bear are a mosaic of habitats that provide food, cover, habitat security, and connectivity. Alternative B modified has plan components, including standards and guidelines, to maintain, improve, and restore ecological conditions within the plan area to contribute to grizzly bear population recovery. In providing such plan components, the Forest has coordinated with other Federal, State, tribal, and private land managers who have management authority over lands relevant to the NCDE grizzly bear population (36 CFR § 219.9).

Habitat in the primary conservation area/recovery zone would be managed so that it serves as a source area with continual occupancy by grizzly bears. Ecosystem and species-specific plan components in the forest plan would maintain baseline habitat conditions in the recovery zone/primary conservation area relative to motorized access and livestock grazing, would limit increases in developed recreation sites designed and managed for overnight use, and would coordinate vegetation management and mineral development to contribute to recovery of the NCDE grizzly bear population. While meeting the requirements of the 2012 planning rule (36 CFR §§ 219.8 and 219.9), the plan must provide for ecosystem services and multiple uses, including outdoor recreation, range, timber, watershed, wildlife, and fish. Plan components for the grizzly bear have been integrated with plan components for ecosystem services and multiple uses (36 CFR § 219.10). The impacts of logging, mining, livestock grazing, and many forms of recreation in grizzly bear habitat can be mitigated through well-designed management programs (USFWS, 1993, p. 22). As stated in the draft Grizzly Bear Conservation Strategy (USFWS, 2013c):

> The available habitat for bears is determined largely by people and their activities. Human activities are the primary factor impacting habitat security. Human activities and the social structure and relationships among resident bears are the two major influences on the accessibility of available foods for bears. The question of how many grizzlies can live in any specific area is a function of overall habitat productivity (e.g., food distribution and abundance), the availability of habitat components (e.g., denning areas, cover types), the levels and types of human activities, grizzly bear social dynamics, learned behavior of individual grizzly bears, and stochasticity. Because carrying capacity in such an omnivorous and opportunistic species can vary annually and even day to day, there is no known way to deductively evaluate habitat components to calculate the maximum number of grizzly bears a landscape can support. Therefore, controlling human-caused mortality, monitoring both population and habitat parameters, and responding when necessary with adaptive management (Walters and Holling 1990) are the best ways to ensure a healthy grizzly population. The USFWS defines adaptive management as “a method for examining alternative strategies for meeting measurable biological goals and objectives, and then, if necessary, adjusting future conservation management actions according to what is learned.”

> This Conservation Strategy allows for modification of management practices in response to new or changing conditions. (p. 18)

The national forests comprise the majority (about 60 percent) of lands in the NCDE primary conservation area; thus, Forest Service management actions make an important contribution to the conservation of the NCDE grizzly bear population. However, because the grizzly bear is a wide-ranging species that uses a broad range of elevations and habitats during the year, the actions of other landowners in the NCDE are also very important, particularly with regard to mortality risk. Although the Forest does not have authority over all the stressors that may affect the grizzly bear, plan components would maintain, improve, or restore grizzly bear habitat. This would be accomplished by plan components, including standards and guidelines for diverse ecosystems, their integrity and connectivity, as detailed in sections 3.7.4, 3.7.5, and 3.7.6.

Cumulative effects

For a discussion of other national forests in the NCDE and cumulative effects to the grizzly bear, see section 6.5.5. The Forest Service would continue to cooperate with other Federal, State, local, and tribal agencies and private landowners in the NCDE to support coordinated grizzly bear conservation. The programmatic plan components in the forest plan are not based on the particular status of the grizzly bear. As a future signatory of the multi-agency final NCDE Grizzly Bear Conservation Strategy, the Forest Service is committed to doing its part and adopting a regulatory framework to support continued recovery of the NCDE grizzly bear population. The draft Grizzly Bear Conservation Strategy outlines monitoring requirements for multiple agencies. All action alternatives include grizzly bear monitoring items MON-NCDE-01 through 08, MON-WL-04, 09, 13, and 14, and numerous other monitoring items for aquatic and terrestrial ecosystems (see chapter 5 in the forest plan for more details). Broadscale monitoring of vegetation conditions would occur on the Forest, and broad-scale monitoring of grizzly bears is anticipated to occur in the NCDE, to inform the forest plan and project implementation in the future. Site-specific consultation with the USFWS would continue to occur, as needed, while the grizzly bear is a federally listed species.

Canada lynx

Introduction

On March 24, 2000, the USFWS published the final rule listing the contiguous United States distinct population segment of Canada lynx (*Lynx canadensis*) as a threatened species (65 FR 16052). In its analysis of threats to the species, the USFWS concluded that the single factor threatening the distinct population segment was the inadequacy of existing regulatory mechanisms, specifically the lack of guidance for conservation of lynx in national forest land and resource management plans and Bureau of Land Management land use plans. The USFWS prepared a recovery outline for the Canada lynx (USFWS, 2005b). A recovery outline is intended to provide interim guidance for consultation and recovery efforts until a formal recovery plan has been approved. No recovery plan has yet been developed for the lynx. The recovery outline did not establish recovery goals but did identify a preliminary set of objectives and potential recovery actions for each area. Under the recovery outline, lynx habitat was stratified into core, secondary, and peripheral areas based on lynx occupancy, reproduction, and use as documented by historical and current records. Core areas were identified by the USFWS where there was strong evidence of long-term persistence of lynx populations, including both historical records of lynx occurrence over time and recent (within the past 20 years) evidence of presence and reproduction. The Forest is in a core area for Canada lynx, as identified by the USFWS (USFWS, 2005b, p. 21).

The Northern Rockies Lynx Management Direction (NRLMD) amended 18 forest plans of the national forests in Idaho, Montana, Utah, and Wyoming, including the Flathead National Forest (USDA, 2007d).

The amendment adopted forest plan components applicable to vegetation management, livestock grazing, human uses, and linkage areas in order to conserve and promote the recovery of the lynx by reducing or eliminating adverse effects from land management activities on NFS lands while preserving the overall multiple-use direction in existing plans (Bertram, 2007; USDA, 2007a, 2007b; USFWS, 2007b). In March of 2007, the USFWS issued a biological opinion on the effects of the northern Rocky Mountains lynx amendment on the Distinct Population Segment of Canada lynx in the contiguous United States. In its 2007 biological opinion, the USFWS concluded that the level of adverse effects to lynx that may result from implementation of the NRLMD are not reasonably expected to either directly or indirectly appreciably reduce the likelihood of survival and recovery of the lynx distinct population segment in the wild by reducing the reproduction, numbers, or distribution of lynx (USFWS, 2007b, p. 75).

Methodology and analysis process

Canada lynx use of habitat within their home range is dependent upon vegetation condition. Lynx analysis units are landscape units that approximate the size of a female lynx annual home range and encompass all seasonal habitats. These may also contain areas of non-lynx habitat such as open meadows, especially in mountainous regions (ILBT, 2013). The existing vegetation condition of Canada lynx habitat is estimated for each lynx analysis unit on the Forest based upon past vegetation treatments and historic fire occurrence data. Past harvest and fire occurrence is based upon data listed in the Forest Service Activity Tracking System (FACTS) and the Forest Fire Atlas. These data sets are linked to a variety of spatial data sets so that past activities and the consequences of alternatives can be analyzed with GIS systems. See section 3.3.1 and the biological assessment (Kuennen et al., 2017) for more details on this and other aspects of the methodology and analysis process. The SIMPPLLE model is a spatially explicit model that uses logic pathways to predict how forests respond over time to succession, wildfires, and insect and disease risks based on cover types, size classes, crown closure, aspect, and slope (Chew, Moeller, & Stalling, 2012). This model was used for assessments of the natural range of variation and the potential future consequences of alternatives.

Information sources and incomplete or unavailable information

A synthesis of information on lynx biology and ecology that is relevant to lynx at the national scale can be found in *Ecology and Conservation of Lynx in the United States* (Ruggiero et al., 1999) and in the Canada Lynx Conservation Assessment and Strategy (ILBT, 2013). The final rule listing the lynx (65 FR 16052) and the notice of remanded determination (68 FR 40076) evaluated population status and threats for the contiguous United States distinct population segment. The recovery outline (USFWS, 2005b) provided preliminary recovery objectives and actions based on an understanding of current and historical lynx occurrence and lynx population dynamics in the contiguous United States.

At the Forest scale, some information used to assess lynx habitat is incomplete or unavailable. At any given point in time in a forest stand's development, it may provide habitat in a suitable condition or it may provide lynx habitat in a temporarily unsuitable condition, depending upon the existing vegetation condition. Vegetation condition is in turn dependent upon time since disturbance (e.g., fire, timber harvest) and the rate of forest succession. Satellite imagery and forest databases can be used to accurately classify recently harvested and burned areas, which helps to identify areas that provide lynx habitat in an unsuitable condition on a temporary basis (see NRLMD glossary in appendix A). However, satellite imagery is poor at detecting both the dense horizontal cover that provides snowshoe hare habitat in a multistory forest structure, which is an important feature of lynx foraging habitat, and downed woody material for denning habitat. Therefore, no forestwide estimates are made for these components of lynx habitat. During site-specific planning, habitat types used for the modeling and mapping of lynx habitat are verified and refined and lynx habitat is further characterized to estimate the amount and distribution of foraging and denning habitat components.

Some commenters on the draft forest plan asked the Forest to use Kosterman's (2014) thesis to inform changes in management of lynx and lynx habitat. Although the Forest considered her findings in a general sense in its description of desired conditions, the parameters and metrics that Kosterman used do not directly correlate to Forest Service vegetation inventory data. Kosterman and Rocky Mountain Research Station scientists are working to refine her lynx habitat classification and publish results in a peer-reviewed scientific journal. Some of the habitat classifications, analysis, or findings in the original thesis may change through that process. Forest Service staff will continue to work in partnership with the USFWS, the Rocky Mountain Research Station, and Kosterman to determine the appropriate application of her information to the management of Canada lynx habitat once it becomes available (Marten, 2016) (see also section 2.4.6).

The biological assessment (Kuennen et al., 2017), biological opinion (USFWS, 2017b), and references section of the final EIS provide references to a comprehensive set of scientific information about the Canada lynx, its habitat requirements, and its response to human activities. This information includes the best available scientific information as well as opposing scientific information. The following description of the affected environment provides a summary, in the context of the northern Rocky Mountains and critical habitat unit 3, which focuses on the Flathead National Forest and information that is necessary to understand the consequences of the alternatives. Canada lynx critical habitat is discussed in a separate section that follows the section on Canada lynx.

Analysis area and temporal scale of analysis

The period considered for the analysis of indirect effects of the alternatives is the anticipated life of the forest plan, which is about 15 years. However, because lynx habitat is dynamic, the anticipated vegetation and changing climate conditions were evaluated over longer time periods. The SIMPPLLE model was used to estimate the natural range of variation as it would have influenced forest ecosystems on the Flathead National Forest going back about 1,000 years (see sections 3.3, 3.8, and appendix 2). Effects of the alternatives on lynx habitat were modeled over the next 50 years by Ecosystem Research Group in 2015. Ecosystem Research Group modeled several scenarios for comparison purposes, including a warmer/drier climate over the next five decades (including acres burned due to anticipated climate changes as well as fire suppression into the future) (see appendix 3 for more details).

The area used for the analysis of indirect effects on Canada lynx is the Forest's modeled lynx habitat (see forest plan appendix A, figure A-01). Canada lynx habitat was initially mapped on the Flathead National Forest in 2000 using a specified set of criteria and biophysical attributes that were derived from remote sensing data and GIS modeling (Ruediger et al., 2000; Ruggiero et al., 1999; USDA, 2000). The area of lynx habitat modeled and mapped by the Forest in 2000 was 1.73 million acres (USDA, 2007c, appendix C). Since 2000, the Forest has acquired additional lands providing lynx habitat. In 2013-2014, the Flathead National Forest initiated the planning process to revise its forest plan and conducted a review of the lynx habitat originally mapped on the Forest in 2000. The review indicated a need to update and refine mapped lynx habitat based on (1) new information from research concerning lynx populations, distribution, habitat use, and prey species on the Forest; (2) improved vegetation classification data; and (3) improved GIS mapping, (4) changes in NFS lands. The updated map was published in the assessment of the Flathead National Forest (April 2014), in the draft forest plan (March 2015), and in the draft EIS (May 2016). The Flathead National Forest's updated estimate of lynx habitat is about 1.795 million acres (Kuennen et al., 2017). The modeling and mapping process used by the Forest is consistent with the definition of lynx habitat (Hanvey, 2016; ILBT, 2013) and is verified at the project level.

Lynx habitat on the Forest is further subdivided into lynx analysis units for the analysis of effects on Canada lynx (see figure 1-50). Lynx habitat within the USFWS Northern Rockies Geographic Area has been divided into lynx analysis units to facilitate analysis, management, and monitoring. Lynx analysis units on the Forest were reviewed and are consistent with guidance in the Canada Lynx Conservation Assessment and Strategy (ILBT, 2013):

> The size of the LAU [lynx analysis unit] reflects female home range size in the geographic unit. A sufficient amount of habitat must be present within the LAU to support a female lynx. For example, in the western United States, it appears that at least 26 km^2 (10 mi^2) of primary vegetation (e.g., spruce/fir) must be present. The arrangement of habitat within the LAU should take into consideration the daily movement distances of resident females. . . . Since the LAU represents a hypothetical female home range, and is the basis for analysis, it can be larger and contain more lynx habitat than an actual home range. (p. 87)

Geographic information system analysis of lynx analysis units on the Forest showed they contain at least 10 square miles of habitat capable of producing primary vegetation (e.g., spruce/fir forest), and this habitat within a lynx analysis unit is arranged considering the movement distances reported by Squires et al. (2013). Lynx analysis units on the Forest are in accordance with guidance provided in the Lynx Conservation Assessment and Strategy and the NRLMD. There are 109 lynx analysis units that are wholly or partially within the Flathead National Forest (see figure 1-50). These lynx analysis units encompass a total of about 2.4 million acres on the Forest. Changes to lynx analysis units may only be made if site-specific habitat information demonstrates it is needed and after review by the Northern Region. Changes have not been made to lynx analysis unit boundaries on the Flathead National Forest subsequent to their delineation in 2000.

The analysis area for effects on critical habitat is the Forest's lynx critical habitat (see figure 1-51). The analysis area for cumulative effects is the larger area of Canada lynx critical habitat unit 3 (USFWS, 2014d). This area is large enough to include the effects of activities on adjoining lands but not so large that it obscures effects on a biologically meaningful unit. This area selected for analysis of cumulative effects encompasses the area identified by Squires et al. (2013) as the current distribution of lynx in western Montana (based upon a compilation of telemetry data from 1998-2007 and monitoring detections confirmed with DNA analysis or remote camera photos. This area also encompasses telemetry locations of lynx captured on the Forest from 2009-2015). The cumulative effects analysis area is about 8.9 million acres in size that includes portions of the Flathead and Kootenai National Forests, the Seeley Lake and Lincoln Ranger Districts on the Lolo and Helena National Forests, and Glacier National Park. The Northern Rockies Geographic Area, a region encompassing 18 national forests and an estimated 18.5 million acres of lynx habitat in Montana, Idaho, Wyoming, and Utah, also provides context for the analysis of cumulative effects. Adjoining areas in Canada were also considered with respect to connectivity.

Affected environment—Canada lynx population, distribution, and status

The range of Canada lynx extends from Alaska across much of Canada (except for the coastal forests), with southern extensions into parts of the western United States, the Great Lakes region, and the northeast. Lynx distribution is closely tied to the distribution of snowshoe hares and boreal forests (McKelvey, Aubry, & Ortega, 1999). The Forest is in the USFWS Northern Rocky Mountain region of the contiguous distinct population segment of Canada lynx.

Snowshoe hares are the primary winter prey of lynx in Montana (J. R. Squires & Ruggiero, 2007), as they are throughout the range of lynx (Aubry, Koehler, & Squires, 1999). Lynx are highly specialized predators of snowshoe hares, with unique adaptations that include a lightweight body frame and large paws that enable them to travel on top of deep snow. In their study of lynx winter diets in northwest Montana, Squires and others (2013) described 86 lynx kills that included 7 prey species. Snowshoe hares contributed about 96 percent of prey biomass, whereas red squirrels, the second most common prey, provided only about 2 percent of prey biomass (J. R. Squires, Ruggiero, Kolbe, & DeCesare, 2006).

Lynx do not occur everywhere within the range of snowshoe hares in the contiguous United States, as discussed in both Bittner and Rongstad (1982) and McCord and Cardoza (1982) (USFWS, 2014d). This may be due to inadequate abundance, density, the spatial distribution of hares in some places, the absence of snow conditions that would allow lynx to express a competitive advantage over other hare predators, or a combination of these factors (USFWS, 2014d). In the southern part of its range, the low densities of lynx populations are likely a result of naturally patchy habitat and lower densities of their snowshoe hare prey (Adams, 1959; Paul Carlo Griffin, 2004; Koehler, Hornocker, & Hash, 1979; Mills et al., 2005).

The lynx recovery outline (USFWS, 2005b) stratified lynx habitat into three categories: core, secondary, and peripheral. Core areas are places where long-term persistence of lynx and recent evidence of reproduction have been documented and where the quality and quantity of habitat provides for both lynx and snowshoe hare. The lynx recovery outline emphasized focusing conservation efforts on core areas to ensure the continued persistence of lynx in the contiguous United States. Six core areas were identified in the recovery outline, one of which is in northwest Montana/northeast Idaho. The Flathead National Forest is located entirely within the northwest Montana/northeast Idaho core area. Museum records, trapping data, and other information verify the historical occurrence of lynx in western Montana (McKelvey et al., 1999).

Squires and others have conducted extensive studies of Canada lynx in northwest Montana to determine their current distribution, stating,

> Our study area encompassed the occupied range of lynx within the northern Rockies as estimated from a compilation of lynx distribution data collected from 1998 to 2007. The study area border followed natural topographic and vegetative boundaries to generally encompass all forested regions with recent evidence of lynx presence, including all telemetry locations we documented for resident lynx from 1998 to 2007 (N = 81,523 locations); this study area represented our best estimate of the current distribution of lynx in western Montana. (J. R. Squires et al., 2013).

The study area delineated by Squires and others encompasses most of the Flathead National Forest, with the exception of the area west of Kalispell known as the Island Unit.

Canada lynx are known to be distributed throughout portions of the Flathead National Forest included in the study area delineated by Squires and others in 2013. During 2010–2015, 15 individual adult or subadult lynx were captured and fitted with radiotelemetry collars on the Flathead National Forest, confirming that the North Fork, Middle Fork, and South Fork of the Flathead River watersheds were occupied by lynx (Holmquist, 2015; L. E. Olson, 2015). Noninvasive sampling techniques have also been used to detect lynx on the Forest. In addition to areas where Squires and others had previously trapped lynx, this effort detected lynx in the Salish Mountains portion of the distribution area, based upon tracks and DNA. A female lynx with two kittens was also photographed on the east side of Hungry Horse Reservoir (Curry et al., 2016; Swanson, 2017; SWCC, 2015).

Reproduction by Canada lynx has been studied in Montana. As reported in 2011 by Olson et al., in Montana, female lynx stayed in natal dens on average for 21 ± 17 days and subsequently used an average of 3 ± 2 maternal dens in a given year (ILBT, 2013). Nine female lynx exhibited roughly equal levels of activity from dawn to dusk when they had newborn to two-month-old kittens. Kittens are left alone at den sites while the female lynx hunts, as noted by Slough in 1999, Moen et al. in 2008, and Olson et al. in 2011 (ILBT, 2013). In northwest Montana, litter sizes vary from one to five kittens per litter, with two or three kittens being the most frequently observed (Kosterman, 2014).

The most commonly reported causes of Canada lynx mortality are (1) starvation, especially of kittens, as reported by Quinn and Parker in 1987, Koehler in 1990a, and Vashon et al. in 2012 (ILBT, 2013) and (2) human-caused mortality, including trapping and shooting (addressed in Ward and Krebs in 1985, Bailey et al. in 1986, and Moen in 2008) (ILBT, 2013). Predation of lynx by mountain lion, coyote, wolverine, gray wolf, fisher, and other lynx has been confirmed by Berrie in 1974, Koehler et al. in 1979, Poole in 1994, Slough and Mowat in 1996, O'Donoghue et al. in 1997, Apps in 2000, Squires and Laurion in 2000, O'Donoghue et al. in 2001, and Vashon et al. in 2012 (ILBT, 2013). Squires and Laurion (2000) reported that two out of six mortalities of radio-collared lynx in Montana were due to mountain lion predation.

In the southern part of the range of Canada lynx , which includes western Montana, lynx population density and productivity are lower than in the northern part of its range; harvest may be an additive source of mortality, and lynx may be highly vulnerable to overexploitation (Koehler, 1990). State wildlife management agencies regulate the trapping of furbearers. Trapping and snaring of lynx is currently prohibited across the contiguous United States. Incidental trapping or snaring of lynx is possible in areas where regulated trapping for other species, such as wolverine, coyote, fox, fisher, marten, bobcat, and wolf, overlaps with lynx habitats (J. R. Squires & Laurion, 2000). A trapped lynx can be released, but there is potential for accidental injury or mortality (Kolbe, Squires, & Parker, 2003). The magnitude of illegal shooting of lynx is unknown. Incidents have been reported throughout the range of the species. Devineau et al. (2010) reported a substantial number of shootings of lynx during the first 10 years after their reintroduction into Colorado (14 known shootings and 5 probable shootings out of 102 known mortalities). Aubry et al. (1999) hypothesized that human-caused mortality such as illegal or incidental harvest could significantly reduce lynx population numbers in southern regions. The state wildlife agencies have taken actions to reduce incidental or illegal trapping and shooting.

Montana Fish, Wildlife and Parks has implemented special regulations to reduce the likelihood of the incidental capture of lynx. A recent court settlement with MFWP established a lynx protection zone (which includes the Flathead National Forest) that restricts the size and placement of traps and snares that can inadvertently catch lynx and requires bobcat trappers to check their traps at least once every 48 hours. The use of fresh meat or feathers as bait is now prohibited in the lynx protection zone. Since the implementation of these changes to the trapping regulations in 2008, the amount of accidental trapping of lynx has decreased. A total of three lynx were captured during the eight license years 2008-2015, and all were released uninjured. Overall, lynx "take" during 2000-2007 averaged 1.6/year, and during 2008-2015, when more protective regulations were in place, they averaged 0.4/year, a fourfold decrease (MFWP, 2016a). Montana Fish, Wildlife and Parks also provides education and outreach programs aimed at preventing the illegal shooting of lynx. The magnitude of illegal shooting of lynx is unknown. Incidents have been reported throughout the range of the species. State wildlife agencies work to reduce lynx mortality by disseminating information to the public and providing hunters with guides to the identifying characteristics of lynx.

The USFWS convened an expert workshop in October 2015 to improve understanding of the status of the contiguous U.S. distinct population segment of Canada lynx (Bell et al., 2016). The workshop was organized by a lynx species status assessment team consisting of USFWS and U.S. Geological Service staff who developed and piloted implementation of the species status assessment framework as well as by other biologists who were working on lynx throughout the range of the distinct population segment. The results of the workshop contributed to the species status assessment report, which compiled and summarized the empirical data, published literature, and expert input. This information is being used by USFWS to develop a final species status review and inform recovery planning direction, classification decisions, and other determinations required by the Endangered Species Act (Bell et al., 2016).

In the geographic unit identified in the species status assessment workshop's final report that encompasses northwest Montana/northeastern Idaho, experts concluded there would be an initially high probability of Canada lynx persistence until 2025 and decreasing probability after that due to projected climate change. For the geographic unit encompassing northwest Montana/northeast Idaho, experts predicted near-term (year 2025) persistence probability ≥ 95 percent and mid-century persistence = 70 percent to 100 percent (median = 90 percent), with increasing uncertainty over time (Bell et al., 2016).

An important consideration for the long-term persistence of lynx in the northern Rockies is maintaining connectivity with lynx populations in Canada (ILBT, 2013). Squires et al. (2013) combined resource selection, step selection, and least-cost path models to predict movement corridors for lynx in the northern Rockies. The models identified a few corridors that extend south from the international border with Canada. Currently, there is no evidence that there are significant impediments to lynx movements or that genetic isolation is occurring in western Montana (J. R. Squires et al., 2013). Lynx are managed provincially in Canada, with each province responsible for its own management program, harvest (trapping) policies, and conservation strategies. Lynx are considered secure in all provinces except New Brunswick and Nova Scotia (Bell et al., 2016).

Affected environment—Canada lynx habitat

The "Affected environment" section for Canada lynx habitat discusses elements that are important to lynx, including vegetation, deep fluffy snow, habitat connectivity, and their current condition on the Forest. For the forest plan, habitats across the Flathead National Forest have been grouped into broad potential vegetation types. These are groupings based upon habitat types (Pfister et al., 1977). Potential vegetation types serve as a basis for describing certain ecological conditions across the Forest and are useful in understanding the various ecosystems and their potential productivity, natural biodiversity, and the kinds of processes that sustain these conditions. Potential vegetation types are based upon vegetation potential, whereas dominance types describe existing vegetation.

Across their range, lynx typically occur in boreal and subalpine coniferous forests dominated by subalpine fir and spruce in landscapes with gentle topography (J. R. Squires et al., 2013). On the Flathead National Forest, the cool-moist and cold potential vegetation types are capable of growing subalpine fir and Engelmann spruce, but the dominance type changes over time due to factors such as fire, insects and disease, vegetation management, and forest succession (see appendix D of the forest plan for more details). Forests with a subalpine fir/spruce dominance type currently occur on an estimated 43 percent (90 percent confidence interval = 39-47 percent) of all Flathead NFS lands (R1 Summary Data Base, Forest Inventory and Analysis (USDA, 1980)). Both tree species may also be found in other forest dominance types because they are very shade tolerant and commonly occur in mid- and understory tree canopy layers with western larch, lodgepole pine, and/or Douglas-fir in the overstory.

During the winter and early spring, availability of den sites is important to lynx. Boutros and others in 2007 as well as Moen et al. in 2008 found that coarse downed woody material provides kittens with protection from extreme temperatures, precipitation, and predators (ILBT, 2013). Lynx dens in northwest Montana are typically found in multistory stands of spruce-fir forests with dense horizontal cover and abundant coarse downed woody material. Squires and others found that 80 percent of dens were in mature forest stands and 13 percent in mid-seral, regenerating stands (J. R. Squires, DeCesare, Kolbe, & Ruggiero, 2008). Young stands that were either naturally sparse or mechanically thinned were seldom used for denning. Denning habitat is generally abundant across the coniferous forest landscape of northwest Montana and is not likely to be limiting for lynx (J. R. Squires et al., 2008; J. R. Squires, Decesare, Kolbe, & Ruggiero, 2010; J. R. Squires et al., 2006).

In Montana, Squires and others (2010) reported that horizontal cover was denser at lynx kill sites than along travel paths. They further reported that lynx kill sites were associated with a higher proportion of spruce-fir overstory than lodgepole pine overstory and that neither snow depth nor snow penetrability influenced lynx kill sites. Hodges reported that snowshoe hare abundance is also positively associated with dense horizontal cover (Hodges, 2000). In western Montana, Griffin and Mills (2007) found the highest snowshoe hare densities in regenerating conifer stands that had a high density of saplings (defined as more than 2,267 stems/acre) and in mature multistory conifer stands that had abundant saplings. Hare abundance was negatively affected in stands treated with traditional precommercial thinning prescriptions that reduced stem densities to about 263-526 stems/acre (Paul C. Griffin & Mills, 2007).

Squires and others (2010) compared lynx resource selection in summer vs. winter, including lynx success in capturing snowshoe hares, their primary prey. During winter, lynx foraged primarily in mid- to high-elevation forests (4,134–7,726 feet) composed of mature, large-diameter (greater than about 11 inches d.b.h.) trees. In a comparison of use versus variability within a lynx home range, Squires and others found that lynx selected forests with relatively denser horizontal cover, more abundant hares, and deeper snow. The preferred forests had a multistory structure with dense horizontal cover provided by the young trees in the understory and conifer boughs touching the snow surface, which could support snowshoe hare populations at varying snow depths throughout the winter. Engelmann spruce and subalpine fir were the dominant tree species in forests used by lynx, but these forests contained a mix of other conifer species, including lodgepole pine, western larch, and Douglas-fir. Squires stated that the primary limiting factor for Canada lynx in northwest Montana appears to be suitable winter foraging habitat.

During the summer months, lynx in Montana broaden their preferred habitat use to include more of the early-successional forest (stand initiation structural stage) with dense horizontal cover provided by abundant shrubs, spruce and fir saplings, and small-diameter trees (J. R. Squires et al., 2010). These conditions can occur in forests burned by wildfire, regenerated by insects or disease, or regenerated by timber harvest. Squires and others found that lynx used slightly higher elevations during the summer but, as in winter, were located below the alpine zone and above the low-elevation dry forests dominated by ponderosa pine. The alpine zone and low-elevation ponderosa pine forests were not modeled as potential lynx habitat on the Flathead National Forest.

Young regenerating stands (20-40 years old) can support high densities of snowshoe hares before growing into a structure that no longer provides the needed dense horizontal cover. A regular influx of this “early stand initiation stage” of forest succession (created by processes such as fire or vegetation management) can help to enhance snowshoe hare production. Cheng and others (2015) studied snowshoe hare densities in areas of Glacier National Park that were burned by wildfire in 1988 and 1994. Hare pellet densities in lodgepole pine stands were 10 times higher 17 years post-fire (at the time of their study) than in the 11-year post-fire forests or other mature forests. Their “best” model for habitat predicted that the mean pellet density for 17-year-old lodgepole forests equates to hare densities nearly three times the threshold believed necessary to support lynx populations. Among the continuous habitat parameters measured in the Cheng et al. study, only understory cover (at a height of 0 to 20 inches above the ground surface) and percent canopy cover were identified as predictors of hare density. Mean pellet density increased slowly with understory cover up to 80 percent, above which pellet densities declined (Cheng et al., 2015). Mean pellet densities increased from 10 percent canopy closure to 70 percent canopy closure when other variables were held at typical values. Cheng and others (2015) stated that snowshoe hares’ association with regenerating lodgepole pine forests is transient because these forests will eventually grow tall enough and dense enough to no longer provide the habitat conditions selected by snowshoe hares.

At the landscape scale, a mosaic of forest structure, from young regenerating to mature multistory stands, is recommended to provide for the habitat needs of lynx (ILBT, 2013). Kosterman collected field data on denning and offspring survival in northwest Montana from 1998–2012, studying the relationship between female lynx reproductive success and habitat composition/arrangement at the scale of a lynx home range on two national forests adjacent to the Flathead (Kootenai and Lolo). Connectivity of mature forest, percent composition of young regenerating forest, low perimeter-area ratio of young regenerating forest patches, and adjacency of mature to young regenerating forest types were the most important predictors for overall lynx reproductive success in her study areas (Kosterman, 2014).

Dynamics of snowshoe hare and lynx habitat on the Flathead National Forest

Historically, fire, insects, and disease have been the primary processes that have affected forest vegetation in lynx habitat, reverting the vegetation to an early stage of succession or creating openings within the forest canopy (USDA). Immediately after a disturbance, forest areas are not yet able to support snowshoe hares and lynx because of the lack of live trees and shrubs, so these areas are in a temporarily unsuitable condition. The NRLMD (USDA, 2007c) defines lynx habitat in an unsuitable condition as being in the stand initiation structural stage where trees are generally less than 10 to 30 years old and have not grown tall enough to protrude above the snow in winter. As a result, trees in this structural stage are too short or too open to provide dense seedling-sapling forage for snowshoe hares during winter, but the trees will become taller and denser as the forests go through vegetative succession.

As vegetation regrows after a disturbance, the burned or harvested areas first develop into summer hare habitat. Then, after approximately 20 years (the typical average time for the Forest), trees and some shrubs will have grown tall enough to have branches at the snow surface and be dense enough to provide winter food and cover for hares. During the next couple of decades, this stage of forest succession will likely continue to provide winter snowshoe hare habitat, but this depends upon the species composition and density of regenerating trees. As trees continue to grow, forests may move into the “stem exclusion” structural stage, where food for hares is lacking. In this stage, tree branches grow out of reach of the hares, tree crowns close, and understory trees and/or shrubs decline due to too much shade. The denser the regenerating forest stand, the faster trees such as lodgepole pine lose their lower live branches and grow out of reach of hares.

Subalpine fir is the indicated climax species across most of the Flathead National Forest. So, given enough time, these shade-tolerant species will eventually dominate. However, both subalpine fir and Engelmann spruce are intolerant of drought and fire due to their shallow roots, thin bark, and tree crowns that extend to the ground, making them susceptible to being killed by even low-severity fires. Though they may regenerate into the opening created by a fire, they have comparably slow growth rates and are soon overtopped by other early-successional species such as lodgepole pine or western larch. However, their shade tolerance allows them to persist indefinitely, and eventually, over many decades to centuries, they will dominate the site unless there is a fire event or other stand-replacing disturbance that re-initiates succession with early-successional species.

On the Forest, the prevalence of subalpine fir and spruce-dominated forests is closely tied to the frequency of fire. More frequent fires will reduce the presence and dominance of these species; long fire-free intervals and/or the lack of a seed source of other species will favor their dominance. Forests dominated by subalpine fir and Engelmann spruce tend to support higher-severity fires due to the lower fire frequency, higher tree densities, multiple canopy layers, and greater litter depths and fuel loads typical in these stands. These stand-replacing fires make lynx habitat temporarily unsuitable. The multistory forest conditions that typically develop in subalpine fir and Engelmann spruce-dominated forests are also highly susceptible to damage from western spruce budworm. In contrast to stand-replacing wildfires, beetles may only kill some of the overstory trees, allowing the understory to respond.

Past disturbances and the natural range of variation

The USFS SIMPPLLE model (SIMulating Patterns and Processes at Landscape scaLEs) was used to model the natural range of variation for lynx habitat in a temporarily unsuitable condition. Ecosystem Research Group provided the Forest with an assessment of SIMPPLLE model outputs (see appendix 3). Figure 53 shows the natural range of variation going back about 1,000 years, for maximum, minimum, and average levels of lynx habitat in an unsuitable condition within the Forest's lynx analysis units, and compares that to the current level, projected back in time for comparison. Decade 1 on the x-axis represents 1,000 years ago and decade 101 represents the decade beginning with 2010.

As shown in figure 53, the acreage of lynx habitat in a temporarily unsuitable condition across the Forest fluctuated a great deal from decade to decade. Many factors (including weather, climate, ignition sources, available fuels, and fire suppression efforts) interact to influence the amount of acreage burned by wildfire in a given year. As shown in figure 53, the current average is estimated to be above maximum natural range of variation for some decades and below maximum natural range of variation for others. The current condition is estimated to be above the long-term average.

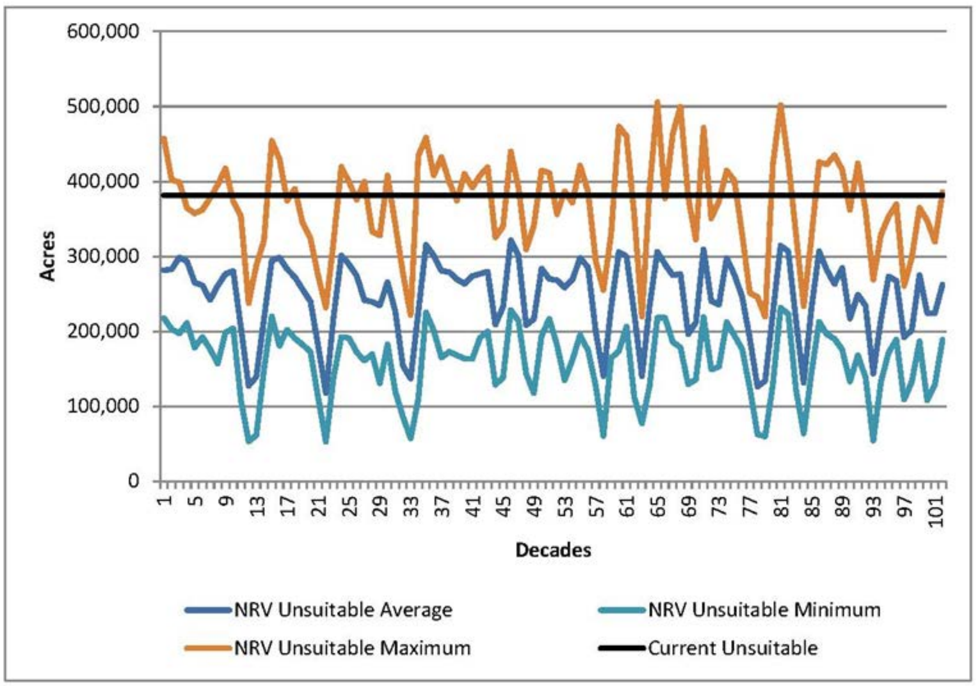


Figure 53. Average, maximum, and minimum levels of lynx habitat in a temporarily unsuitable condition modeled for the past 102 decades: natural range of variation (NRV) and current levels

Standard VEG S1 of the NRLMD limits vegetation management projects designed to regenerate forests if more than 30 percent of lynx habitat in a lynx analysis unit does not yet provide winter snowshoe hare habitat (is in a temporarily unsuitable condition). To provide context for NRLMD standard VEG S1, the natural range of variation for the number of lynx analysis units with more than 30 percent of lynx habitat in a temporarily unsuitable condition was also modeled for the Flathead National Forest. The model estimated that, at a maximum level of lynx habitat, 13.8 percent of Forest lynx analysis units would have had more than 30 percent of the lynx habitat in a lynx analysis unit in an unsuitable condition. At a minimum level, 4.0 percent of lynx analysis units would have had more than 30 percent of lynx habitat in an unsuitable condition, with a mean level of 8.6 percent.

Analysis of acreage burned on the Forest over the last 125 years or so also shows a large amount of variation. Figure 54 displays Forest acres burned from 1889-2015. The number of acres burned on the Flathead National Forest in 2016 totaled less than 500 acres. During the largest fire years, which occurred about a century ago, the actual area burned on the Flathead National Forest was estimated as about 140,000 acres in 1890, 432,500 acres in 1910, 150,000 acres in 1919, and 90,000 acres in 1929. From 1939 to 1987, very few acres were burned. Starting in 1988, there has been an increase in acres burned; the three largest recent fire years burned about 235,000 acres in 2003, 120,000 acres in 2008, and 100,000 acres in 2014.

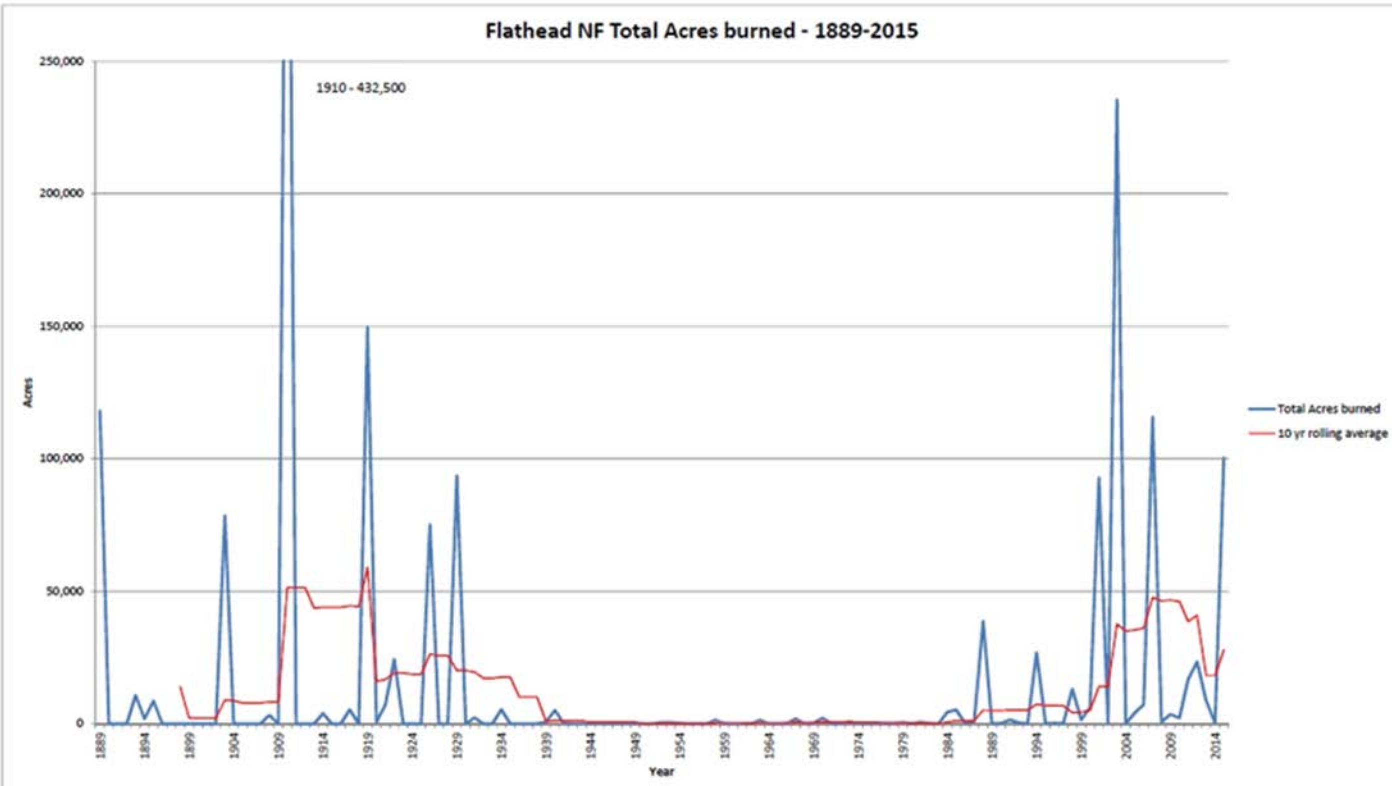


Figure 54. Flathead National Forest estimate of total acres burned, 1889-2015

Associated with the recent increase in the prevalence and extent of wildfires, about 381,336 acres (approximately 21 percent) of lynx habitat in lynx analysis units on NFS lands of the Forest were burned by wildfire within the last two decades. In the subalpine zone that provides lynx habitat, wildfires are typically stand-replacing events. For purposes of forestwide modeling, areas burned in the past 20 years are not yet providing snowshoe hare habitat in all seasons.

The SIMPPLLE model was also used to estimate the maximum and minimum amounts of the stand initiation structural stage (which may have provided hare habitat) that would have occurred historically due to naturally occurring fires. Modeling indicates that the stand initiation phase would have been a maximum of about 13 percent of all lynx habitat at the forestwide scale. There is a wide range of variation of about 180,000 acres between the maximum and minimum natural range of variation. This is because the stand initiation phase occurs for a relatively short period of time following major disturbances (e.g., stand-replacing fire); it typically begins once small trees and shrubs have regenerated but may only last another decade or two until the stand moves into stem exclusion condition (depending upon factors such as elevation and stem density). Some of the extremely dense lodgepole pine forests that regenerated after wildfires in 1910, 1919, and 1929 have stagnated in the stem exclusion stage and are lacking in food for snowshoe hare.

Since about 1950, the stand initiation structural stage has also been created in lynx habitat by vegetation management activities, including timber harvest. About 30,926 acres (approximately 2 percent) of lynx habitat in lynx analysis units was treated by regeneration harvest on NFS lands of the Flathead National Forest from 1994-2013. Observations suggest that, similar to the effects of wildfire, regeneration harvest units do not develop into stand initiation snowshoe hare habitat until 20 years post-harvest, on average. Telemetry locations of lynx on the Forest indicate that lynx begin to use the harvested stands for foraging once sufficient tree and shrub growth has occurred, and they will continue to frequent harvested stands if the stands develop a multistoried structure. In past harvest units in the cool-moist potential vegetation type of the Forest, tree density and composition often support lynx use. Tree density and composition are affected by natural factors as well as by post-harvest treatments (depending upon factors such as aspect, elevation, type of harvest, and whether the stand was precommercially thinned and/or planted with small trees after harvest).

Squires and others are conducting research evaluating how lynx and snowshoe hares respond to fire across a continuum of fire age and post-fire silvicultural treatment. A retrospective analysis of stand history (harvest prescription, fuels disposal, tree planting, precommercial thinning) is also underway to gain a better understanding of how silvicultural practices influence lynx habitat use, as determined using previously collected telemetry locations of lynx (J. Squires, personal communication to R. Kuennen, June 2016).

Existing vegetation conditions

To provide context, existing vegetation conditions are discussed here relative to NRLMD vegetation standards. Within the lynx analysis units on the Forest, an estimated 1.8 million acres provide potential lynx habitat where NRLMD management direction applies. The remainder of Forest lands occur at low elevations lacking in deep, fluffy snow or are inclusions that are not capable of producing boreal forest habitat (e.g., dry forest types, non-forested lands).

Under NRLMD standard VEG S1, if more than 30 percent of the lynx habitat in a lynx analysis unit is currently in a stand initiation structural stage that does not yet provide winter snowshoe hare habitat, no additional habitat may be regenerated by vegetation management projects unless

- it meets criteria applicable to the wildland-urban interface (as discussed in the wildland-urban interface section) or
- a broad-scale assessment has been completed that substantiates different historic levels of stand initiation structural stages.

As of 2016, about 25 of the 109 (23 percent) lynx analysis units on the Flathead National Forest were modeled as having more than 30 percent of lynx habitat modeled as being in an early stand initiation condition as a result of stand-replacing wildfires that does not yet provide winter snowshoe hare habitat (see table 85). Wildfire has clearly been the driver in creating substantial acreages on the Forest in a condition where they do not yet provide winter snowshoe hare and lynx habitat. None of the lynx analysis units are estimated to exceed VEG S1 due to regeneration harvest on NFS lands. Although a large percentage of some lynx analysis units is in the wildland-urban interface, as shown in table 85, the percentage of lynx habitat affected by regeneration harvest has generally been minor in comparison.

Under NRLMD standard VEG S2, no more than 15 percent of lynx habitat on NFS lands can be regenerated by timber management projects within a lynx analysis unit in a 10-year period unless it meets criteria applicable to the wildland-urban interface.

Table 85 displays the condition of lynx analysis units based on forestwide modeling. Since the forest plan was amended to include the NRLMD in 2007, none of the lynx analysis units has had more than 15 percent of its lynx habitat acres regenerated by timber management projects in the last decade. Only 5 of the 109 lynx analysis units have had 5 percent or more of the lynx habitat acres regenerated by vegetation management projects over the time period of 2007-2016.

Table 85. Existing conditions of lynx analysis units on the Flathead National Forest

Lynx analysis unit *	Percent of NFS lands in the lynx analysis unit	Acres of lynx habitat on NFS lands	Percent of lynx habitat on NFS lands affected by wildfire 1997-2016[a]	Percent of lynx habitat on NFS lands affected by regeneration harvest 1997-2016[a]	VEG S2—percent of lynx habitat regenerated by timber management projects on NFS lands over the past 10 years[b]	Approximate percentage of lynx habitat on NFS lands in the wildland-urban interface[c]
Albino Necklace	99%	14,269	13%	None	None	None
Ashley Herrig	30%	6,660	None	5%	5%	87%
Babcock Creek	100%	11,665	8%	None	None	None
Bear Creek	96%	21,039	28%	< 0.5%	< 1%	52%
Bent Whitcomb	100%	21,268	63%	1%	None	4%
Big Prairie Cayuse	100%	11,042	49%	None	None	None
Big Salmon Lake	97%	22,216	46%	None	None	None
Black Bear Helen	100%	14,766	79%	None	None	None
Blacktail	79%	13,680	< 0.5%	6%	6	80%
Bond	82%	10,903	None	None	None	37%
Buck	68%	9,854	16%	None	None	61%
Bunker Creek	100%	23,273	45%	< 0.5%	<1%	None
Canyon	96%	23,578	45%	3%	None	16%
Challenge Granite	100%	17,419	18%	< 0.5%	< 1%	None
Clayton Anna	100%	16,183	66%	4%	None	None
Coram Abbot	84%	6,653	none	None	None	37%
Cox Creek	100%	19,936	4%	None	None	None
Dirtyface Spruce	100%	13,023	5%	None	None	6%

Lynx analysis unit *	Percent of NFS lands in the lynx analysis unit	Acres of lynx habitat on NFS lands	Percent of lynx habitat on NFS lands affected by wildfire 1997-2016[a]	Percent of lynx habitat on NFS lands affected by regeneration harvest 1997-2016[a]	VEG S2—percent of lynx habitat regenerated by timber management projects on NFS lands over the past 10 years[b]	Approximate percentage of lynx habitat on NFS lands in the wildland-urban interface[c]
Dolly Varden Creek	100%	24,864	14%	None	None	None
Doris Creek	100%	24,118	24%	3%	None	9%
Dryad Miner	99%	16,882	< 0.5%	None	None	None
Elk	77%	18,879	7%	7%	1%	29%
Emery Creek	100%	12,844	None	1%	None	2%
Essex Java	99%	14,052	15%	< 0.5%	< 1	29%
Evers Reid	73%	9,586	< 0.5%	10%	3%	82%
Felix Logan	100%	17,471	13%	None	None	None
Foolhen Danaher	100%	25,440	10%	None	None	None
Glacier	92%	21,066	40%	6%	2%	20%
Graves Forest	100%	21,221	8%	None	None	< 0.5%
Haskill Mount	76%	7,885	None	5%	2%	37%
Hay	90%	22,318	None	None	None	11%
Holbrook Bartlett	100%	29,119	47%	None	None	None
Holland	81%	8,294	None	3%	3%	53%
Hungry Horse Creek	100%	11,537	None	None	None	None
Hungry Picture	100%	18,561	30%	None	None	None
Kah Soldier	100%	15,288	9%	1%	1%	8%
Krause	85%	13,308	< 0.5%	None	None	50%
Lakalaho	100%	21,148	< 0.5%	None	None	18%
Lake Five	58%	2,745	None	None	None	99%
Lion	98%	10,950	< 0.5%	4%	None	None
Little Salmon Creek	100%	27,766	11%	None	None	None
Lodgepole Creek	100%	21,319	4%	None	None	None
Long Cy	100%	21,494	23%	None	None	none
Lost	78%	12,365	12%	None	None	< 0.5%
Lost Jack Mid	100%	13,182	91%	None	None	None

Lynx analysis unit *	Percent of NFS lands in the lynx analysis unit	Acres of lynx habitat on NFS lands	Percent of lynx habitat on NFS lands affected by wildfire 1997-2016[a]	Percent of lynx habitat on NFS lands affected by regeneration harvest 1997-2016[a]	VEG S2—percent of lynx habitat regenerated by timber management projects on NFS lands over the past 10 years[b]	Approximate percentage of lynx habitat on NFS lands in the wildland-urban interface[c]
Lost Tally	89%	9,590	None	4%	3%	99%
Lower Beaver	86%	16,661	< 0.5%	7%	1%	39%
Lower Big	99%	18,543	93%	< 0.5%	None	9%
Lower Coal	53%	13,968	58%	None	None	17%
Lower Good	84%	19,746	< 0.5%	6%	2%	56%
Lower Gordon Creek	100%	15,795	42%	None	None	None
Lower Griffin	93%	17,622	57%	6%	1%	25%
Lower Whale	94%	18,341	27%	3%	< 1%	22%
Lower White River	100%	17,902	38%	None	None	None
Lower Youngs Creek	100%	18,885	50%	None	None	None
Martin Stillwater	90%	15,804	None	5%	None	16%
Meadow	87%	7,248	41%	5%	1%	4%
Moccasin Nyack	92%	13,427	2%	< 0.5%	< 1%	64%
Moose	82%	11,102	None	1%	< 1%	48%
Mud Lake	100%	10,488	62%	None	None	None
Murray Canyon	100%	12,625	None	0.50%	< 1%	None
North Crane	78%	10,258	None	2%	None	65%
North Trail	85%	26,722	1%	< 0.5%	< 1%	25%
Pale Clack	100%	13,956	3%	None	None	None
Paola Ridge	92%	9,534	< 0.5%	2%	< 1%	48%
Peters Crossover	100%	17,925	None	None	None	None
Piper	91%	18,696	< 0.5%	7%	< 1%	15%
Porcupine	63%	8,087	None	None	None	1%
Quintonkon Creek	100%	15,888	7%	< 0.5%	None	2%
Rapid Basin	100%	29,821	25%	None	None	None

Lynx analysis unit *	Percent of NFS lands in the lynx analysis unit	Acres of lynx habitat on NFS lands	Percent of lynx habitat on NFS lands affected by wildfire 1997-2016[a]	Percent of lynx habitat on NFS lands affected by regeneration harvest 1997-2016[a]	VEG S2—percent of lynx habitat regenerated by timber management projects on NFS lands over the past 10 years[b]	Approximate percentage of lynx habitat on NFS lands in the wildland-urban interface[c]
Red Meadow	87%	21,956	None	None	None	27%
Schmidt	83%	9,677	None	None	None	52%
Shadow Dean	100%	27,399	24%	None	None	None
Sheppard	94%	21,352	80%	17%	12%	22%
Silvertip Creek	100%	12,540	35%	None	None	None
Slippery Bill	100%	12,587	14%	< 0.5%	< 1%	None
Soup	18%	2,351	None	None	None	None
South Cold	93%	17,989	< 0.5%	2%	< 1%	13%
South Crane	97%	13,938	None	3%	None	36%
South Firefighter	100%	10,726	None	3%	3%	None
South Trail Tepee	93%	20,236	76%	3%	< 1%	40%
South Woodward	94%	13,370	1%	3%	1%	8%
Spotted Bear Mountain	100%	20,943	53%	< 0.5%	None	1%
Squeezer	51%	10,759	2%	1%	None	None
Stadium Gorge	100%	25,091	13%	None	None	None
Stanton Grant	95%	16,800	None	1%	< 1%	51%
Stony Jungle	100%	17,700	61%	1%	< 1%	3%
Strawberry Creek	100%	16,688	27%	None	None	None
Sullivan Creek	100%	27,743	16%	1%	None	None
Teakettle	59%	6,868	1%	None	None	70%
Three Sisters Bungalow	100%	27,654	18%	None	None	None
Trail Bowl	100%	24,727	78%	None	None	None
Twin Creek	100%	18,890	5%	< 0.5%	None	< 0.5%
Upper Beaver	96%	10,684	< 0.5%	< 0.5%	< 1%	< 0.5%
Upper Big	98%	18,039	24%	None	None	None

Lynx analysis unit *	Percent of NFS lands in the lynx analysis unit	Acres of lynx habitat on NFS lands	Percent of lynx habitat on NFS lands affected by wildfire 1997-2016[a]	Percent of lynx habitat on NFS lands affected by regeneration harvest 1997-2016[a]	VEG S2—percent of lynx habitat regenerated by timber management projects on NFS lands over the past 10 years[b]	Approximate percentage of lynx habitat on NFS lands in the wildland-urban interface[c]
Upper Coal	93%	23,894	7%	< 0.5%	None	None
Upper Good	98%	28,384	15%	9%	5%	23%
Upper Gordon Creek	99%	12,638	5%	None	None	None
Upper Griffin	81%	15,844	5%	5%	4%	1%
Upper Logan	80%	17,893	< 0.5%	9%	5%	15%
Upper Trail	100%	15,404	None	None	None	None
Upper Whale	100%	21,775	< 0.5%	None	None	None
Upper White River	100%	12,521	24%	None	None	None
Upper Youngs Creek	100%	26,021	59%	None	None	None
Vinegar Moose	100%	21,481	10%	None	None	4%
West Columbia	87%	7,851	None	None	None	86%
Wheeler Creek	100%	15,087	None	None	None	14%
Wildcat Mountain	100%	15,831	20%	1%	None	None
Woodward	21%	3,743	None	1%	None	1%

a. It is assumed that forests burned by stand-replacing wildfire from 1997-2016 are not yet winter snowshoe hare habitat Acres burned by wildfire are estimates for comparison with standard VEG S1. Burned areas may include areas with previous regeneration harvest, so wildfire and regeneration percentages are not additive. These percentages are estimates based upon Forest-scale data and need to be verified at the project level.

b. Acres are based on the Forest Service Activity Tracking System database, which does not include decisions not yet implemented. This percentage is shown for comparison to standard VEG S2, which requires 15% or less in a 10-year period unless exempted for fuels reduction projects in the wildland-urban interface.

c. The wildland-urban interface is based upon community protection plans as displayed in the USFS GIS database (see figure 1-13).

* Shaded lynx analysis units are estimated to have more than 30 percent of lynx habitat that is not yet winter snowshoe hare habitat due to stand-replacing wildfire. Estimates need to be verified at the project level.

In its biological opinion on the NRLMD (USFWS, 2007b), the USFWS concluded that there was potential for incidental take to occur in lynx habitat, mostly due to the exemptions and exceptions to the vegetation standards, which could diminish the value of lynx habitat and thereby impair feeding and reproduction by adult female lynx and survival of kittens. Because of the difficulty of determining the incidental take of lynx, the USFWS used the total estimated acreage of the exemptions and exceptions as a surrogate measure. The amount of incidental take thus was anticipated to be represented by fuels treatments on up to 6 percent of lynx habitat across the entire northern Rockies analysis area over 10 years (729,000 acres) and by precommercial thinning for other resource benefits on up to 64,320 acres (less than 0.5 percent) of snowshoe hare habitat (lynx foraging habitat) over a 10-year period. The USFWS provided reasonable and prudent measures and terms and conditions in order to minimize incidental take. Standards VEG S1, VEG S2, VEG S5, and VEG S6 include an exemption for fuels treatments to protect communities at risk in lynx habitat within the wildland-urban interface. Such fuels treatments may not occur on more than 6 percent of lynx habitat on each national forest considered “occupied,” as defined in the NRLMD, which limits fuels treatments to about 103,800 acres on the Flathead National Forest (USDA, 2007c). (For additional discussion of the wildland-urban interface, see the Canada lynx critical habitat section below.)

Annual monitoring and reporting is a requirement of the NRLMD biological opinion (USFWS, 2007b) in order to ensure that the level of incidental take is not exceeded. During the period 2007-2016, the Flathead National Forest used the exemption for fuel treatment projects in the wildland-urban interface on about 10,079 acres of lynx habitat, about 9 percent of the limit allowed under the NRLMD consultation incidental take statement and less than 1 percent of lynx habitat on the Forest. None of the lynx analysis units exceeded the VEG S2 standard of 15 percent in the last 10 years (see table 85 and table 86).

Standard VEG S5 also contains six listed exceptions that allow for precommercial thinning in lynx habitat to meet other specific resource objectives. VEG S6 contains several listed exceptions for vegetation management projects that reduce snowshoe hare habitat in multistory mature or late-successional forests. The estimated acres that would possibly be treated through precommercial thinning exceptions are shown in appendix K of the final EIS for the NRLMD. For the Flathead National Forest, the estimated number of acres to be thinned under the exceptions to the vegetation standards was 1,460 acres over a 10-year period (less than 0.1 percent of the lynx habitat on the Forest). During the same period, the Flathead National Forest had decisions for 940 acres (including 939 acres treated under the VEG S5 exceptions and 1 acre treated under VEG S6 exceptions; see table 86). The vast majority of thinning completed under the exceptions was of western white pine, in which 80 percent of the winter snowshoe hare habitat was retained as required by the standard. The allowable level of incidental take has not been exceeded for the northern Rockies analysis area (Conway & Hanvey, 2017) nor for the Flathead National Forest (table 86).

Table 86. Acres of lynx habitat on the Flathead National Forest treated with exceptions and exemptions to the forest plan vegetation standards

Habitat	Estimated acres in the 2007 NRLMD final EIS	Sum of acres with decisions for treatment
Lynx habitat outside the wildland-urban interface with decisions for precommercial thinning using the VEG S5 exceptions (only 1 acre was treated using the VEG S6 exceptions)	1,460 (over 10 years)	672 (2007-2017)
Lynx habitat inside the wildland-urban interface with decisions for treatment using the fuels reduction exemption	103,800 (cumulative)	10,385 (2007-2017)

Note. Some decisions have not yet been implemented.

Winter recreation

Under some conditions, ski resorts and motorized over-snow vehicle use may have detrimental effects on lynx. Winter activity associated with ski resorts, including skiing, ski-lift operation, and grooming of ski runs, may cause disturbance or displacement of individual lynx and may also affect prey availability. Effects to lynx from Montana’s ski resorts were assessed in 2000 and 2001 after the Canada lynx was listed as threatened under the Endangered Species Act in 2000 (USDA-USDI, 2000; USFWS, 2001). In 2007, when consultation on the NRLMD occurred, the effects of ski areas and other types of winter recreation on lynx were further analyzed. The Flathead National Forest has two ski resorts—Whitefish Mountain Resort (formerly known as Big Mountain) and Blacktail Mountain Resort. About 3,100 acres of the Lakalaho lynx analysis unit is in the Whitefish Mountain Resort permit area. The Blacktail Mountain Resort is located in the Blacktail lynx analysis unit, and winter operations occur on about 600 acres of NFS lands. The effects of both of these resorts on lynx were addressed in biological opinions (USFWS, 2001, 2007b), and there has also been subsequent site-specific consultation (USFWS, 2013b). In its 2007 biological opinion, the USFWS determined that although individual lynx may be adversely affected by recreation development, the management direction in the NRLMD would reduce potential impacts at the landscape scale, thus preventing an appreciable reduction in the reproduction, numbers, and distribution of lynx. Since 2007, the Forest has consulted on the effects of projects within the Whitefish Mountain Resort, including consultation for Canada lynx critical habitat (USDA-USFWS, 2016; USFWS, 2007a, 2011b, 2013b, 2015). The Blacktail Mountain Resort is not in critical habitat.

In November 2006, the Flathead National Forest issued the decision for its motorized winter recreation plan, also known as amendment 24 to the forest plan. The decision clarified where, when, and under what conditions motorized over-snow vehicles are allowable on the Flathead National Forest. The specific areas and routes that are suitable for motorized over-snow vehicle use are identified on maps that were incorporated into the forest plan (see figure 1-46). Under this decision, about 32 percent of lynx habitat on the Forest is open to motorized over-snow vehicle use or is in cross-country ski areas where trails are groomed. Across the Forest, there are about 1,098 miles of routes, in lynx habitat, open to motorized over-snow vehicle use at various times throughout the year, snow conditions permitting.

In their March 3, 2006, biological opinion on amendment 24 (USFWS, 2006b), the USFWS concurred with the Flathead National Forest's determination that the proposed Federal action was not likely to adversely affect the Canada lynx. The USFWS based their determination on (1) the proposal's compatibility with the Lynx Conservation and Assessment Strategy, (2) snow compaction that would occur in areas and routes remaining open for snowmobiling, (3) a decrease of more than 300,000 acres in the overlap between modeled lynx habitat and areas open to snowmobiling, (4) a decrease of about 220 miles in routes open for snowmobiling through lynx habitat, (5) the fact that no new snowmobile areas or routes would be opened under amendment 24, and (6) the possible indirect benefit of a reduced risk of inadvertent trapping. Lynx cannot be legally trapped in Montana, but trapping for other furbearer species does occur and is regulated by MFWP.

In the past, some researchers have speculated that compacted trails could indirectly affect Canada lynx by serving as travel routes that might enable competing predators (e.g., coyotes) to access snowshoe hare prey in lynx habitat (Murray & Boutin, 1991; Murray, Boutin, & O'Donoghue, 1994; Ruggiero et al., 1999). However, in its remanded determination (68 FR 40076), the USFWS (2003a) found no evidence of competition between lynx and other predators such as coyotes or, if competition exists, there is no evidence that it exerts a population-level impact on lynx. Therefore, the USFWS did not consider compacted trails to be a threat to lynx. Additionally, Kolbe, Squires, Pletscher, and Ruggiero (2007) completed a study of the effect of snowmobile trails on coyote movements in lynx habitat in northwest Montana. They reported that coyotes in their study area were primarily scavengers in winter (snowshoe hare kills composed only 3 percent of coyote feed sites). Furthermore, coyotes did not forage closer to compacted snowmobile trails than random expectation, and the overall influence of snowmobile trails on coyote movements and foraging success appeared to be minimal (Kolbe et al., 2007). John Squires confirmed that Kolbe's findings are the best available science for the Flathead National Forest (J. Squires, 2015; N. Warren, 2016b). However, because snow compaction results varied across the 18 national forests encompassed by the NRLMD, guideline HU G11 specified that designated over-the-snow routes or designated play areas should not be expanded outside baseline areas of consistent snow compaction unless designation serves to consolidate use and improve lynx habitat.

Squires and others (2010) reported on the effects of snowmobiling on Canada lynx in their Seeley Lake study area, south of the Forest. They were unable to quantify the number of snowmobiles using NFS roads in lynx home ranges, but one primary groomed trail was used by approximately 130 snowmobiles/day. They reported that they found no evidence that lynx selected areas away from NFS roads or groomed snowmobile trails during winter.

Habitat connectivity or linkage

The NRLMD identified lynx linkage areas, which are intended to maintain connectivity and allow for the movement of lynx between blocks of habitat that are otherwise separated by intervening non-habitat areas such as basins, valleys, and agricultural lands or places where habitat naturally narrows due to topographic features. These linkage areas were initially identified on the basis of expert opinion and were coarsely mapped at a broad scale. The group anticipated that linkage areas would be further refined as more information became available. Subsequently, Squires and others (2013) used telemetry data for 64 lynx monitored during 1998–2007 to create a broad-scale resource selection model that predicted probable lynx habitat and “putative movement corridors” across the species’ distribution in the northern Rocky Mountains. This analysis included quantification of the relative likelihood of lynx crossing major highways, one of the major hypothesized anthropogenic threats to lynx connectivity.

Squires et al. (2013) reported that the putative movement corridors they identified for lynx also showed reasonable correspondence with previously published models for wolverines (Michael K. Schwartz et al., 2009), for wolves (Oakleaf et al., 2006), and for grizzly bears (R. D. Mace et al., 1999). The Forest used the updated information published by Squires and others in 2013 in developing its plan components for habitat connectivity (Kuennen, 2017b).

Citing a 2002 article by Hansen et al., Squires and others (2013) stated, “Given that increased traffic and urbanization are projected for the northern Rockies, mitigation such as land purchases and conservation easements may be necessary to preserve connectivity among lynx populations” (p. 194). Private land development, especially along highway corridors in mountain valleys, may also fragment habitat and impede the movement of lynx. The Flathead National Forest does not have jurisdiction over State or Federal highways or lands on other ownerships (e.g., private, State, tribal). The Forest Service can support habitat connectivity through its management of NFS lands by encouraging or acquiring conservation easements along highways or cooperating in identifying appropriate locations for installation of highway crossing structures. Activities on other ownerships are discussed in the analysis of cumulative effects.

Environmental consequences—Canada lynx

The Lynx Conservation Assessment and Strategy (ILBT, 2013) identified anthropogenic influences that may affect lynx and lynx habitat, sorted into either the “upper tier” or the “lower tier.” The upper tier includes the anthropogenic influences that are of greatest concern to the conservation of the lynx: vegetation management, wildland fire management, fragmentation of habitat, and climate change. The lower tier of anthropogenic influences includes recreation (primarily snowmobiling), minerals and energy management, forest/backcountry roads and trails, grazing by domestic livestock, and mortality due to incidental trapping or illegal shooting. It is thought that the lower-tier activities could affect individual lynx but are not likely to have a substantial effect on lynx populations; these are of less concern for conservation of the species (N. Warren, 2016b).

Key stressors

Key stressors are discussed in the “Affected environment” section and are summarized below.

Land management

Vegetation management activities such as timber harvest, fuels reduction, planting, and precommercial thinning can affect lynx habitat connectivity, forest composition and structure, the amount and distribution of dense horizontal cover providing snowshoe hare habitat, the amount and availability of large downed wood providing denning habitat, and the development of multistory hare habitat used by lynx for winter foraging (ILBT, 2013). Stand-replacing wildfires (the most common type within lynx habitat on the Forest) remove understory vegetation and tree canopy cover in the short term but can promote development of dense horizontal cover and recruitment of downed wood in the longer term. During the early post-fire period, a large stand-replacing fire may negatively affect the ability of a lynx to secure food resources within its home range. Lynx are known to use unburned patches in large, newly burned fire areas.

Fragmentation of habitat

Human-caused alterations of natural landscape patterns can reduce the total area of habitat, increase the isolation of habitat patches, and affect movement between those patches of habitat (ILBT, 2013). Habitat fragmentation may be permanent (e.g., converting forest habitat for residential developments or agricultural use) or temporary (e.g., creating a forest opening through timber harvest until trees and shrubs regrow).

Changing climate

The Lynx Conservation Assessment and Strategy did not provide management recommendations specific to changing climate, although it did identify several information needs. Possible effects on lynx as a result of future changes in climate have been hypothesized as (1) potential upward shifts in elevation or latitudinal distribution of lynx and their prey; (2) changes in the periodicity of when snowshoe hares change color or loss of snowshoe hare cycles in the north; (3) reductions in the amount of lynx habitat and associated lynx population size due to changes in precipitation, particularly snow suitability and persistence, and changes in the frequency and pattern of disturbance events (e.g., fire, insect outbreaks); (4) changes in the demography of lynx, such as survival and reproduction rates; and (5) changes in predator-prey relationships. There is a high level of uncertainty about some of these hypothesized effects.

Other stressors are as follows:

Recreation

Some kinds of recreational activities cause loss of habitat, behavioral responses to human disturbance, or snow compaction (ILBT, 2013). Permanent habitat loss can occur within ski resorts from the clearing of trees for permanent infrastructure. Changes in winter habitat can result from vegetation removal and grooming of ski runs. Some anecdotal information suggests that lynx are quite tolerant of humans, although this has not been well studied. A variety of behavioral responses may be expected from individual lynx and in different contexts (ILBT, 2013).

Minerals and energy

Impacts to lynx from minerals and energy activities could include the potential alteration or removal of lynx habitat, increased fragmentation, and the potential for human-caused mortality from high-speed traffic or high traffic levels on roads.

Forest/backcountry roads

Road construction results in a small reduction of lynx habitat by removing forest cover. On the other hand, if a road is closed, regrowth of dense vegetation may provide good snowshoe hare habitat, and lynx may use the roadbed for travel and foraging (Koehler & Brittell, 1990). Extensive backtracking studies in

Montana found that lynx did not avoid gravel forest roads (J. R. Squires et al., 2010). Trails are typically narrow routes with a native surface; there is no information to suggest that trails have negative impacts on lynx (ILBT, 2013).

Livestock grazing

No existing research indicates that grazing or browsing by domestic livestock on Federal lands would reduce the snowshoe hare prey base or have a substantial effect on lynx (ILBT, 2013). However, it is possible that livestock browsing or grazing could reduce the forage and dense horizontal cover needed by snowshoe hares in some environments.

Mortality due to highways and high-speed forest roads

Mortalities of lynx due to vehicle collisions have been documented in Colorado (reintroduced animals on paved highways), in Minnesota (on paved highways), in Maine (on high-speed gravel roads), and in Montana (on highways). Collisions are unlikely to occur on NFS roads, which are traveled at slower speeds and have lighter traffic volumes than highways.

Mortality due to incidental trapping or illegal shooting of Canada lynx

Trapping, snaring, and shooting of lynx is currently prohibited in the contiguous United States. Lynx occasionally are captured in traps set for other species. A trapped lynx can be released, but there is a risk of injuries or unintended mortality, which is known to have occurred in Montana. Most trapping of other furbearer species occurs in winter.

Key indicators for analysis

Resource elements discussed in the analysis are based upon anthropogenic influences identified in the 2013 Lynx Conservation Assessment and Strategy, which relate to risk factors and habitat effectiveness (see table 87).

Table 87. Key indicators for assessing effects to Canada lynx

Resource element	Indicator
Vegetation and wildland fire management	• Terrestrial ecosystems and Canada lynx habitat diversity, vegetation change modeling.
Habitat fragmentation	• Canada lynx habitat connectivity, linkage areas, modeled travel corridors.
Recreation	• Developed ski areas and Canada lynx habitat; and • Suitability for motorized over-snow vehicle use and Canada lynx habitat
Minerals	• Suitability for minerals and Canada lynx habitat
Forest/backcountry roads	• Forest/backcountry roads and indirect effects of motorized access on the risk of trapping and shooting
Livestock grazing	• Livestock grazing and vegetation change in Canada lynx habitat
Driver/Stressor	• Anticipated changes in climate and effects on Canada lynx habitat

Consequences common to all alternatives

All of the alternatives would retain the management direction in the NRLMD for the conservation of lynx except for two Forest-specific changes that are assessed for the action alternatives. The effects of the

NRLMD (appendix A) are discussed as consequences common to all alternatives, with the exception of a Forest-specific change to HUG 11 and an additional numbered exception to VEG S6, assessed under the consequences of alternatives B modified, C, and D (along with additional plan components associated with the forest plan).

Consequences of vegetation and fuels reduction treatments in the wildland-urban interface

As stated in forest plan appendix A, the wildland-urban interface is defined by the Healthy Forests Restoration Act (see glossary). The USFWS biological opinion on the NRLMD (USFWS, 2007b) stated that in recognition of the escalating monetary and societal costs associated with fires in the wildland-urban interface, fuels treatment projects in the wildland-urban interface would be exempted from compliance with VEG S1, VEG S2, VEG S5, and VEG S6 under certain conditions designed to protect communities at risk. For NRLMD analysis purposes, the wildland-urban interface was modeled in 2007 as a 1-mile buffer surrounding communities with more than 28 people/square mile. Over the entire northern Rocky Mountains Geographic Area analyzed by the USFWS, about 6 percent of lynx habitat was found to be within 1 mile of communities. The 2007 incidental take statement, updated in 2017, constrains wildland-urban interface exemption treatments to no more than 6 percent (cumulatively) of lynx habitat on an individual national forest. Although 6 percent was used in the NRLMD biological opinion for the purposed of estimating incidental take, the Forest has treated less than 1 percent of its lynx habitat through exemptions for fuels treatment projects in the wildland-urban interface. All action alternatives would carry forward the 6 percent exemption for vegetation treatments within the wildland-urban interface (which is 103,800 acres for the Flathead National Forest) for the life of the forest plan, which is anticipated to be 15 years (Kuennen et al., 2017).

Fuels treatments in the wildland-urban interface are anticipated to have adverse effects on lynx and their snowshoe hare prey because the intent would be to maintain lower tree density in these areas, resulting in less area of dense horizontal cover. Reductions in snowshoe hare habitat due to fuels treatments and precommercial thinning could lead to lowered reproduction and survival of lynx. However, adverse effects are limited in their extent and distribution. In its previous biological opinion on the NRLMD (USFWS, 2007b), the USFWS assumed that fuel treatments within the wildland-urban interface would not be excessively concentrated in adjacent lynx analysis units because fuel treatment projects may not result in more than three adjacent lynx analysis units exceeding standard VEG S1. Except to create defensible space, the exceptions may not be used in lynx analysis units that have more than 30 percent in stand initiation structural stage that does not yet provide winter snowshoe hare habitat. These limitations would continue to limit the concentration of impacts to Canada lynx in the future. On the Flathead National Forest, 48 of the 109 lynx analysis units (44 percent) do not contain any identified wildland-urban interface; these are mostly located within the Bob Marshall Wilderness Complex (Kuennen et al., 2017).

The wildland-urban interface on the Forest is defined by community protection plans (see figure 1-13). The Salish Mountains geographic area has the highest percentage of lynx habitat in the wildland-urban interface (ranging from 1 to 99 percent of individual lynx analysis units), followed by the North Fork of the Flathead River (ranging from 9 to 70 percent) and the Swan Valley geographic area (ranging from 0 to 61 percent). An analysis of wildland-urban interface boundaries on the Forest shows that much of the wildland-urban interface is at lower elevations and is relatively poor habitat for lynx, based upon modeling by Squires and others (J. R. Squires et al., 2013), which reduces the magnitude of effects.

Consequences of other vegetation management treatments

The USFWS biological opinion on the NRLMD (USFWS, 2007b) stated that limited exceptions to vegetation standards VEG S5 and VEG S6 could occur for other resource benefits, such as to restore whitebark pine, which is a candidate species for listing under the Endangered Species Act. Under all of the alternatives, the estimated acres that could have vegetation management treatments under the numbered exceptions to standards VEG S5 and VEG S6 (see appendix A in the forest plan) would be updated to reflect the anticipated 15-year life of the forest plan. The Forest consulted with the USFWS on the updated acres and types of treatments (Kuennen et al., 2017; N. Warren et al., 2017).

Plan components provide for the conservation of Canada lynx and their habitat. They are aligned with the conservation measures for vegetation management in core habitat listed in the 2013 Lynx Conservation and Assessment Strategy (ILBT, 2013, p. 91) at the forestwide scale, considering exceptions allowed by the incidental take statement (Kuennen et al., 2017).

In summary, standard VEG S1 limits regeneration by vegetation management projects if more than 30 percent of the lynx habitat in a lynx analysis unit is currently in a stand initiation structural stage that does not yet provide winter snowshoe hare habitat, with certain exceptions or exemptions allowed under the incidental take statement. As a result of recent large wildfires, approximately 25 of the 109 lynx analysis units on the Forest exceed the 30 percent VEG S1 threshold (see the “Affected environment” section), which limits adverse effects to lynx because regeneration by vegetation management projects cannot occur until vegetation regrows into snowshoe hare habitat. Standard VEG S2 limits regeneration by vegetation management projects to no more than 15 percent of lynx habitat on NFS lands within a lynx analysis unit in a 10-year period, with certain exceptions or exemptions allowed under the incidental take statement. By limiting the rate of regeneration harvest in each lynx analysis unit, these standards would contribute to a mosaic of habitat over time, which would benefit lynx by supporting the distribution of prey resources within a lynx analysis unit and across the landscape.

Standard VEG S5 limits precommercial thinning projects during the stand initiation structural stage until the stand no longer provides winter snowshoe hare habitat, with certain exceptions or exemptions allowed under the incidental take statement. The intent is to maintain the habitat conditions that are expected to produce high densities of snowshoe hares, which would benefit lynx by supporting high-quality habitat. There are six exceptions to standard VEG S5 that could be used to meet other resource objectives (see appendix A). The exceptions to VEG S5 for precommercial thinning are anticipated to result in the short-term loss of lynx foraging habitat in some treated stands, which could have an adverse effect on lynx survival and reproduction by reducing prey resources, but this effect is limited in intensity and extent. Precommercial thinning at administrative sites and for research or genetic tests would generally have little or no adverse effect on lynx because few acres are involved and the acres impacted are widely distributed. Thinning to enhance whitebark pine and aspen would benefit other wildlife species and would occur on a limited number of acres of lynx habitat, resulting in a minor adverse effect on lynx. Daylight thinning would be allowed around individual western white pine in a manner that retains most winter snowshoe hare habitat. Daylight thinning might reduce lynx habitat quality in the short term but might allow the development of multiple, dense canopy layers in the long term. The Forest now has an abundance of acres that have burned since 2000, creating many forest stands that are, or soon will be, providing stand initiation hare habitat, so the adverse effects of proposed precommercial thinning are expected to be minor.

Standard VEG S6 limits vegetation management projects that would reduce winter snowshoe hare habitat in multistory mature or late-successional forests, with certain exceptions or exemptions allowed by the standard. Timber harvest would be allowed in areas that have the potential to improve winter snowshoe hare habitat but that presently have poorly developed understories (and thus do not provide winter snowshoe hare habitat), thus benefiting lynx by developing forests with a dense understory to support their snowshoe hare prey. The effects of the numbered exceptions to VEG S6 would create short-term loss of hare habitat quality or quantity, but these are anticipated to be minor because they are limited in intensity and extent. Implementation of standard VEG S6 would benefit lynx by retaining and developing important winter habitat over much of the Forest.

As stated in the forest plan appendix A, VEG O1, VEG O2, and VEG O4 encourage management of vegetation to mimic or approximate natural succession and disturbance processes while maintaining lynx habitat components. Guideline VEG G1 encourages the development of projects that are designed to recruit a high density of conifers, hardwoods, and shrubs where such habitat is scarce or not available. Guideline VEG G5 is to provide habitat for alternative prey species, particularly red squirrel, in each lynx analysis unit. Guideline VEG G10 states that all the vegetation standards should be considered when designing fuel treatment projects within the wildland-urban interface to promote lynx conservation and that this should be explained in the project NEPA documentation. Guideline VEG G11 describes how denning habitat should be retained and distributed in each lynx analysis unit. These guidelines benefit lynx by encouraging practices that create or maintain lynx habitat components, and these guidelines would continue to be considered as site-specific projects are developed under all the alternatives. Plan components provide for a mosaic of habitat conditions over time that support dense horizontal cover and high densities of snowshoe hare, with winter snowshoe hare habitat provided by the stand initiation stage and by mature multistory conifer vegetation in support of lynx conservation. Analysis of Forest Inventory and Analysis data on snags and large downed woody material for the Flathead National Forest forest plan shows that the availability of snags and large downed woody material has increased due to an increase in wildfires. Plan components for snags and downed woody material promote their retention. Denning is not considered a limiting factor across the landscape.

Wildland fire management

As stated in the NRLMD, VEG O3 encourages fire use activities that restore ecological processes and maintain or improve lynx habitat. Under guideline VEG G4, prescribed fire activities should not create permanent travel routes that facilitate snow compaction, and permanent firebreaks should not be constructed on ridges or saddles. As displayed in the "Affected environment" section, fire has historically played a substantial role in creating forested landscape patterns on the Flathead National Forest, and fire continues to do so. Most of the boreal forest zone where lynx habitat occurs on the Forest has not been strongly influenced by past fire suppression efforts since these areas naturally burn with a frequency of about every 100 years or longer. Since the late 1980s, the Forest has experienced an increase in the number of large, stand-replacing wildfires. This is resulting in a spike in the amount of lynx habitat that is currently in a temporarily unsuitable condition. In the next 15 years or so, a substantial portion of burned forest is expected to develop sufficient height and density to provide dense horizontal cover of branches at the snow surface to provide snowshoe hare habitat under all alternatives.

Fragmentation of habitat

Many actions that fragment habitat, such as highway expansions and residential developments, are not under the authority of the Forest Service. However, forest plan components under all alternatives are beneficial to Canada lynx by maintaining or improving habitat connectivity on NFS lands and would help to reduce or minimize adverse effects. Standard ALL S1 specifies that new or expanded permanent developments and vegetation management projects must maintain habitat connectivity in a lynx analysis unit and/or linkage area. In linkage areas, potential highway crossings will be identified (LINK S1), and Forest Service lands should be retained in public ownership (LINK G1). Guideline ALL G1 says that methods that avoid or reduce effects on lynx should be used when constructing or reconstructing highways or NFS highways across Federal land. Guideline HU G6 says that methods to avoid or reduce the effects on lynx in lynx habitat should be used when upgrading unpaved roads to maintenance levels 4 or 5 if the result would be increased traffic speeds and volumes or a foreseeable contribution to increases in human activity or development in lynx habitat. Guideline HU G7 states that new permanent roads should not be built on ridgetops or saddles or in areas identified as important for lynx habitat connectivity. New permanent roads and trails should be situated away from forested stringers. LINK O1 encourages working with landowners to pursue conservation easements, habitat conservation plans, land exchanges, or other solutions in mixed ownership areas to reduce the potential of adverse impacts on lynx and lynx habitat. These plan components help to reduce fragmentation of lynx habitat and provide for habitat connectivity.

Recreation—Developed ski areas

Downhill ski resorts typically are located at high elevations in areas with coniferous forests and deep snow, which coincides with lynx habitat. On the Flathead National Forest, two ski resorts, Whitefish Mountain Resort (formerly known as Big Mountain Resort) and Blacktail Mountain Resort contain lynx habitat, each located within one lynx analysis unit. In a 2000 consultation for 12 ski resorts in Montana, including Big Mountain and Blacktail Mountain Resorts, existing conditions, proposed expansions, and ongoing operations were determined to be likely to adversely affect lynx. However, given the small proportions of the lynx analysis units affected and other factors, USFWS concluded that ongoing and proposed actions were not likely to jeopardize the species nor to result in incidental take of individual lynx. The 2007 biological opinion on the NRLMD (USFWS, 2007b) reconfirmed the conclusion that individual lynx may be adversely affected through habitat avoidance, alteration, or loss but that the total area affected is limited and the objectives, standards, and guidelines would reduce the potential impacts. Under all the alternatives, the two ski resorts would continue to operate within their existing permit area boundaries.

As stated in the NRLMD, HU O1 discourages the expansion of snow-compacting activities in lynx habitat; HU O2 says to manage recreational activities to maintain lynx habitat and connectivity; HU O3 encourages concentrating activities in existing developed areas; and HU O4 says to provide for lynx habitat needs and connectivity when developing or expanding existing developed recreation sites or ski areas. No standards were adopted because recreational activities were not considered to be a threat to the population of lynx. Two guidelines in the NRLMD address ski area development or expansion: HU G1 says that provisions should be made for intertrail islands that maintain winter snowshoe hare habitat, and HU G2 encourages providing foraging habitat, consistent with the ski area's operational needs. Guideline HU G3 says that recreation development and operations should be planned to provide for lynx movement and to maintain the effectiveness of lynx habitat.

Minerals

At the present time, there is little mineral or energy exploration and development activity occurring on the Flathead National Forest. Existing oil and gas leases were suspended and would require further NEPA analysis and decisionmaking before any activity could occur. The final EIS for the NRLMD (USDA, 2007d) anticipated little or no effect on lynx related to mineral and energy activities, which would continue to be the case under this alternative (see section 3.23 for more details). As stated in forest plan appendix A, HU O5 says to manage human activities, including minerals and oil and gas exploration and development, to reduce impacts to lynx and lynx habitat. Guideline HU G4 encourages remote monitoring of mineral and energy development sites and facilities to reduce snow compaction; guideline HU G5 addresses development of a reclamation plan to restore lynx habitat when mineral and energy development sites and facilities are closed. HU G12 limits winter access for non-recreation special uses and mineral and energy exploration and development to designated routes or designated over-the-snow routes. The application of these measures is expected to minimize adverse effects on lynx.

NFS and backcountry roads

On the Forest, implementation of road access management associated with amendment 19 has resulted in decreased road mileage, decreased road maintenance, and many miles of public road use restrictions, reducing potential risks to lynx associated with public road access (see section 3.7.5, subsection "Grizzly bear," for more details). As stated in forest plan appendix A, four forest plan guidelines concern NFS roads: HU G6 says to use methods that avoid or reduce effects on lynx when upgrading unpaved roads to maintenance levels 4 or 5; HU G7 discourages building new permanent roads on ridgetops, saddles, or forested stringers or in areas identified as important for lynx habitat connectivity; HU G8 says that brushcutting along low-speed, low-traffic-volume roads should be done to the minimum level necessary to provide for public safety; and HU G9 says that public motorized use should be restricted on new roads built for projects. These plan components would continue to limit the potential local impacts of roads on lynx and lynx habitat.

Livestock grazing

Very little livestock grazing occurs on the Flathead National Forest (see section 3.24 for more details). As stated in forest plan appendix A, four guidelines concern livestock grazing in lynx habitat. Objective GRAZ O1 is to manage livestock grazing to be compatible with improving or maintaining lynx habitat. Guideline GRAZ G1 says to manage livestock grazing in fire- and harvest-created openings so that regeneration of shrubs and trees is not prevented; under GRAZ G2, livestock grazing in aspen stands should be managed to contribute to the long-term health and sustainability of aspen; under GRAZ G3, livestock grazing in riparian areas and willow carrs should be managed to contribute to maintaining or achieving a preponderance of mid- or late-seral stages; and under GRAZ G4, livestock grazing in shrub-steppe habitats that are in the elevation ranges of forested lynx habitat in lynx analysis units should be managed to contribute to maintaining or achieving a preponderance of mid- or late-seral stages. With these components in place, the effects of livestock grazing on lynx and lynx habitat were judged to be minimal across the northern Rockies analysis area. Under this alternative, there would continue to be little or no effect on lynx attributable to livestock grazing.

Summary of modeled alternative consequences

In the Lynx Conservation and Assessment Strategy (ILBT, 2013), no conservation measures are identified for climate change due to the limited ability of Federal land management agencies to alter the current trajectory, but the conservation measures for vegetation include the following measure:

> Conduct a landscape evaluation to identify needs or opportunities for adaptation to climate change. Consider potential changes in forest vegetation that could occur as a result of climate change (e.g., Gärtner et al. 2008). Identify reference conditions relative to the landscape's ecological setting and the range of future climate scenarios. For example, the historical range of variability could be derived from landscape reconstructions (e.g., Hessburg et al. 1999, Blackwell et al. 2003, Gray and Daniels 2006). (p. 91)

Plan alternatives were analyzed using a landscape evaluation that considered reference conditions relative to the landscape's ecological settings and the range of future climate scenarios, considering the interaction of vegetation management, wildland fire, and possible effects on fragmentation of habitat.

Ecosystem Research Group modeled the effects of the alternatives (appendix 3). The natural range of variation was modeled going back about 1,000 years, and effects of the alternatives were projected for the next 50 years, including anticipated changes in climate and the fire suppression logic of the model. Effects of vegetation management associated with each alternative set of management areas, combined with modeling of natural processes such as wildfires, insects and disease, and forest succession, were modeled in 2015. Ecosystem Research Group modeled the effects of several future scenarios for comparison purposes, including a warmer and drier climate over the next five decades that would result in more acres burned (due to expected climate change), as well as continuing the current level of fire suppression into the future. Effects were modeled using the SIMPPLLE model (which simulates future pathways of natural vegetation change across the Forest) and the Spectrum model (which simulates future vegetation management associated with an alternative and its mix of management areas across the Forest). The SIMPPLLE and Spectrum models provide a probabilistic assessment of the subset of Federal actions that provide a programmatic framework for vegetation management activities across the Forest over a 50-year future time period. However, since the exact location, extent, and timing of future fires, timber harvest, thinning, and planting are unknown, future site-specific actions would be subject to the requirements of section 7 of the Endangered Species Act at a future time.

Ecosystem Research Group's modeling used the GIS layer of modeled and mapped lynx habitat for the Flathead National Forest. Two analyses for lynx were done to assess their habitat requirements: (1) a stand initiation habitat analysis and (2) a potential multistoried habitat analysis. Stand initiation hare habitat was modeled as any cover types within grand fir or subalpine fir/spruce habitat types (often mixed with other species). Grand fir (which is not abundant on the Forest) was included because it occurs in close juxtaposition to subalpine fir/spruce lynx habitat and is known to produce snowshoe hares. Stand initiation hare habitat was modeled as the seedling/sapling size class with a canopy cover class of 40–100 percent and 20 or more years since the previous stand-replacing disturbance (high-severity fire or regeneration harvest). Modeled multistoried habitat is limited to cover types that contain subalpine fir or Engelmann spruce (which may be mixed with other species) within subalpine fir/spruce habitat groups. Multistoried lynx habitat is provided by forests with a high proportion of trees in the diameter classes of 7-11 inches and 11+ inches (J. R. Squires et al., 2010; J. R. Squires et al., 2006) and a dense understory providing snowshoe hare habitat. Although snowshoe hares require a dense understory, the SIMPPLLE model is dependent on R1 VMap classes and did not allow the incorporation of understory density. To model lynx habitat, the assumption was made that all cover types with presence of subalpine fir/Engelmann spruce (which may be mixed with other species) in all diameter classes with an average above 10 inches and at least 40 percent VMap canopy cover provide habitat. VMap areas with spruce/sub-alpine fir and canopy cover classes greater than or equal to 40 percent accounted for 85 percent (5,515 of 6,505) of lynx telemetry locations on the Flathead National Forest.

To estimate the current condition, available Forest data sets are not able to estimate horizontal cover associated with snowshoe hare and lynx habitat, but overall density can be estimated based upon Forest Inventory and Analysis field measurements of canopy cover. A large portion of the Forest—about 65 percent of the area in the cool-moist potential vegetation type—is currently in a moderate- to high-density class. Over the first three decades, modeling estimates that this proportion remains steady but then declines, but the proportion of low-density forest increases. In the model, lower forest densities are largely driven by natural disturbances (fire, insects, disease) that convert large areas to early-successional forest in the latter modeled decades, with temporarily less canopy cover. The increasing proportion of forest with low canopy cover may temporarily reduce the quality and connectivity of lynx habitat; however, this would improve over time with development of vegetation in the understory and midstory. According to the modeling of the natural range of variation, fire cycles affecting the amount of multistoried and stand initiation habitat have occurred in the past and are likely to occur in the future in the mid- to high-elevation subalpine fir and spruce forests of the Forest. This is a natural fluctuation over time associated with the characteristic fire regimes and disturbance processes.

Ecosystem Research Group modeled a multistory forest that provides snowshoe hare and lynx habitat over the next five decades. Since the model is not able to discern whether a dense understory is present or not, this should be interpreted as areas with a potential to provide winter snowshoe hare and lynx habitat. What the model depicts is the trend in forest stands that are most likely to have a multistoried structure, high canopy closure, and presence of subalpine fir and spruce. For potential multistory habitat, the range between maximum and minimum natural range of variation is very large, almost 650,000 acres. Since the model reduces harvest based upon lynx standard VEG S6 and applies fire suppression logic as well as forest succession for all alternatives, levels of modeled multistoried lynx habitat slightly exceed the maximum range of natural range of variation for the first two decades. By the third decade, modeled levels of fire and/or insects and disease increase, consistent with projected changes in climate. If insects and disease kill scattered patches of trees in the overstory of multistoried forests, that could increase the density of the understory, creating multistoried stands after a lag time of a few decades, provided the loss of canopy cover is not too great. In contrast, stand-replacing wildfires would create more stand initiation habitat after a lag time of a few decades. Over the next five decades, the acres of modeled stand initiation habitat fluctuates up and down decade by decade.

Despite plan components to maintain or increase multistoried hare and lynx habitat, modeled declines below current levels are projected to occur by the end of five decades due to natural disturbances, which were modeled as increasing with a warmer, drier summer climate. Modeling of vegetation management that would occur under the preferred alternative, in combination with natural processes, shows that potential multistory hare and lynx habitat is expected to stay within the natural range of variation.

Modeling results discussed above are believed to be a worst-case scenario with respect to changing climate, stand-replacing wildfire, and insects and disease. The Forest made updates to the SIMPPLLE model between the draft EIS and the final EIS based upon input from scientists that the model may have projected too much effect from spruce bark beetle and Douglas-fir beetle infestation. This resulted in differences in future projected conditions for some of the vegetation conditions. The magnitude of decline in multistoried habitat by the fourth and fifth decades would likely be less because the extent of tree mortality from Douglas-fir beetle and spruce bark beetle would decrease across about 150,000 acres per decade, on average.

In the updated modeling, the Forest also tested the effects of an earlier increase in stand-replacing wildfire. This resulted in stand-replacing wildfire occurring on about 80,000 more acres. This would initially create more temporarily unsuitable habitat for Canada lynx for about the first two decades, followed by an increase in stand initiation hare habitat for subsequent decades.

As stated in the 2013 Lynx Conservation and Assessment Strategy (ILBT, 2013), "There is some uncertainty about the rate and magnitude of impacts from climate change, and federal agencies may be limited in actions that can be taken to ameliorate those impacts. Nevertheless, those impacts will interact with and perhaps magnify the effects of vegetation management, wildland fire, and fragmentation of habitat" (p. 68). Monitoring items listed in chapter 5 of the forest plan include lynx habitat, wildland fire, and vegetation management activities. The plan can be modified in the future if warranted.

Alternative A

Under alternative A, there would be no change to the plan components for lynx, as listed in appendix A of the forest plan. The effects to lynx that were described in the 2007 final EIS (volumes 1 and 2), biological assessment, biological opinion, and record of decision for the NRLMD are incorporated by reference. Continued implementation of the forest plan is anticipated to maintain or improve lynx habitat in the long term, although some short-term adverse effects may occur, primarily due to the reduction of snowshoe hare habitat allowed under the exemptions to the vegetation standards. The forest plan direction as a whole will promote conservation of the lynx population.

Under alternative A, the Flathead National Forest's estimated acreages for the exceptions to vegetation standards VEG S5 and VEG S6, which were estimated for the period 2017-2021 for purposes of determining incidental take (Conway & Hanvey, 2017), would be carried forward unchanged, adjusted for a time period of 15 years following approval. Under alternative A, the estimate of the acres to be thinned under the VEG S5 and VEG S6 exceptions would be adjusted from 1,460 acres over a 10-year period to 2,190 acres over a 15-year period. The limitations on the acreage for numbered exceptions to VEG S5 and VEG S6 (2,190 acres over 15 years) represents less than 0.1 percent of lynx habitat on the Forest. The small acreage and circumstances where the numbered exceptions could be used makes it likely that there would be minor or undetectable adverse effects on the lynx population.

Under amendment 24, specific routes and areas were designated as suitable or not suitable for motorized over-snow motorized vehicles. About 68 percent of the lynx habitat on the Forest is closed to motorized over-snow vehicle use (see figure 1-42). Lynx are well distributed across the Forest, including areas such as Big Creek and Skyland Creek that receive substantial use by snowmobiles. As discussed previously, Kolbe et al. (2007) found that compacted trails from over-snow motorized vehicles in their study area (western Montana) did not promote a competitive interaction between coyotes and lynx. Mountain lions are a known source of mortality of lynx, accounting for roughly one third of documented mortalities in northwest Montana study areas, but all documented mountain lion predation on lynx occurred in the snow-free period (N. Warren, 2016b). Motorized over-snow vehicles provide access for trapping of other furbearers, which has the potential to increase the risk of incidental trapping of lynx. The biological opinion on amendment 24 (USFWS, 2006b) found that, overall, the level and distribution of winter recreation under this alternative is not likely to adversely affect the lynx population. Guideline HU G11 states that designated motorized over-snow vehicle routes or designated play areas should not expand outside baseline areas of consistent snow compaction unless designation serves to consolidate use and improve lynx habitat within a lynx analysis unit or a combination of immediately adjacent lynx analysis units. This would reduce the risk of human disturbance. Based on scientific findings on snow compaction, competing predators, and risk of accidental trapping mortality relevant to northwest Montana, there would be minimal risk to lynx.

Consequences common to the action alternatives

Consequences of other vegetation management treatments

Under alternatives B modified, C, and D, the estimate for exceptions and exemptions to the vegetation standards is increased in comparison to alternative A. The estimate for all of the numbered exceptions to vegetation standards VEG S5 and VEG S6 is given as a range of acres, from about 10,900 to 15,460 acres, and was updated in 2016 (Kuennen et al., 2017). The estimated acres are for purposes of a programmatic plan. Actual acres implemented would depend upon funding and site-specific analysis. For planning purposes, the upper end of the range reflects potential treatment needs anticipated over the 15-year time period following plan implementation, distributed as follows:

- about 500 acres for defensible space (VEG S5/S6 exception 1);
- about 1,510 acres for research studies and genetic tree tests (VEG S5/S6 exception 2);
- about 1,800 acres for conifer removal or daylight thinning of aspen (VEG S5 exception 4);
- about 4,750 acres for daylight thinning of planted, rust-resistant western white pine (VEG S5 exception 5);
- about 2,500 acres to restore whitebark pine in wildfire areas and forests with sapling-size trees (VEG S5 existing exception 6); and

- about 4,400 acres to restore whitebark pine in forests with trees larger than sapling size (VEG S6 new Forest-specific exception).

As previously analyzed in the biological assessment for the NRLMD (Bertram, 2007), the Forest anticipates that the overall acres for purposes of incidental take would be limited to no more than 15,460 acres (about 0.9 percent of lynx habitat on the Forest) but that there would be flexibility as to which exception categories are used in order to respond to changing budgets, conditions, and needs. For example, the Forest might do more vegetation treatments for defensible space but less for research studies. Additional consultation and site-specific analysis would occur at the project level to determine site-specific effects on Canada lynx and its habitat.

Wildland fire management

As a result of recent wildfires, there is a large pulse of lynx habitat in the early stand initiation stage on the Flathead National Forest. It is likely that these stands will develop into good-quality winter snowshoe hare habitat within about 20 years. However, burned areas that have regenerated into very dense monotypic stands (with densities of 20,000-50,000 trees per acre) are likely to stagnate in the stem exclusion stage. Recently burned areas provide an opportunity to test modified techniques for precommercial thinning with the aim of increasing tree species diversity, promoting development and retention of dense horizontal cover over longer time periods and shortening the time it takes for burned forests with very high densities of regenerating trees (often lodgepole pine and/or western larch) to develop into multistory mature forest with a dense understory of spruce and subalpine fir. The Forest is actively working with research scientists to design and conduct studies that clarify the relationships between stand treatments and the effects on lynx. Acres listed under VEG S5 exception 2 (see above) include about 1,260 acres of anticipated precommercial thinning that may occur for research studies. Some of this research may involve study of the effects of precommercial thinning in wildfire areas and/or alternative precommercial thinning treatments designed to provide long-term lynx habitat benefits. VEG S5 exception 3 may allow treatment of burned areas in the future, but this exception has not been included in the acreage estimates because use of this exception first requires peer review and acceptance by the regional level of the Forest Service and the State level of the Fish and Wildlife Service, with a written determination stating that a project would not be likely to adversely affect lynx or would be likely to have short-term adverse effects on lynx or its habitat but long-term benefits to lynx and its habitat.

Natural ecosystem processes such as wildland fire would contribute to denning habitat for Canada lynx (for example, in management areas such as management area 1), as would forestwide plan components for old growth, snags, and downed wood such as FW-STD-TE&V-01 and 03, FW-GDL-TE&V-06 and 07, and FW-GDL-TIMB-01 and 03).

New exception to standard VEG S6 for noncommercial thinning around mature whitebark pine trees

Standard VEG S5 has an exception that allows precommercial thinning to restore whitebark pine, but VEG S6 does not provide a comparable exception in multistory mature stands. Under alternative B modified, standard VEG S6 would have an additional exception that would allow noncommercial felling of trees of any size that are growing within 200 feet of disease-resistant whitebark pine trees used for cone, scion, and pollen collection. Under the Forest’s new VEG S6 exception, it is estimated that a total of about 4,400 acres would be treated with noncommercial thinning to protect and restore whitebark pine over the next 15 years. The acreage estimate is for the entire stand, although not all of the acres within a stand would be affected because only trees located within 200 feet of the selected whitebark pine trees would be felled. Preliminary analysis, subject to further site-specific analysis, suggests that 18 out of the 109 lynx analysis units distributed in all but the Salish Mountains geographic area may have treatments using this new exception. No more than 6 percent of the lynx habitat in any one lynx analysis unit is identified for possible treatment (estimated exception acres in lynx analysis units on the Forest for purposes of determining incidental take; see figure B-8 in Kuennen et al. (2017)).

Removal of the trees that surround selected mature, rust-resistant whitebark pine trees in mature multistory stands has the potential to decrease the habitat quality of lynx and snowshoe hare habitat. At this time, it is not known whether the stands that would be targeted for treatment actually provide the dense horizontal cover needed by snowshoe hares, and therefore the effects on lynx are uncertain, but site-specific consultation would be conducted when treatments are proposed. Since the felled trees would not be removed from the site, the downed logs would provide additional horizontal cover that might partially offset the effects of felling trees. Exceptions 2-6 to VEG S5 shall only be utilized in lynx analysis units where standard VEG S1 is met. Exceptions 2, 3, and 4 to VEG S6 shall only be utilized in lynx analysis units where VEG S1 is met. Overall, any adverse effects on individual lynx are anticipated to be minor because of the limited number of acres of lynx habitat that would be treated. It is not likely that there would be a detectable impact on the lynx population as a result of this new exception category.

Habitat connectivity, travel corridors, and linkage areas

Objectives, standards, and guidelines carried forward from the 2007 NRLMD under all alternatives, such as standard ALL S1 and guideline ALL G1, help to provide connectivity and minimize fragmentation (see appendix A). These, and additional plan components for the action alternatives, are aligned with conservation measures to minimize habitat fragmentation in core habitat listed in the 2013 Lynx Conservation and Assessment Strategy (ILBT, 2013, p. 93) at a forestwide scale (see Kuennen et al., 2017 for more details).

In addition to plan components that are common to all alternatives, additional plan components in the action alternatives (B modified, C, and D) address habitat connectivity and travel corridors on a Forest-specific basis. Forestwide plan components for riparian management zones (e.g., FW-STD-RMZ-06 and FW-GDL-RMZ-09) support connectivity of lynx habitat by providing for cover conditions that support lynx travel and access to foraging habitats and also provide for distribution of cover across the Forest (see figure 1-07). The following geographic area desired conditions provide emphasis on connectivity, incorporating putative travel corridors identified by Squires and others (2013): GA-HH-DC-03, GA-MF-DC-04, GA-NF-DC-06, GA-NF-DC-07, GA-SM-DC-03, GA-SV-DC-09 (see section 3.7.6 for more details). Plan components that would apply to summer corridors identified by Squires and others (2013) would also facilitate long-distance movements and potential range shifts.

Alternatives B modified, C, and D have a guideline stating that when conducting vegetation management projects, cover of trees and/or tall shrubs should be retained (if available) between areas of forest where cover is lacking (e.g., recent stand-replacement fire areas) so that connectivity between forested patches is not severed. This guideline is intended to benefit multiple wildlife species and would benefit lynx.

Connectivity of mature forest, percent composition of young regenerating forest, low perimeter-area ratio of young regenerating forest patches, and adjacency of mature to young regenerating forest types are important for lynx reproduction and survival at the scale of a lynx home range (Kosterman, 2014). The perimeter-area ration of young regenerating forest patches is anticipated to be highly variable across the Forest, depending upon whether patches are created by wildfire or by vegetation management activities such as timber harvest. Plan components for old growth and riparian management zones, integrated with plan components for vegetation management, help to provide for adjacent mature and regenerating forests at the scale of a lynx home range; lynx are likely to travel through such habitat while accessing patches of boreal forest within their home range.

While many actions that fragment habitat, such as highway expansions and residential developments, are not under the authority of the Forest Service, plan components in the forest plan are beneficial in maintaining or improving habitat connectivity on NFS lands and would help to reduce or minimize adverse effects. Management direction allows for activities to occur to meet social, economic, and multiple-use objectives of the Forest while promoting the recovery of the Canada lynx population.

Motorized over-snow vehicle use and winter routes

Unlike some other national forests within the northern Rockies, under forest plan amendment 24 (USDA, 2006) the Flathead National Forest designated specific routes and areas, as well as seasons, for motorized over-snow vehicle use in accordance with § 212.81 of the Travel Management Rule. Under the action alternatives, changes in suitability for motorized over-snow vehicle use would occur in some site-specific areas. Under all action alternatives, the wording of HU G11 would be replaced with a Forest-specific guideline to maintain ecological conditions for recovery of Canada lynx, as shown in table 88, while also considering the Forest's desired conditions for social and economic sustainability.

Table 88. NRLMD guideline HU G11

NRLMD, guideline HU G11	Flathead National Forest-specific modification of HU G11 under alternative B modified, C, and D
Designated over-the-snow routes or designated play areas should not expand outside baseline areas of consistent snow compaction, unless designation serves to consolidate use and improve lynx habitat. This is calculated on an LAU [lynx analysis unit] basis, or on a combination of immediately adjacent LAUs. This does not apply inside permitted ski area boundaries, to winter logging, to rerouting trails for public safety, to accessing private inholdings, or to access regulated by Guideline HU G12.	To provide ecological conditions to support Canada lynx on NFS lands at a forestwide scale, there should be no net increase in miles of designated motorized over-snow vehicle routes, groomed routes, or areas where motorized over-snow vehicle use would be suitable. The "no net increase" is in comparison to suitability displayed in figure B-11. This guideline does not apply inside permitted ski area boundaries, to winter logging, to rerouting trails for public safety, to accessing private inholdings, or to access regulated by guideline HU G12.

This guideline provides a strategy for management of over-snow motorized vehicle use that will be more adaptive in the future compared to the current guideline for addressing designated routes and play areas and areas of consistent snow compaction. Squires and others (2010) reported that they found no evidence that lynx selected areas away from NFS roads or groomed snowmobile trails during winter. Lynx are distributed across the Forest, with telemetry data documenting lynx use of areas such as Big Creek and Skyland Creek that receive relatively high levels of use by snowmobiles.

Increased competition from other predators due to snow compaction is a minor concern. As discussed previously, Kolbe et al. (2007) found that compacted trails from motorized over-snow vehicles in their study area (western Montana) had only minimal impacts on coyote movements and foraging success and that snowshoe hares were an insignificant portion of the winter diet of coyotes, indicating that snow compaction did not promote a competitive interaction between coyotes and lynx. Mountain lions are a known source of mortality of lynx, accounting for roughly one third of documented mortalities in northwest Montana study areas, but all documented mountain lion predation on lynx occurred in the snow-free period (N. Warren, 2016a).

Although the Forest is closed to lynx trapping, a potential indirect effect of motorized over-snow vehicle use is that it could facilitate access to lynx habitat and increase the vulnerability of lynx to incidental or accidental trapping or illegal shooting. Since 2008, changes in trapping regulations by MFWP have greatly reduced the number of lynx caught in traps, as explained in the "Affected environment" section. Glacier National Park is closed to trapping and to public motorized over-snow vehicle use, greatly reducing the risk of mortality. Wilderness areas of the Forest are closed to motorized use. The Bob

Marshall Wilderness Complex, due to its large size and its remoteness, also has a low risk of lynx mortality due to trapping. The combined area of Glacier National Park and the Flathead's portion of the Bob Marshall Wilderness Complex is over 2 million acres. Shifting areas suitable for motorized over-snow vehicle use within the Forest would not increase the risk of accidental or incidental trapping. In summary, the level and distribution of winter recreation is not likely to negatively impact the overall lynx population, although there is some risk of injury or mortality to individual lynx.

Minerals and energy

The Forest has low potential for locatable minerals and low to high potential for leasable minerals (such as oil and gas). Many acres of NFS lands on the Forest are withdrawn from mineral entry (see figure B-37 in Kuennen et al. (2017) and the "Grizzly bear" subsection of section 3.7.5 for more details).

Withdrawal of large areas of the Forest from mineral development reduces the risk of Canada lynx habitat loss, disturbance, displacement, and mortality. All withdrawals are subject to valid existing rights. The Forest Service does not have the discretion to deny the exercise of an outstanding mineral right. However, the developer does not have unrestricted rights because the developer's rights are limited to using only as much of the surface as is reasonably necessary to explore, develop, and transport materials. The developer must provide an operating plan to the Forest, and the Forest has some ability to manage surface resources. Forest Service Manual 2832 provides direction for administration of an outstanding mineral right (the source of minerals information is volume 2 of the 2014 Flathead National Forest assessment, as updated by the 2015 leasing withdrawal). Existing oil and gas leases were suspended and would require further NEPA analysis and consultation before any activity could occur. The action alternatives limit the area where new leasable mineral activities may occur (subject to valid existing rights) within 97 lynx analysis units because there would be a standard requiring no surface occupancy for new leases in the grizzly bear primary conservation area. Since a large portion of the grizzly bear primary conservation area is also lynx habitat, this benefits lynx.

NFS and backcountry roads

Standards to maintain baseline densities of motorized routes in the grizzly bear primary conservation area and Salish demographic connectivity area would limit potential risks to lynx associated with motorized public access (see section 3.7.5, subsection "Grizzly Bear," for more details).

Livestock grazing

Very little livestock grazing occurs on the Flathead National Forest (see figure 1-69). The action alternatives further limit the amount of grazing allowed in the future within the lynx analysis units because grizzly bear standard FW-STD-GR-05 specifies that there will be no net increase in the number of active cattle grazing allotments above the baseline in the grizzly bear primary conservation area. In addition, a guideline for the Swan Valley geographic area (GA-SV-GDL-04) addresses closing open and active grazing allotments if the opportunity arises with a willing permittee (see section 3.7.5, subsection "Grizzly Bear," for more details). There would continue to be little or no effects to lynx attributable to livestock grazing.

Effects of plan components related to potential vegetation types

Although standards and guidelines carried forward from the 2007 NRLMD provide direction for many aspects of land management, the action alternatives have additional plan components that integrate Canada lynx habitat with desired conditions for vegetation that are tied to potential vegetation types, within the context of the natural range of variation. The following paragraph discusses the effects of these plan components on Canada lynx.

Desired conditions in proposed alternative B modified are aligned with conservation measures for vegetation management in core habitat listed in the 2013 Lynx Conservation and Assessment Strategy (ILBT, 2013, p. 91; Kuennen et al., 2017). Under the action alternatives, desired conditions for vegetation pattern are tied to potential vegetation types. The majority of modeled Canada lynx habitat is in the cool-moist and cold groups, which correspond to boreal forest habitat types capable of growing spruce and fir trees. A desired condition is a description of specific social, economic, and/or ecological characteristics of the plan area, or a portion of the plan area, toward which management of the land and resources should be directed. Desired conditions are not commitments or final decisions approving projects and activities. The desired condition for some resources may currently exist, but for other resources they may only be achievable over a long time period.

Forestwide desired condition FW-DC-TE&V-19 promotes ecological conditions to support Canada lynx habitat and its connectivity because it is consistent with the vegetation conditions described in the section on the affected environment for Canada lynx habitat. Desired condition FW-DC-T&V-09 provides direction to maintain native plant species diversity, including conifers, in aspen stands.

Alternative B modified

In seven lynx analysis units, there would be an increase in the area suitable for motorized over-snow vehicle use, but this would be offset by a reduction in five other lynx analysis units. The change to HU G11 would result in no net increase in the area suitable for motorized over-snow vehicle use on the Forest, but areas would be shifted. In the North Fork geographic area, acres suitable for motorized over-snow vehicle use would increase by about 217 acres in the Lower Big lynx analysis unit and by about 7,660 acres in the Canyon lynx analysis unit (see figure 1-46; figure B-12 in Kuennen et al. (2017)). There would be an increase of about 485 acres in the middle of an existing route in the Upper Big lynx analysis unit and an increase of about 260 acres in the Upper Coal lynx analysis unit. In the Red Meadow lynx analysis unit, there would be an increase of about 235 acres adjacent to an existing area. In the Middle Fork geographic area, there would be an increase of about 1,548 acres adjacent to an existing open area in the Bear Creek lynx analysis unit and about 602 acres in the Challenge-Granite lynx analysis unit. Additional snow compaction would occur on some but not all of this acreage because there are portions where tree cover is too dense for snowmobiles to navigate. At a forestwide scale, the above increases would be offset by changing some areas in five different lynx analysis units to make them unsuitable for motorized over-snow vehicle use. These changes would total about 48 acres in the Bunker Creek lynx analysis unit, about 2,646 acres in the Kah Soldier lynx analysis unit, about 94 acres in the Stony Jungle lynx analysis unit, about 8,812 acres in the Sullivan lynx analysis unit, and about 344 acres in the Slippery Bill lynx analysis unit. In addition, there would be some very minor adjustments in suitable and non-suitable areas (generally less than 15 acres) scattered across about 30 lynx analysis units in order to clean up boundaries previously mapped in a raster format or to assist in the enforcement of closed areas. Thus, for the Forest as a whole there would be no net increase in the percentage of lynx habitat designated as suitable for motorized over-snow vehicle use.

In the lynx analysis units with an increase in acres suitable for motorized over-snow vehicle use, an increase in this use would be expected to occur. Although lynx are believed to be tolerant of many types of human activities, there is a potential for indirect effects to lynx due to disturbance, displacement, and/or mortality risk (from non-target trapping) in winter. In vicinities that are already heavily used by motorized over-snow vehicles, such as Canyon Creek, there is a potential for the additional suitable areas to result in an increase in the area of consistent snow compaction, as defined by the NRLMD. The effects of this increase on Canada lynx are anticipated to be minor, based upon findings by Squires and others (Kuennen, 2017a; J. R. Squires et al., 2010; J. R. Squires et al., 2013) and Kolbe and others (2007). In addition, not all of the acreage in the added suitable areas would be expected to have an increase in the area of consistent snow compaction because terrain and vegetation influence where motorized over-snow vehicles can physically go. Vegetation conditions are dynamic over time and change in response to disturbance and succession. Wildfire may initially open up dense forest for motorized over-snow vehicle use, but as high densities of dead trees fall or as succession occurs, areas previously open to motorized over-snow vehicle use become unavailable because the machines cannot physically maneuver between or over the trees.

In the future, there would be no net increase in routes, groomed routes, or areas that are suitable for motorized over-snow vehicle use across the Forest as a whole under alternative B modified. By limiting where snow compaction and disturbance could occur in the future, there might be a small benefit to lynx because some areas that would become unsuitable provide higher-quality habitat than some areas that would become suitable (see figure 1-47; figure 1 in Squires et al. (2013); Kuennen, Van Eimeren, and Trechsel (2017)). There would be no net increase in suitable areas, so the risk of accidental trapping would not increase. Some of the recommended wilderness areas (management area 1a) included in alternative B modified are large or increase the size of the Bob Marshall Wilderness Complex, further reducing the risk of accidental trapping of lynx because these areas are not suitable for motorized over-snow vehicle use. Changes to areas or routes suitable for motorized over-snow vehicle use would go through site-specific consultation at the project level.

On the whole, modified alternative B would promote conservation of the Canada lynx population because (1) the regulatory framework provided by the NRLMD would remain in place with two Forest-specific modifications that would have minor effects, (2) plan components for vegetation in the potential vegetation types that include boreal forest habitat types would support lynx habitat diversity over the long term, and (3) management area allocations and their effects have been modeled for lynx habitat (based on a worst-case scenario with respect to modeled changes in climate over five decades following plan implementation). Modeling has shown that anticipated combined effects would remain within the range of natural variation of the Forest’s historically fire-dominated landscape.

Alternative C

Consequences of plan components in appendix A, other forestwide plan components, and other geographic area plan components are the same for all action alternatives. The primary difference in alternatives is in the mix of management areas. Alternative C has more acres of recommended wilderness than the other alternatives (see figure 1-03). It is anticipated that desired conditions for Canada lynx in these areas would be primarily affected by natural ecosystem processes such as wildfire, insects, and disease. Insects and disease would be anticipated to create small canopy gaps in the coniferous tree canopy over time. If this occurs in the cool-moist and cold potential vegetation types (see forest plan figure B-03), it would promote development of a dense understory and create multistoried hare and lynx habitat. If insect infestation is epidemic or if stand-replacing wildfire occurs that results in tree mortality in most of the canopy, multistoried hare habitat would be reduced and stand initiation hare and lynx habitat would develop over a period of about 20 years (and would provide this habitat condition for another 10-20 years, depending upon tree density).

As an indirect effect of recommended wilderness, fewer areas would be suitable for motorized over-snow vehicle use under alternative C compared to the other alternatives, and the distribution of suitable areas would change (see figure 1-48). Many additional areas, both large and small, that are within recommended wilderness would be designated as unsuitable for motorized over-snow vehicle use. This change would occur in 10 lynx analysis units within the North Fork geographic area, 7 lynx analysis units in the Middle Fork geographic area, 13 lynx analysis units within the Hungry Horse geographic area, 3 in the South Fork geographic area, 13 in the Swan Valley geographic area, and 1 in the Salish Mountains geographic area for a total of about 177,000 acres. In total, almost 10 percent of the Forest’s 1.8 million acres of lynx habitat would change from suitable to unsuitable for motorized over-snow vehicle use. In addition, under alternative C, most late spring motorized over-snow vehicle use areas (which also include lynx habitat) would be incorporated into recommended wilderness areas. Suitable areas added include an area in the Upper Big, Lower Big, and Canyon lynx analysis units (about 13,395 acres) and small linear areas adjacent to existing suitable areas in the Bear Creek, Challenge, and Slippery Bill lynx analysis units (about 385 acres). As explained in the “Affected environment” section, the effects of motorized over-snow vehicle use on Canada lynx in northwest Montana are believed to be minor, so these changes would be anticipated to have minor consequences for lynx.

Alternative D

This alternative does not have any recommended wilderness. It emphasizes more active vegetation management, including timber harvest, to achieve desired conditions. The consequences of vegetation management under alternative D would be similar to those described for alternative B modified, but there are more acres suitable for timber production in this alternative, particularly acres in management area 6c, where a higher level of vegetation management intensity is anticipated (see figure 1-04). Vegetation management standards for Canada lynx would apply regardless of management area. Under this alternative there would be more emphasis on frontcountry and dispersed mechanized recreation opportunities. This alternative has additional management area 7 (focused recreation) in lynx habitat. As explained in the “Affected environment” section, lynx are generally tolerant of human activity. The effects of nonmotorized recreation on Canada lynx in northwest Montana are believed to be minor, so these changes would be anticipated to have minor consequences for lynx.

Under alternative D, there would be a small net increase of 1 percent in the area suitable for motorized over-snow vehicle use of the Forest’s 1.8 million acres of lynx habitat (see figure 1-49). As with alternative C, an area in the Lower Big and Canyon lynx analysis areas would be added as suitable for motorized over-snow vehicle use (about 13,850 acres). Additional areas in the Canyon and Lakalaho lynx analysis units, totaling about 2495 acres, would also become suitable for motorized over-snow vehicle use. Two small areas totaling about 1,900 acres in the Bear Creek and Challenge-Granite lynx analysis units also would become suitable. Two small areas in the Glacier and the Slippery Bill lynx analysis units would become unsuitable for motorized over-snow vehicle use. These changes would result in a net increase in the area suitable for motorized over-snow vehicle use of about 19,594 acres on the Forest. In vicinities that are already heavily used by motorized over-snow vehicles, such as Canyon Creek, there is a potential for the additional suitable areas to result in an increase in the area of consistent snow compaction, as defined by the NRLMD. The effects of this increase on Canada lynx are anticipated to be minor, based upon findings by Squires and others (Kuennen et al., 2017; J. R. Squires et al., 2010; J. R. Squires et al., 2013) and Kolbe and others (2007). In addition, not all of the acreage in added suitable areas would be expected to have an increase in the area of consistent snow compaction.

Consequences of management areas allocations

Management area allocations provide the on-the-ground framework that guides which allowable uses may occur in a particular area of the Forest. Table 89 summarizes the approximate percentage of management areas in lynx habitat by alternative (see figures 1-01 through 04). This section characterizes the management areas in Canada lynx habitat and discusses the effects of the resulting management direction on the species. A more detailed description of the management areas can be found in chapter 3 of the forest plan.

Table 89. Canada lynx habitat in each Forest management area by alternative

Management Area	Alternative A Potential Lynx Habitat (%)	Alternative B modified Potential Lynx Habitat (%)	Alternative C Potential Lynx Habitat (%)	Alternative D Potential Lynx Habitat (%)
1a Designated wilderness	43	43	43	43
1b Recommended wilderness	4	9	24	0
2a Designated wild and scenic rivers	< 1	< 1	< 1	< 1
2b Eligible wild and scenic rivers	0	1	1	1
3b Special areas	0	< 1	< 1	<1
4a Research natural areas	< 1	< 1	< 1	< 1
4b Experimental and demonstration forests	< 1	< 1	< 1	< 1
5a, 5b, 5c, 5d Backcountry	18	15	7	22
6a General forest low-intensity vegetation management	4	6	10	6
6b, 6c General forest medium- and high-intensity vegetation management	30	23	15	24
7 Focused recreation areas	< 1	2	1	2

Wilderness (management area 1a)

About 43 percent of lynx habitat on the Forest is in existing wilderness in the Mission Mountains Wilderness and the Bob Marshall Wilderness Complex (table 89). Planned and natural ignitions are allowed under all alternatives and contribute to desired vegetation conditions in these areas. Periodic wildfires create a mosaic of forest conditions. This management area maintains large, remote habitats for lynx that are likely to have a lower amount of human presence due to the lack of wheeled or motorized over-the-snow vehicle use and limited nonmotorized access. The wilderness management area provides habitat connectivity with Glacier National Park and, from there, to the international border with Canada, helping to provide linkage with lynx populations in British Columbia and Alberta.

Recommended wilderness (management area 1b)

Recommended wilderness ranges from 0 percent of potential lynx habitat under alternative D to about 9 percent of lynx habitat, distributed across 46 of the Forest’s 109 lynx analysis units, under alternative B modified and 22 percent under alternative C (table 89). Effects are similar to those for management area 1a. The recommended additions to the Bob Marshall, Great Bear, and Scapegoat Wildernesses would provide habitat for lynx in 38 lynx analysis units. The recommended Tuchuck addition would help provide a large block of habitat in seven lynx analysis units in close proximity to lynx habitat in Canada, contributing to habitat connectivity as well as genetic connectivity.

Designated and eligible wild and scenic rivers (management area 2)

Approximately 1 percent of potential lynx habitat is located within these management areas in all alternatives (table 89). The Forest has one designated river with three forks (the North, Middle, and South Forks of the Flathead), and an additional 24 rivers are eligible. Wild and scenic river segments are classified as wild, scenic, or recreational segments (see section 3.17 for more details). Timber harvest is not allowable in river segments classified as wild. River segments classified as scenic or recreational are not suitable for timber production, but timber harvest may be allowed to meet desired social, economic, or ecological conditions. Management area 2 management direction helps to maintain wide forested corridors along major waterways that may facilitate lynx movement through the landscape, providing connectivity.

Special areas (management area 3b)

Less than about 1 percent of lynx habitat is located within this management area under all the alternatives (table 89). This management area provides protection for areas with unique botanical features such as fens, sloughs, *Howellia* sites, and groves of cedar, larch, or ponderosa pine. This management area is not suitable for timber production, nor is it suitable for commercial use of non-timber forest products. Vegetation management may be allowed to maintain desired ecological conditions and values. Effects to lynx are minor due to their small size and low percentage. These areas may or may not provide the kind of vegetation conditions that provide lynx foraging, denning, or habitat connectivity.

Research natural areas (management area 4a)

Approximately 1 percent of potential lynx habitat is located within this management area under all the alternatives (table 89). The Forest has six research natural areas in three geographic areas. Research natural areas are generally natural appearing, and human influence on their ecological processes is limited and is guided by the Rocky Mountain Research Station. This management area is not suitable for timber production. Vegetation management may be allowed for study and research purposes or if needed to protect the values for which the research natural area was designated. Although very limited in their number and size, research natural areas help provide a continuum of security habitat and connectivity for lynx.

Experimental forest and demonstration forest (management area 4b)

Less than about 1 percent of lynx habitat is located within this management area under all the alternatives (table 89). The Forest has one experimental forest in the Hungry Horse geographic area and one demonstration forest in the Salish Mountains geographic area. In experimental forests and demonstration forests, vegetation management for research purposes is likely, with exceptions for research allowed under the vegetation standards for lynx. Periodic wildfires, prescribed fires, and other types of vegetation management, including timber harvest, precommercial thinning, commercial thinning, and planting, may create a mosaic of forest conditions, benefiting lynx. Wheeled motorized travel may occur on designated routes and motorized over-snow vehicle use may occur, subject to other forestwide plan components (discussed under effects of alternative A and effects common to all action alternatives).

Backcountry (management area 5)

This management area ranges from about 22 percent of lynx habitat under alternative D to about 7 percent of lynx habitat under alternative C. Alternatives A and B modified have about 15 and 18 percent of backcountry, respectively (table 89). In management area 5a, motorized use is not allowed. Year-round motorized use is allowed in management area 5b, motorized over-snow vehicle use is allowed in management area 5c, and summer wheeled motorized use is allowed in management area 5d. Motorized use in management area 5d is generally dispersed trail use, whereas motorized over-snow vehicle use in management area 5c includes dispersed trail use as well as larger areas. Mechanized transport (e.g., mountain bikes, game carts) are allowed in this management area. Lynx are generally tolerant of human presence and the types of uses that occur in backcountry areas. However, motorized over-the-snow vehicle use may be great enough to cause disturbance or displacement of individual lynx in some circumstances. The action alternatives limit areas where motorized over-snow vehicle use can occur, reducing the risk of population-level effects (see also the discussion under effects common to all action alternatives). This management area is not suitable for timber production, but timber harvest may be allowable under some circumstances to meet desired ecological, social, or economic conditions. Because most of management area 5a is in inventoried roadless areas where road building is not allowed, timber harvest would be likely to occur at low levels. Periodic wildfires, prescribed fires, and other types of vegetation management, including precommercial thinning, commercial thinning, and planting, may contribute to a mosaic of forest conditions, benefiting lynx.

General forest (management area 6)

Approximately 4 percent of lynx habitat is located within management area 6a for alternative A, about 6 percent for alternatives B modified and D, and about 10 percent for alternative C (table 89). Management area 6a is anticipated to have the lowest intensity of timber harvest because it is not suitable for timber production, followed by management area 6b, which is suitable for timber production but also contributes to habitat connectivity in key areas for lynx. In the North Fork, Hungry Horse, and Swan Valley geographic areas, some of management areas 6a and 6b is located in areas along putative travel corridors identified by Squires and others (2013).

Approximately 15 percent of lynx habitat is located within management areas 6b and 6c under alternative C, about 23-24 percent under alternatives B modified and D, and about 30 percent under alternative A. Lynx habitat located within general forest management areas 6b and 6c has a mosaic of successional stages in a roaded environment due to past timber harvest and road construction. In this management area, active management activities, including prescribed fire, timber harvest, fuels reduction, precommercial thinning, commercial thinning, and planting, are most likely to continue to create a mosaic of forest conditions. Within management areas 6b and 6c, riparian management zones are not suitable for timber production, providing an interconnected network that contributes to habitat connectivity for lynx. Much of management area 6c is in the wildland-urban interface, where timber harvest intensity is anticipated to be higher. Management area 6c is where exemptions to the vegetation standards for lynx are most likely to result in short-term adverse effects but long-term benefits to hare habitat by creating a mosaic of successional stages. Grizzly bear management direction prescribes no net increase to baseline densities of roads open to public motorized use during the non-denning season, which would also reduce the potential for disturbance to lynx. In the grizzly bear primary conservation area, total road densities would also be subject to a standard of no net increase to baseline densities, and there would be no net decrease in secure core, providing large areas of relatively high habitat connectivity.

Focused recreation area (management area 7)

Approximately 2 percent of lynx habitat is located within management area 7 under alternative B modified (table 89). The percentage is similar for D and is about 1 percent for alternatives A and C. Focused recreation areas typically have recreational uses such as a large lake or reservoir, large campgrounds, or trail systems for featured recreational activities such as hiking, mountain biking, cross-country skiing, and/or wheeled motorized vehicle use on designated routes and areas. There are two developed ski areas or year-round resorts in this management area. Focused recreation areas may have a relatively high level of human activities and associated infrastructure near roads. There may be roads, utilities, and trails as well as signs of past and ongoing activities of actively manage forest vegetation in these areas. Although individual lynx may be adversely affected by recreation developments, the management direction in the NRLMD would reduce potential impacts to lynx.

Cumulative effects on Canada lynx

As described previously, the Lynx Conservation Assessment and Strategy (ILBT, 2013) identified four anthropogenic influences (the upper tier) as being of greatest concern to the conservation of the lynx: climate change, vegetation management, wildland fire management, and fragmentation of habitat. These are therefore considered in some detail in this section to evaluate the potential for cumulative adverse effects. The lower tier of anthropogenic influences include recreation, minerals and energy management, forest/backcountry roads and trails, grazing by domestic livestock, and mortality due to incidental trapping or illegal shooting. Although these lower-tier activities could affect individual lynx, they are not expected to have a substantial effect on the overall lynx population and are unlikely to cause cumulative adverse effects. Therefore, they are not discussed in detail. The analysis of cumulative effects considers the previous analysis and decision under the NRLMD final EIS (USDA, 2007d).

The cumulative effects analysis area is predominantly NFS lands and also includes Glacier National Park, State-managed lands, tribal lands, and private lands. Two national forests make up the bulk of the lands in this area—the Flathead and the Kootenai National Forests (the Kootenai is adjacent to the Flathead to the west). There are 47 lynx analysis units on the Kootenai National Forest, encompassing about 1,151,000 acres of lynx habitat (i.e., boreal forest habitat types). To the south, the Seeley Lake District on the Lolo National Forest and the Lincoln District on the Helena National Forest also provide lynx habitat in the cumulative effects analysis area, as does a small portion of the Idaho Panhandle National Forest, which is in critical habitat unit 3. Lynx habitat on these national forests is managed through implementation of a consistent set of forest plan objectives, standards, and guidelines (USDA, 2007c). Habitat management on these units, in concert with the Flathead National Forest, promotes the conservation of lynx.

Future changes in climate

The preliminary Northern Region Adaptation Partnership risk assessment for the Canada lynx (McKelvey & Buotte, in press) states that lynx have little or no adaptive capacity to live in areas lacking snow and limited ability to shift their diet away from snowshoe hares. There is a potential that climate change will reduce the extent of deep snow habitats preferred by lynx. McKelvey et al. (in press) estimated that contiguous areas of spring snow cover would become smaller and more isolated throughout the Columbia River Basin, with greatest losses at the southern periphery but possible increases in snow at higher elevations in the lynx core (including the Flathead National Forest). Regardless of snow depth, the timing of snowmelt has been occurring about two weeks earlier in recent decades. Mills and Johnson (2013) used an ensemble of locally downscaled climate projections and forecasted that the annual average duration of snowpack will decrease by 29–35 days by midcentury. Unless snowshoe hares show enough plasticity to adapt to earlier snowmelt, the reduced snow duration will increase the number of days that white hares will be mismatched on a snowless background. This lack of camouflage coloration may make lynx more successful in detecting their primary prey, but in the long term it may also reduce snowshoe hare numbers, especially at relatively lower elevations where snow reductions in the northern Rockies are anticipated to be greatest. McKelvey and Buotte (in press) estimate that the likelihood of future climate change effects is high, with a moderate magnitude of effects by 2030 and a high magnitude of effects by 2050.

Large wildfires in lynx habitat are also believed to be strongly associated with changing climate factors. Westerling et al. (2006) compiled information on large wildfires in the western United States from 1970–2004 and found that large wildfire activity increased suddenly and markedly in the mid-1980s, with higher frequency of large wildfire, longer wildfire durations, and longer wildfire seasons. The greatest increases occurred in mesic, mid- and high-elevation forest types in the northern Rocky Mountains. Westerling stated that fire exclusion (suppression) has had little impact on the natural fire regimes of these higher-elevation forest types in this area; instead, climate appears to be the primary driver of forest wildfire risk.

As discussed above, stand-replacing wildfires on the Forest have created a greater amount of early stand initiation habitat in recent decades. Increases in wildfire may initially create more habitat that is temporarily unsuitable for snowshoe hares and lynx foraging but may greatly increase suitable habitat within a few decades (Vanbianchi, Murphy, & Hodges, 2017). Plan components for fire would allow the Forest to adapt its future management to changing conditions.

Vegetation management

In the past, timber harvest removed all size classes of trees, snags, and downed logs in mixed-species forests containing spruce and subalpine fir, resulting in loss of multistory stands as well as fragmentation of cover. On cool-moist habitat types, forests that were regenerated in the 1950s and 1960s, including those that had precommercial thinning following harvest, are now developing into forests with a multistoried canopy structure, in some cases containing a dense understory. During the same time period, an extensive insect and disease outbreak killed large-diameter spruce. Salvage harvest of scattered mature spruce trees, or dead trees creating canopy gaps, allowed a dense understory of subalpine fir and shrubs to grow in many of these areas.

National forests in the cumulative effects analysis area manage lynx habitat to provide boreal forest landscapes supporting a mosaic of differing successional forest stages and containing the presence of snowshoe hares and their preferred habitat conditions. These Forests follow management direction in the NRLMD. During the last decade, timber harvest practices have been more favorable for lynx as a result of forest plan amendments, with fewer acres impacted by temporary loss of multistory stands that provide snowshoe hare and lynx habitat. Outside the wildland-urban interface, precommercial thinning practices have also been more favorable for lynx, with fewer acres experiencing short-term reductions in snowshoe hare habitat. In response to increases in stand-replacing wildfires, fuels reduction programs have increased in recent decades and are expected to continue on managed portions of Forest Service, State, tribal, and private lands within the boundaries of Forest geographic areas, particularly in the wildland-urban interface. On national forests in the cumulative effects analysis area, the wildland-urban interface has vegetation treatments using the exceptions and/or exemptions to the NRLMD vegetation standards, which may adversely affect stand initiation or multistory hare and lynx habitat. Table 90 shows the approximate acres of exceptions or exemptions used by the Forests (or portions of Forests) in the cumulative effects analysis area through 2016.

Table 90. Acres of hare habitat treated in critical habitat unit 3 through 2016

Exception or exemption category	Flathead National Forest (acres)	Kootenai National Forest (acres)	Seeley Ranger District, Lolo National Forest (acres)	Lincoln Ranger District, Helena-Lewis and Clark National Forest (acres)
VEG S5 exceptions	940	1,860	0	0
wildland-urban interface exemptions	6,456	3,095	0	954

- exemptions for fuels management in the wildland-urban interface is no more than 57,052 acres. Exceptions for precommercial thinning projects for resource benefits could affect another approximately 11,862 acres. Thus far, the level of effects related to vegetation management on the national forests is substantially lower than that anticipated in the 2007 record of decision for the NRLMD (USDA, 2007c) and the USFWS biological opinion (USFWS, 2007b). From 2007-2012, approximately 7,271 acres were burned by wildfires in lynx habitat within lynx analysis units on the Kootenai National Forest (J. Anderson, personal communication, August 9, 2013).
- On the Helena-Lewis and Clark National Forest, the maximum acres of lynx habitat that could be affected by the wildland-urban interface exemption is 26,400 acres. Exceptions for precommercial thinning projects for resource benefits are limited to 730 acres. Combined, the exemptions and exceptions could affect about 6 percent of the lynx habitat on the Forest. To date, the level of effects to lynx is substantially lower than that anticipated in the record of decision for the NRLMD because

the actual amount of treatments on the Helena National Forest total only about 200 acres under the wildland-urban interface exemption (D. Pengeroth, personal communication, March 29, 2016).

- On the Lolo National Forest as a whole, the maximum acres of lynx habitat that could be affected by exemptions for fuels management in the wildland-urban interface is no more than 16,900 acres. Exceptions for precommercial thinning projects for resource benefits could affect another approximately 2,200 acres of lynx habitat. To date, the level of effects to lynx are substantially lower than that anticipated in the record of decision for the NRLMD because the actual amount of treatments on the Lolo National Forest total only about 300 acres under the wildland-urban interface exemption (E. Roberts, personal communication, April 26, 2016).

Glacier National Park and the Confederated Salish and Kootenai Tribes incorporated the Lynx Conservation Assessment and Strategy into their management plans. Glacier National Park does not conduct commercial timber sales but does use fire as a vegetation management tool. Vegetation management in lynx habitat on the Confederated Salish and Kootenai Tribes reservation is similar to that on the national forests.

The Montana Department of Natural Resources and Conservation manages the Stillwater State Forest in the Salish Mountains geographic area, the Coal Creek State Forest in the North Fork geographic area, and the Swan State Forest, as well as sections acquired from Plum Creek Timber Company, in the Swan Valley geographic area. The Montana Department of Natural Resources and Conservation manages lynx according to their Habitat Conservation Plan (MTDNRC, 2011). In their record of decision on the proposed issuance of a permit to Montana Department of Natural Resources and Conservation authorizing incidental take of endangered and threatened species on forested trust lands in western Montana, the USFWS concluded that the removal of winter foraging habitat from scattered parcels in occupied habitat would not result in adverse effects on lynx for the following reasons: (1) scattered parcels in occupied lynx habitat support about 13 percent (11,600 acres) of the total winter foraging habitat in the Habitat Conservation Plan project area, (2) the anticipated 230 acres of annual harvest of winter foraging habitat would be spread across more than 11,600 acres of winter foraging habitat on scattered parcels in occupied habitat, (3) the amount of occupied habitat treated would likely represent a small proportion of a lynx home range and would not be enough to measurably reduce snowshoe hare productivity in the home range, and (4) viable lynx habitat would be retained through implementation of the Habitat Conservation Plan commitments combined with the availability of habitat on adjacent lynx analysis units where standards on Federal lands regulate treatments of winter foraging habitat in multistoried stands (MTDNRC, 2011). Where practicable, Montana Department of Natural Resources and Conservation will consider harvest unit designs at the project level to maintain a connected network of suitable lynx habitat along riparian areas, ridgetops, and saddles that connect third-order drainages. Measures for grizzly bears that will limit the size of forest openings that can be created through timber harvesting, as well as measures for secure cover, will also provide habitat connectivity for Canada lynx.

Most private lands within the Forest's geographic area boundaries are at elevations too low to be lynx habitat, but lynx do travel through some of these areas. Some private parcels in the Middle Fork and North Fork of the Flathead River, as well as in the Swan Valley and Stillwater Valley near Olney, are at elevations suitable for lynx. Some of these landowners are clearing vegetation to reduce the risk of wildfire, which may reduce the potential for lynx foraging, although whether lynx would forage in close proximity to human dwellings, dogs, etc., is unknown. Fuels treatments in lower montane forests (that burned naturally with mixed severity) may help to prevent uncharacteristically severe fires from occurring or spreading to lynx habitat at higher elevations.

Wildland fire management

On all lands, large wildfires in lynx habitat are believed to be strongly associated with changing climate factors. Wildland fires are likely to be actively suppressed to prevent loss of infrastructure and investments on all lands. Wildfires are likely to play a natural role in large portions of Glacier National Park.

Fragmentation of habitat due to loss of cover

Although lynx are known to cross openings, Squires and others (2013) found that lynx generally use habitat within about 300 feet of cover. Most of northwest Montana is heavily forested, with the largest non-cover areas occurring in agricultural valleys (such as the Flathead Valley) and in areas recently burned by stand-replacing wildfire on all lands (see figure B-21 in Kuennen et al. (2017) for more details). Because cover is altered by wildfire, insects, disease, and actions on other land ownerships, it is difficult to predict when or where these effects to cover would occur.

Fragmentation of habitat due to highways

Various studies have documented lynx crossings of highways, but highways pose a risk of direct mortality to lynx, and two-lane or four-lane highways with high traffic volumes, or impediments such as fences on both sides of a highway, may impede lynx movement. According to Alexander and others in 2005 (ILBT, 2013), traffic volumes between 3,000 and 5,000 vehicles per day may be the threshold above which successful crossings by carnivores are impeded. There are no four-lane highways in the cumulative effects analysis area, and Squires's radiotelemetry data indicates that lynx cross the existing two-lane highways (Kuennen, 2017d). There are no known highway mortalities in critical habitat unit 3 (Broderdorp, 2016).

If traffic volume in the cumulative effects analysis area greatly increases, the construction of wildlife crossing structures could be considered (Clevenger & Waltho, 2005; J. R. Squires et al., 2013). To address these potential changes on private lands, alternatives B modified, C, and D have a forestwide desired condition stating that land ownership adjustments, through purchase, donation, exchange, or other authority, will be considered to improve national forest management by consolidating ownership, reducing wildlife-human conflicts, providing for wildlife habitat connectivity, improving public access to public lands, and retaining or acquiring key lands for wildlife and fish and within wild and scenic river corridors. Because these actions require a willing landowner, it is difficult to predict when or where they may actually occur.

Connectivity to Canada

Connectivity to source populations of lynx in Canada is considered critical to the persistence of populations in most parts of the range in the United States (68 FR 40076; J. R. Squires et al., 2013). Connectivity from the Forest to Canada is currently high, with cover conditions that facilitate lynx travel. Glacier National Park provides high levels of connectivity to Canada and, on the National Forests, only two-lane gravel roads occur near the Canadian border within most of the cumulative effects analysis area.

Mortality due to incidental trapping or illegal shooting of Canada lynx

Trapping and snaring of lynx is currently prohibited across the contiguous United States. Incidental trapping or snaring of lynx is possible in areas where regulated trapping for other species overlaps with lynx habitat (J. R. Squires & Laurion, 2000). State wildlife management agencies regulate the trapping of furbearers. On all lands, areas open to motorized over-snow vehicle use occur in lynx habitat, and these areas may have increased risk of incidental trapping of lynx because trapping seasons for other species occur in the winter. However, many areas of lynx habitat have limited accessibility for off-route motorized over-snow vehicle use due to high tree densities and rugged topography. On the Kootenai National Forest, there are approximately 120 miles of groomed motorized over-snow vehicle routes and approximately another 46 miles of designated motorized over-snow vehicle routes in lynx habitat within lynx analysis units. One lynx was reported trapped on the Kootenai National Forest in December 2012 and was released unharmed (J. Zelenak, personal communication to Jeremy Anderson, August 26, 2013). Glacier National Park is closed to trapping and to motorized over-snow vehicle use, greatly reducing the risk of mortality. Incidental trapping-related mortality of radio-collared animals has been documented to occur in the Seeley-Swan study area (N. Warren, 2016b).

Recreational activities

Scientific evidence to date indicates that most recreational activities pose a low risk of having negative effects on lynx (ILBT, 2013).Within the cumulative effects analysis area outside the Flathead National Forest, there is one ski area on the Kootenai National Forest (Turner Mountain). This is a very small ski area with only one lift and very little development at the base. The ski area affects about 263 acres of lynx habitat, with 164 acres of cleared ski runs and 98 acres of gladed skiing, so any effects to lynx are minor. In addition, the Snowbowl ski area is located on the Lolo National Forest and affects about 1,190 acres of lynx habitat in the Rattlesnake lynx analysis unit. Over 90 percent of this lynx analysis unit is within the Rattlesnake National Recreation Area and Wilderness. Although the Turner Mountain and Snowbowl ski areas may have some local adverse effects, they would not be expected to contribute to cumulative adverse effects on the lynx population. Additionally, on the Kootenai National Forest there are approximately 5 miles of groomed cross-country ski trails in lynx habitat within lynx analysis units and another 5 miles that are designated for cross-country ski use. These mileages are less than what was analyzed in the NRLMD final EIS due to better mapping and some routes being dropped due to lack of snow (USDA, 2013a, p. 224).

Minerals and energy exploration and development

On the Kootenai National Forest, no leasable minerals (e.g., oil, gas, coal, geothermal resources, etc.) are being produced. As on the Flathead National Forest, all leases are currently suspended in accordance with the 1985 court decision of Conner v. Burford (848 F. 2d 1441 (9th Cir. 1988). The Troy copper and silver mine was in operation for over 20 years on the Kootenai National Forest and affects approximately 50 acres on NFS lands and an additional 400 acres of private lands. In 2006, the USFWS issued a biological opinion for the restart of the Troy silver mine (USFWS, 2006d) that concluded that the mine would not have adverse effects on lynx. This mine has now been shut down and is moving into the reclamation phase. Various analyses have also been prepared for the Rock Creek Mine, which determined that the mine is not likely to adversely affect lynx or lynx habitat (USFWS, 2006c). There are no plans of operation or notices of intent to explore or operate any commercial mines in lynx habitat on the Lolo National Forest. The Cotter Basin Mine on the Helena National Forest produced copper and silver in the past. In its biological opinion on the NRLMD, USFWS (2007b) concluded that the application of the amendment guidelines would result in no or only minor adverse effects to lynx due to minerals and energy development. No adverse cumulative effects are anticipated.

Forest roads

Much of the lynx habitat on the Kootenai, Lolo, and Helena-Lewis and Clark National Forests overlaps with grizzly bear habitat, where road construction and motorized use is constrained (see chapter 6.5.5). Additionally, the objectives and guidelines related to lynx in the amended forest plans reduce or minimize any potential adverse effects (USFWS, 2007b), and no adverse cumulative effects are anticipated.

Livestock grazing

The effects of livestock grazing were anticipated to be minimal under the NRLMD (USFWS, 2007b), and there is no new information to suggest that this has changed. No adverse cumulative effects are anticipated.

Canada lynx critical habitat

Introduction

On September 12, 2014, the USFWS issued a final rule revising the critical habitat designation and the distinct population boundary for the contiguous United States distinct population segment of the Canada lynx (USFWS, 2014a). Under the Endangered Species Act, specific areas within the geographical area occupied by the species at the time it was listed are included in a critical habitat designation if they contain physical or biological features that (1) are essential to the conservation of the species and (2) may require special management considerations or protection. Areas outside the geographical area occupied by the species at the time it is listed could also be designated as critical habitat if a designation limited to its current range would be inadequate to ensure the conservation of the species.

In its designation of critical habitat, the USFWS stated, “We consider lynx habitat to include forested areas with the potential, through natural succession, to produce high-quality snowshoe hare habitat, regardless of their current stage of forest succession” (79 FR 54808). This is consistent with the Flathead’s mapping and modeling of potential lynx habitat. The USFWS also stated,

> When determining critical habitat boundaries, we made every effort to avoid including developed areas such as lands covered by buildings, pavement, and other structures because such lands lack physical or biological features necessary for lynx. The scale of the maps we prepared under the parameters for publication within the Code of Federal Regulations may not reflect the exclusion of such developed lands. Given the scale of the lynx critical habitat units, it was not feasible to completely avoid inclusion of water bodies, including lakes, reservoirs, and rivers; grasslands; or human-made structures such as buildings, paved and gravel roadbeds, parking lots, and other structures that lack the PCE [primary constituent element] for the lynx. These areas, including any developed areas and the land on which such structures are located, that exist inside critical habitat boundaries are not intended to be designated as critical habitat. Any such lands inadvertently left inside critical habitat boundaries shown on the maps of this final rule have been excluded by text in this rule. Therefore, a Federal action involving these lands would not trigger section 7 consultation with respect to critical habitat and the requirement of no adverse modification unless the specific action would affect the physical or biological features in the adjacent critical habitat. (USFWS, 2014a, p. 54823)

In 2017, the USFWS issued a biological opinion on the effects of the NRLMD on Canada lynx critical habitat, which stated that “it is the Service’s biological opinion that the effects of the NRLMD are not likely to result in the destruction or adverse modification of designated Canada lynx critical habitat” (USFWS, 2017c). The USFWS stated that under the NRLMD, adverse effects on primary constituent element 1a (see definition in the section on “Key indicators” below) would be “limited in severity and in scale to the extent that critical habitat would continue to produce adequate densities of snowshoe hares and adequate levels of cover to support persistent lynx populations” across critical habitat unit 3 and that “the proposed action will not alter the physical or biological features of critical habitat to an extent that appreciably diminishes the value of critical habitat for the conservation of lynx. The alterations will not preclude or significantly delay development of such features. The critical habitat units would retain their current ability for the primary constituent element to be functionally established” (p. 34). The conclusion in this biological opinion was based primarily on the biological assessment of the effects of the NRLMD on lynx critical habitat (Conway & Hanvey, 2017).

Affected environment—Critical habitat

The Flathead National Forest lies within Canada lynx critical habitat unit 3 (see figure 1-51). Lynx critical habitat unit 3 consists of about 9,783 square miles in the northern Rocky Mountains. Lynx are known to be widely distributed throughout this unit, and breeding has been documented in multiple locations. Lynx critical habitat unit 3 coincides with the lynx core area in northwest Montana/northeast Idaho. National Forest System lands account for about 74 percent of critical habitat unit 3, including portions of the Kootenai, Flathead, Idaho Panhandle, Lolo, and Helena-Lewis and Clark National Forests. According to the USFWS, critical habitat unit 3 appears to support the highest-density lynx populations in the northern Rockies. It likely acts as a source population and provides connectivity to other portions of the lynx's range in the Rocky Mountains. This area contains the physical and biological features essential to the conservation of the lynx (the primary constituent elements and its components) laid out in the appropriate quantity and spatial arrangement.

Critical habitat for lynx occurs on about 3,425 square miles of Flathead National Forest lands, which is about 35 percent of critical habitat unit 3. About 49 percent of the critical habitat on the Flathead National Forest is in wilderness. There are only two lynx analysis units on the Flathead National Forest that do not include some critical habitat: the Haskill Mount and Blacktail lynx analysis units west of Flathead Lake and Highway 93.

Key indicators

Federal projects within designated critical habitat areas are analyzed under the section 7 consultation process. To determine whether an action would result in the destruction or adverse modification of critical habitat, this analysis of resource elements important to Canada lynx critical habitat focuses on the primary constituent element.

The USFWS determined that the primary constituent element for lynx critical habitat is

1. Boreal forest landscapes supporting a mosaic of differing successional forest stages and containing:

a. Presence of snowshoe hares and their preferred habitat conditions, which include dense understories of young trees, shrubs or overhanging boughs that protrude above the snow, and mature multistoried stands with conifer boughs touching the snow surface;

b. Winter snow conditions that are generally deep and fluffy for extended periods of time;

c. Sites for denning that have abundant coarse woody debris, such as downed trees and root wads; and

d. Matrix habitat (e.g., hardwood forest, dry forest, non-forest, or other habitat types that do not support snowshoe hares) that occurs between patches of boreal forest in close juxtaposition (at the scale of a lynx home range) such that lynx are likely to travel through such habitat while accessing patches of boreal forest within a home range. (73 FR 10867)

In matrix habitat, activities that change vegetation structure or condition would not be considered an adverse effect to lynx critical habitat unless those activities would create a barrier or impede lynx movement between patches of foraging habitat and between foraging and denning habitat within a potential home range or would adversely affect adjacent foraging or denning habitat.

Environmental consequences

Primary constituent element

The designation of critical habitat does not prohibit development or forest management activities, but Federal agency actions must not result in destruction or adverse modification of critical habitat. All Federal actions must be separately evaluated for their effects on lynx and on its critical habitat.

In its final rule designating lynx critical habitat, USFWS identified the following Federal actions that potentially could adversely modify critical habitat. Briefly, these are as follows:

1. Actions that would reduce or remove understory vegetation within boreal forest stands on a scale proportionate to the large landscape used by lynx. . . . These activities could significantly reduce the quality of snowshoe hare habitat such that the landscape's ability to produce adequate densities of snowshoe hares to support persistent lynx populations is at least temporarily diminished.

2. Actions that would cause permanent loss or conversion of the boreal forest on a scale proportionate to the large landscape used by lynx. . . . Such activities could eliminate and fragment lynx and snowshoe hare habitat.

3. Actions that would increase traffic volume and speed on roads that divide lynx critical habitat. . . . These activities could reduce connectivity within the boreal landscape for lynx, and could result in increased mortality of lynx. (73 FR 10876)

The NRLMD was completed in 2007, prior to the final designation of lynx critical habitat, and therefore did not include an analysis of the effects on lynx critical habitat. Nevertheless, the NRLMD amendment to 18 national forest plans adopted plan components that maintain the physical and biological features that provide lynx critical habitat and directly or indirectly contribute to the primary constituent element, the key indicator for analysis of critical habitat. Table 91 shows how the management components of the NRLMD contribute to or support the critical habitat primary constituent element. A detailed discussion of these plan components and their effects can be found in the section above on Canada lynx and in the biological assessment for Canada lynx designated critical habitat (Conway & Hanvey, 2017).

Table 91. Canada lynx critical habitat primary constituent elements and associated plan components in the NRLMD

Primary Constituent Element	Primary Constituent Element Description	Associated NRLMD Objectives, Standards, and/or Guidelines[1]
1.	Boreal forest landscapes supporting a mosaic of differing successional forest stages and containing:	VEG O1, VEG O2, VEG O3, VEG O4
a	Presence of snowshoe hares and their preferred habitat conditions, including dense understories of young trees, shrubs, or overhanging boughs that protrude above the snow and mature multistoried stands with conifer boughs touching the snow surface;	VEG O1, VEG O2, VEG O3, VEG O4; VEG S1, VEG S2, VEG S5, and VEG S6; VEG G1, VEG G4; GRAZ G1, GRAZ G2, GRAZ G3; HU G1, HU G2, HU G8 (and VEG G10 in the wildland-urban interface)
b	Winter snow conditions that are generally deep and fluffy for extended periods of time;	VEG G4; HU G4, HU G11, HU G12
c	Sites for denning that have abundant coarse woody debris (downed trees and root wads);	VEG O1; VEG G11; HU G1

Primary Constituent Element	Primary Constituent Element Description	Associated NRLMD Objectives, Standards, and/or Guidelines[1]
d	Matrix habitat (e.g., hardwood forest, dry forest, non-forest, or habitat types that do not support snowshoe hares) that occurs between patches of boreal forest in close juxtaposition (at the scale of a lynx home range) such that lynx are likely to travel through such habitat while accessing patches of boreal forest within a home range.	ALL 01, ALL S1, ALL G1; GRAZ G1; HU G3, HU G7, HU G8; LINK 01; LINK S1; LINK G1

1. Some objectives, standards, or guidelines are not listed because they do not apply to the site-specific conditions of the Flathead National Forest.

Primary constituent element 1a

Primary constituent element 1a is dense understories of young trees, shrubs, or overhanging boughs that protrude above the snow. Conservatively, areas where regeneration timber harvest has occurred since 1990 may not yet have developed primary constituent element 1a. About 2 percent of lynx critical habitat on the Forest has had regeneration timber harvest since 1990 (including lands in the wildland-urban interface as well as lands outside it). In addition, areas that have been burned by wildfire since 1990 may not yet have developed dense understories of young trees, shrubs, or overhanging boughs that protrude above the snow. About 24 percent of critical habitat on the Forest has been burned by stand-replacing wildfires since 1990, also temporarily reducing primary constituent element 1a.

The forest plan standard VEG S1 limits regeneration by vegetation management projects in a lynx analysis unit if wildfire creates a situation where more than 30 percent of a lynx analysis unit does not yet provide winter snowshoe hare habitat. This standard helps to ensure that actions that would reduce or remove understory vegetation within boreal forest stands do not occur on a scale proportionate to the large landscape used by lynx. The forest plan standard VEG S2 promotes development of primary constituent element 1a but limits regeneration harvest on NFS lands to 15 percent of lynx habitat in each lynx analysis unit per decade in order to provide for distribution of hare habitat over time and space. All alternatives for the forest plan would protect existing lynx habitat that provides primary constituent element 1a, except for allowed exemptions to the vegetation standards within the wildland-urban interface and allowed exceptions for other resource purposes listed under VEG S5 and VEG S6. Exemptions to standards are allowed for fuels treatment projects within the wildland-urban interface as defined by the Healthy Forests Restoration Act (see glossary), subject to a cumulative limit of no more than 6 percent of lynx habitat on the Forest under the incidental take estimate for the 2007 NRLMD. Additionally, fuels treatment projects may not result in more than three adjacent lynx analysis units exceeding the standards. This requirement helps to ensure that actions that would remove understory vegetation and reduce the quantity or quality of hare habitat within boreal forest stands do not occur disproportionately in one portion of Canada lynx critical habitat. Figure 1-13 displays the wildland-urban interface, and figure B-20 in Kuennen (2017) displays the wildland-urban interface in relation to critical habitat.

The Forest proposes that the same acreage for fuels treatment under the wildland-urban interface exemption would be continued under all alternatives. The maximum wildland-urban interface exemption estimate is 103,800 acres for the Flathead National Forest out of approximately 2.2 million acres of critical habitat on NFS lands on the Forest. National Forest System lands in the Salish geographic area that are west of Kalispell and south of U.S. Highway 2 are not in critical habitat, so cumulative wildland-urban interface exemptions could be used on a maximum of about 5 percent of critical habitat across the Forest. As of 2015, about 0.4 percent of critical habitat had been affected by wildland-urban interface exemptions. Fuel treatments under the wildland-urban interface exemption would reduce the density of the understory that provides primary constituent element 1a.

The Forest estimates that the acreage that could be treated under the exceptions to VEG S5 and VEG S6 might be higher under the action alternatives compared to the estimates under alternative A. Under alternative B modified, exceptions to the vegetation standards would be estimated to occur on up to 15,460 acres, compared to about 1,460 acres under alternative A. For programmatic planning purposes, potential treatment needs, updated in 2016, are as follows:

- about 500 acres for defensible space (VEG S5/S6 exception 1)
- about 1,510 acres for research studies and genetic tree tests (VEG S5/S6 exception 2)
- about 1,800 acres for conifer removal or daylight thinning of aspen (VEG S5 exception 4)
- about 4,750 acres for daylight thinning of planted, rust-resistant western white pine (VEG S5 exception 5)
- about 2,500 acres to restore whitebark pine in wildfire areas and forests with sapling-size trees (VEG S5 existing exception 6)

The listed vegetation exceptions under alternative A would remain in place under alternatives B modified, C, and D except for one forest-specific change. An additional exception to VEG S6 would allow the felling of trees within 200 feet of disease-resistant whitebark pine trees used for cone, scion, and pollen collection. This new exception to VEG S6 would be anticipated to reduce primary constituent element 1a within about 4,400 acres of boreal forest stands, affecting about 0.2 percent of Canada lynx critical habitat, a minor amount.

The Forest anticipates that the overall acres will be constrained but that the exception categories that are used might change in order to respond to changing conditions and needs. Standards VEG S1 and VEG S2 limit the amount of habitat that can be treated at any given time and also limit the distribution of treatments. Use of exceptions to standards would require additional site-specific consultation at the project level.

Primary constituent element 1b (see table 91)

It is not possible to reliably predict the effects of future winter climate change on deep, fluffy snow at the Forest scale (see discussion below for the scale of critical habitat unit 3). The effects of proposed changes in plan components for winter recreation on deep, fluffy snow are discussed. Under the action alternatives, there would be new, integrated plan components to replace those in alternative A (amendment 24 adopted in 2006) and a new Forest-specific guideline to replace the previous NRLMD guideline HU G11 (adopted in 2007). Amendment 24 designated specific areas, routes, and seasons of use for motorized over-snow vehicle use. Seasons of use would not be changed under the action alternatives. Many of the areas and routes suitable for motorized over-snow vehicle use would not be changed under the action alternatives, but some routes and areas suitable for motorized over-snow vehicle use would be changed to respond to changing forest conditions and public input (see figures 1-46 through 1-49).

As described in detail in the section on Canada lynx, the action alternatives would have a guideline that limits future increases in motorized over-snow vehicle use. The forest plan forestwide guideline FW-GDL-REC-03 states,

> To provide ecological conditions to support Canada lynx on NFS lands at a forestwide scale, there should be no net increase in miles of designated routes for motorized over-snow vehicle use, groomed routes, or areas where motorized over-snow vehicle use is identified as suitable.

> This guideline does not apply inside permitted ski area boundaries, to winter logging, to rerouting trails for public safety, to accessing private inholdings, or to access regulated by guideline HU G12 (see appendix A).

Under alternatives B modified and D, motorized over-snow vehicle use would be suitable on approximately 28 percent of critical habitat. Under alternative A, approximately 27 percent would be suitable, and under alternative C approximately 20 percent would be suitable. Designated cross-country ski areas would occur on < 1 percent of Canada lynx critical habitat. Based upon the findings of Squires and others (2010) and of Kolbe and others (2007) for northwest Montana, proposed changes in management direction for motorized over-snow vehicle use are anticipated to have minor effects on critical habitat. Even in areas where motorized over-snow vehicle use is suitable, dense forest cover limits access and prevents snow compaction in some suitable areas. As direction in the forest plan is implemented, proposed changes in routes, groomed routes, or areas open to motorized over-snow vehicle use would undergo additional site-specific consultation at the project level, so if changes in primary constituent element 1b occur due to a changing climate, they could be assessed at that time.

Nonmotorized over-snow vehicle use also occurs across the Forest but is generally dispersed, except in designated cross-country ski areas. Designated cross-country ski areas are included in management area 7 under the action alternatives. Two of these areas, Round Meadow and Essex, are located in Canada lynx critical habitat. The boundaries of these areas are not proposed to change with the action alternatives, so there would be no effects to primary constituent element 1b.

Primary constituent element 1c (see table 91)

Lynx dens in northwest Montana are typically found in mature multistory stands of spruce-fir forests with dense horizontal cover and abundant coarse woody debris (downed wood), although they may also be located in mid-seral, regenerating stands (J. R. Squires et al., 2008). Young stands that are either naturally sparse or mechanically thinned are seldom used for denning. Denning habitat is generally abundant across the coniferous forest landscape of northwest Montana and is not likely to be limiting for lynx (J. R. Squires et al., 2008, 2010; J. R. Squires et al., 2006). Table 92 displays the current estimates for the amount of downed wood across the potential vegetation types (see forest plan figures B-03 to B-09) that have the potential to provide boreal forest landscapes supporting a mosaic of differing successional forest stages (a critical habitat primary constituent element).

Table 92. Current estimates in average total tons per acre of downed wood, as averaged across all forested acres within each potential vegetation type on the Forest

Potential Vegetation Type	Current Estimate (total tons per acre)[1]
Cool-moist	18.6
Cold	12

1. Source: Forest Inventory and Analysis data using R1 Summary database (Hybrid 2011) analysis tools.

Downed woody material providing primary constituent element 1c is highly variable in amount, sizes, species, and stages of decay, both across the landscape and over time. Management areas that emphasize natural ecosystem processes (such as management area 1) and forestwide plan components for old growth, snags, and downed wood would provide for downed woody material. Recent stand-replacing fires have increased, and as the snags fall there will be a period of time where downed woody material will be especially high in these fire areas. About 20-30 years (on average) following a wildfire on the Forest, dense horizontal cover is abundant in lynx habitat. Denning habitat is anticipated to be abundant in burned areas and in old-growth forest. Salvage harvest of dead trees could reduce downed woody material in some portions of critical habitat. However, in areas with vegetation management, the forest plan alternatives B modified, C, and D have guideline FW-GDL-TE&V-08, which states, "To contribute to maintenance of soil function and provide desired habitat and forest structural diversity for wildlife within timber harvest units, a minimum of approximately eight tons per acre of downed woody material greater than 3 inches in diameter should be retained within the unit. Retained material should consist of the longest and largest pieces present." Exceptions may occur, such as when there is insufficient material of suitable size prior to harvest, within developed recreation sites, or where fuels reduction is desired to decrease expected fire behavior and protect identified assets (e.g., within the wildland-urban interface). Under alternative A, amendment 21 specifies that an average of 30-32 pieces per acre that are 9-20 inches diameter should be retained and an average of 15 pieces per acre that are greater than 20 inches should also be retained. In addition, guideline VEG G11 in appendix A addresses the distribution of denning habitat for Canada lynx and ensures that it would be assessed site-specifically. On the heavily forested Flathead National Forest, management activities are not likely to result in a shortage of primary constituent element 1c at the large landscape scale discussed in the critical habitat rule.

Primary constituent element 1d (see table 91)

- Matrix habitat, by definition, is habitat that is important to lynx for movement. However, the vegetative condition and structure of matrix habitat is not relevant to its value. Therefore, in matrix habitat, activities that change vegetation structure or condition would not be considered an adverse effect to lynx critical habitat unless those activities would create a barrier or impede lynx movement between patches of foraging habitat and between foraging and denning habitat within a potential home range (USFWS, 2014a). Under all alternatives, standards ALL S1 and LINK S1 and guidelines ALL G1 and LINK G1 would provide for matrix habitat, which is primary constituent element 1d. ALL S1 requires that new or expanded permanent development and vegetation management projects must maintain connectivity in a lynx analysis unit and/or linkage area and ensures that connectivity would be assessed site-specifically during project level consultation in critical habitat. Guideline ALL G1 states that methods to avoid or reduce effects on lynx should be used when constructing or reconstructing highways, including forest highways across Federal land. In addition to lynx plan components, alternative B modified includes the following plan components related to habitat connectivity:
- plan components that provide for riparian connectivity (FW-DC-WTR-02,; FW-STD-RMZ-01, 05, and 06; FW-GDL-RMZ-09 and 12);
- plan components for forest vegetation connectivity (FW-DC-TE&V-14 and 19; FW-GDL-TE&V-03, 06, and 07; MA6a-DC-02, MA6b-DC-02, and MA6c-DC-02);
- plan component FW-GDL-IFS-12, which states that within areas specifically identified as important for wildlife connectivity across highways, the USFS should cooperate with highway managers and other landowners to implement crossing designs that contribute to wildlife and public safety.
- plan components for connectivity in areas that have been modeled as important for several wide-ranging carnivores or big game species, including Canada lynx, wolverines, grizzly bears, and elk (GA-HH-DC-03, GA-MF-DC-04, GA-NF-DC-06 and 07, GA-SM-DC-03, and GA-SV-DC-09). For example, GA-HH-DC-03 states that the Coram connectivity area provides habitat connectivity for a north-south movement corridor for wide-ranging species (e.g., grizzly bear, Canada lynx, wolverine) moving between the southern and northern watersheds on the Forest.
- plan components to retain NFS lands in public ownership or acquired lands by purchase, donation, exchange, or other authority as opportunities arise to improve national forest management (FW-DC-LSU-01).

Plan components for connectivity and linkage areas are designed to provide for multiple species, would allow continued movement of lynx along the putative travel corridors identified by Squires and others in 2013, and would address the objectives of matrix habitat (J. R. Squires et al., 2013).

Actions that have the potential to adversely modify critical habitat

Effects common to all alternatives

Permanent loss or conversion of boreal forest

There are no actions contemplated under the forest plan alternatives that would cause permanent loss or conversion of boreal forest at the large landscape scale discussed in the critical habitat rule. Standard ALL S1 requires that new or expanded permanent developments and vegetation management projects in a lynx analysis unit and/or a linkage area must maintain habitat connectivity.

Traffic volume and speed

None of the alternatives contemplate increasing traffic volume or speed on roads that divide critical habitat. Under guideline HU G6, methods to avoid or reduce the effects on lynx in lynx habitat should be used when upgrading unpaved roads to maintenance levels 4 or 5 if the result would be increased traffic speeds and volumes or a foreseeable contribution to increases in human activity or development in lynx habitat.

Highway construction and expansion are not under the authority of the Forest Service, but several forest plan components address highway coordination, particularly in linkage areas. These include objective LINK O1, which encourages working with landowners to pursue conservation easements, habitat conservation plans, land exchanges, or other solutions in mixed ownership areas to reduce the potential of adverse impacts on lynx and lynx habitat. In linkage areas, potential highway crossings will be identified (LINK S1), and Forest Service lands should be retained in public ownership (LINK G1). These forest plan components are beneficial in maintaining or improving habitat connectivity on NFS lands and would help to reduce or minimize adverse modification of critical habitat.

Actions that would reduce or remove understory vegetation within boreal forest stands on a scale proportionate to the large landscape used by lynx

Vegetation standards VEG S1, VEG S2, VEG S5, and VEG S6 are specifically aimed at providing adequate amount and arrangement of foraging habitat over time. All alternatives would protect existing lynx habitat that provides primary constituent element1a, except for allowed exceptions or exemptions within the wildland-urban interface. Fuels treatments in the wildland-urban interface would occur under all alternatives (as discussed in the section above on primary constituent element 1a). Although some treatments in the wildland-urban interface would reduce or remove understory vegetation within boreal forest stands and result in reductions in the quality or quantity of snowshoe hare and lynx habitat, they would not occur on a scale proportionate to the large landscape used by lynx. There are no actions contemplated under the forest plan alternatives that would reduce understory vegetation within boreal forest stands in critical habitat at the large landscape scale discussed in the critical habitat rule.

Alternatives B modified, C, and D

The action alternatives are very similar to alternative A in protecting understory vegetation within boreal forest stands (see forest plan, appendix A). An additional exception to VEG S6 would allow the felling of trees within 200 feet of disease-resistant whitebark pine trees used for cone, scion, and pollen collection. This could result in short-term adverse effects to critical habitat that would be greater under alternatives B modified, C, and D than under alternative A but would occur on very few acres of critical habitat.

Although some treatments would reduce or remove understory vegetation within boreal forest stands and would result in short-term reductions in the quality or quantity of snowshoe hare and lynx habitat, they would not occur on a scale proportionate to the large landscape used by lynx. The Forest consulted with the USFWS on anticipated wildland-urban interface treatments (Kuennen et al., 2017; USFWS, 2017b).

Consequences of management area allocations in lynx critical habitat

Table 93 lists Canada lynx critical habitat in each management area, by alternative (see figures 1-01 through 04). Management area allocations and lands suitable for timber production also have potential consequences. Existing and proposed wilderness areas (management area 1), inventoried roadless areas (located within management areas 5a or 4a, for example), some special areas (management area 3b), and other management areas (such as management area 6a) are not suitable for timber production. The effects for each management area are described in detail in the section above on Canada lynx.

Table 93. Acres and percentages of Canada lynx critical habitat in each Forest management area, by alternative

Management Area	Alternative A Critical Habitat (%)	Alternative B modified Critical Habitat (%)	Alternative C Critical Habitat (%)	Alternative D Critical Habitat (%)
1a Designated wilderness	49	49	49	49
1b Recommended wilderness	4	9	23	0
2a Designated wild and scenic rivers	< 1	< 1	< 1	< 1
2b Eligible wild and scenic rivers	0	1	1	1
3b Special areas	< 1	< 1	< 1	< 1
4a Research natural areas	< 1	< 1	< 1	< 1
4b Experimental and demonstration forests	< 1	< 1	< 1	< 1
5a, 5b, 5c, 5d Backcountry	17	14	6	20
6a General forest low-intensity vegetation management	4	5	8	5
6b, 6c General forest medium- and high-intensity vegetation management	25	20	12	20
7 Focused recreation areas	< 1	2	< 1	2

Under all alternatives, about 49 percent of critical habitat would be in wilderness. Recommended wilderness ranges from 0 percent under alternative D to 23 percent under alternative C. Under alternative B modified, the preferred alternative, about 57 percent of critical habitat, which is distributed across 78 of 109 lynx analysis units, would be in wilderness or recommended wilderness. Wilderness and recommended wilderness areas have had stand-replacing wildfires as well as trees killed by insect or disease activity, creating abundant denning habitat as trees fall down. In the future, these natural processes are expected to create an abundance of snags and downed wood in critical habitat, providing denning habitat and abundant stand initiation habitat as trees regrow (primary constituent elements 1a and 1c). No motorized vehicle use or mechanized transport and no commercial timber harvest would occur in these management areas. No effects to primary constituent elements 1b or 1d are anticipated.

Management areas with lands that are suitable for timber production (management areas 4b, 6b, 6c, and portions of 7) are likely to have vegetation management, including timber harvest, which could affect primary constituent elements 1a and 1c. In total, these management areas occur on no more than 13 percent of lynx critical habitat under alternative C, no more than 26 percent of lynx critical habitat under alternative A, and no more than 23 percent under alternative D. Under alternative B modified, these lands comprise 21 percent of lynx critical habitat distributed across 68 of 109 lynx analysis units on the Forest. Timber harvest could also occur on lands that are not suitable for timber production but where timber harvest is allowable. All timber harvest must be consistent with desired conditions, standards, and guidelines of the forest plan. Many of the forests in management areas suitable for timber production and within wildland-urban interface areas could be anticipated to have less understory vegetation and less downed wood after vegetation treatments. However, as explained in the Canada lynx “Affected environment” section, downed wood for denning habitat is not a limiting factor for lynx in northwest Montana. On the heavily forested Flathead National Forest, there are no actions contemplated in management areas that would reduce or remove understory vegetation within boreal forest stands on a scale proportionate to the large landscape used by lynx. Additional site-specific consultation would occur at the project level.

Adequacy of plan components for Canada lynx and their critical habitat

The 2012 planning rule requires the Forest to determine whether or not the plan components provide the ecological conditions necessary to contribute to the recovery of federally listed threatened and endangered species that occur within the plan area (36 CFR 219.9(b)(1)). Key ecosystem characteristics for the Canada lynx are deep, fluffy snow and a mosaic of forest habitats to provide foraging and denning habitat, arranged in such a manner to provide for connectivity, reproduction, and survival. The preferred alternative has plan components, including standards and guidelines, to maintain, improve, and restore ecological conditions within the plan area to contribute to the recovery of the Canada lynx (36 CFR § 219.9).

On September 12, 2005, the USFWS issued a recovery outline for Canada lynx (USFWS, 2005b). The outline is to serve as an interim strategy to guide and encourage recovery efforts until a recovery plan is completed. In the recovery outline, USFWS categorizes lynx habitat as core areas, secondary areas, and peripheral areas. The areas with the strongest long-term evidence of the persistence of lynx populations within the contiguous United States are defined as “core areas.” Core areas have both persistent verified records of lynx occurrence over time and recent evidence of reproduction. The Flathead National Forest is in a core area. According to the USFWS, focusing lynx conservation efforts on these core areas will ensure the continued persistence of lynx in the contiguous United States by addressing fundamental principles of conservation biology (USFWS, 2007b). The recovery outline says “Recovery of the lynx will be achieved when conditions have been attained that will allow lynx populations to persist long-term within each of the identified core areas” (USFWS, 2005b).

Ecosystem and species-specific plan components in the forest plan, including standards and guidelines, will maintain, improve, and restore habitat conditions relative to vegetation management, habitat connectivity and linkage areas, human uses, and livestock grazing while allowing for ecosystem services and multiple uses. The vegetation management direction set forth in the preferred alternative (alternative B modified) conserves the most important components of lynx habitat: a mosaic of early-successional, mature, and late-successional forests with high levels of horizontal cover and structure. These components ensure that the habitat maintains its inherent capability to support both snowshoe hare prey base and adequate lynx foraging and denning habitat during all seasons. These standards are required for vegetation management actions on at least 93 percent of the lynx habitat in the plan area. According to the biological opinion of the USFWS on the effects of the NRLMD on Canada lynx critical habitat, (2017c),

> The Forest Service designed the NRLMD to address those risk factors to lynx that were relevant in terms of Forest Plan direction. Overall, the NRLMD reduces or avoids the potential for adverse effects to lynx critical habitat. The benefits of the NRLMD to lynx critical habitat come primarily from the vegetation management objectives and implementation of the standards and guidelines. As stated by the USFWS, This suite of objectives, standards, and guidelines clearly conserve snowshoe hare and lynx habitat (PCE [primary constituent element] 1a) in all occupied, mapped lynx habitat in the action area. However, the NRLMD is likely to result in adverse effects to lynx critical habitat, with the main influence from actions that impact snowshoe hare habitat or PCE 1a. The majority of adverse effects to lynx critical habitat from the NRLMD would be a result of the exemptions from (fuel treatment projects in the WUI [wildland-urban interface]), and exceptions to (activities for other resource benefit), the vegetation standards. . . . Although the exemptions from, and exceptions to, the NRLMD vegetation management standards may result in some adverse effects to lynx critical habitat, vegetation objectives, standards, and guidelines overall would contribute to creating and maintaining landscape patterns that sustain snowshoe hare and lynx populations. The habitat would retain its inherent capacity to regenerate. Vegetation management under the NRLMD may adversely affect areas of critical habitat, specifically PCE 1a. However, any affected LAUs [lynx analysis units] are expected to remain capable of producing adequate densities of snowshoe hares to support continual lynx presence and would continue to serve their intended conservation role for lynx. (p. 29)

No cumulative adverse effects to lynx are anticipated to occur as a result of management actions on other national forests within the cumulative effects analysis area. Glacier National Park and the Confederated Salish and Kootenai Tribes incorporated the Lynx Conservation Assessment and Strategy into their management plans, and Montana Department of Natural Resources and Conservation manages their lands in accordance with their Habitat Conservation Plan (MTDNRC, 2011). These plans help to minimize adverse effects on those lands. Only a small fraction of lynx habitat occurs on private lands, and there is little potential for adverse cumulative impacts. Mortality due to incidental trapping or illegal shooting has the potential to cause cumulative adverse effects, but the magnitude of this mortality is unknown and MFWP has implemented several programs and regulations aimed at reducing this risk. Climate change has the potential to cause adverse cumulative effects due to larger or more frequent disturbances than were typical in the past and to the potential reduction in the amount and persistence of deep, fluffy snow. At this time, the magnitude of effects of future climate change across the cumulative effects analysis area is uncertain. Vegetation management standard VEG S1 would limit regeneration harvest in lynx analysis units with recent and large stand-replacing wildfires on NFS lands. The effects of winter climate changes on lynx depend upon whether more winter precipitation falls as rain or as snow.

Although the Forest does not have authority over all the stressors that may affect the Canada lynx and its critical habitat, the preferred alternative includes plan components that would maintain, improve, and restore Canada lynx habitat, including but not limited to the primary constituent element described in the final rule designating critical habitat. This would be accomplished by plan components, including standards and guidelines, to retain diverse ecosystems and their integrity, as detailed in section 3.7.4. While meeting the requirements of the 2012 planning rule (36 CFR §§ 219.8 and 219.9), the plan must provide for ecosystem services and multiple uses, including outdoor recreation, range, timber, watershed, wildlife, and fish. Plan components for the Canada lynx have been integrated with plan components for ecosystem services and multiple uses (36 CFR § 219.10). Broadscale monitoring of vegetation conditions will occur on the Forest and broad-scale monitoring of mesocarnivores (including Canada lynx) is anticipated to occur in the Northern Region, so changes in vegetation conditions can inform the forest plan and project implementation in the future.

Cumulative effects—Canada lynx critical habitat unit 3

In June of 2017, the Northern Region submitted a biological assessment (Conway & Hanvey, 2017) analyzing the potential impacts of implementing the programmatic guidance in the NRLMD on Canada lynx critical habitat, including critical habitat unit 3. The Region determined that the programmatic management direction may affect and is likely to adversely affect critical habitat due to the potential for adverse effects on primary constituent element 1a. Effects to the other primary constituent elements were determined to be insignificant (for anticipated treatment acres on each national forest, see Conway and Hanvey (2017).

Primary constituent element 1a: The Flathead National Forest and other national forests in critical habitat unit 3 are managed in accordance with the NRLMD, which provides for primary constituent element 1a. Tribal lands within the proposed critical habitat Unit 3 include about 370 square miles of the Flathead Indian Reservation in Montana, which is managed by the Confederated Salish and Kootenai Tribes. In their 2014 Final Environmental Assessment: Revised Designation of Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx, the USFWS (2014d) stated:

> In accordance with Secretarial Order 3206, "American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act" (June 5, 1997); the President's memorandum of April 29, 1994, "Government-to-Government Relations with Native American Tribal Governments" (59 FR 22951); Executive Order 13175 "Consultation and Coordination with Indian Tribal Governments;" and the relevant provision of the Departmental Manual of DOI (512 DM 2), the Service [USFWS] believes that fish, wildlife, and other natural resources on Tribal lands are better managed under Tribal authorities, policies, and programs than through Federal regulation wherever possible and practicable. We excluded Tribal lands from the final designation in 2009, and we are again considering excluding Tribal lands from the final revised designation. (p. 46)

Natural disturbance processes have historically played an important role in maintaining a mosaic of boreal forest successional stages (primary constituent element 1) that provides habitat for both snowshoe hare and Canada lynx. Glacier National Park occupies portions of lynx critical habitat between the Bob Marshall Wilderness Complex and Canada. In these areas, there is a high potential for natural disturbance processes to play a continued role in maintaining a vegetation mosaic, supporting lynx, and providing connectivity to Canada. In Glacier National Park, an increase in wildfires since about 1990 has affected about 12 percent of lynx critical habitat. These burned areas will provide primary constituent element 1a, described above, once trees and shrubs have grown tall enough and dense enough to support snowshoe hares and lynx.

Primary constituent element 1b: On all lands, there is a potential for future changes in climate to reduce the extent of deep snow habitats preferred by lynx. According to the Canada lynx species status assessment (Bell et al., 2016), climate models project that the northwest Montana/northeast Idaho unit will maintain snow into the future. McKelvey et al. (in press) estimated that contiguous areas of spring snow cover would become smaller and more isolated throughout the Columbia River Basin, with greatest losses at the southern periphery but with possible increases in snow at higher elevations in the core. Effects on critical habitat will depend upon the elevation at which precipitation falls as rain vs. snow. In addition, spring snowmelt is already occurring about two weeks earlier in recent decades. Mills and Johnson (2013) forecasted that the annual average duration of snowpack will decrease by 29–35 days by midcentury. This may result in a contraction of the area where lynx have a competitive advantage in deep snow, but lynx could adapt to what is essentially more abundant summer snowshoe hare and lynx habitat. Downscaled winter climate and precipitation models have a higher level of uncertainty than summer climate models (Joyce, Talbert, Sharp, Morissette, & Stevenson, in press).

Primary constituent element 1c: In Glacier National Park, on tribal wilderness lands, and in wilderness areas on all national forests, wildfires, insects, and disease are likely to provide abundant downed trees for primary constituent element 1c. Denning habitat is generally abundant across the coniferous forest landscape of critical habitat unit 3 and is not likely to be limiting for lynx (J. R. Squires et al., 2008, 2010; J. R. Squires et al., 2006).

Primary constituent element 1d: Federal transportation-related projects within designated critical habitat areas would be analyzed under the section 7 consultation process for potential effects to the primary constituent element of lynx critical habitat. (USFWS, 2014d). Conservation efforts for lynx might include remote monitoring, construction of habitat structures such as overcrossings or underpasses, bridge lengthening, fencing, or development of databases to track key habitat linkages. Private lands are generally found at elevations that are too low to provide critical habitat. Where they overlap, development will likely continue and may reduce habitat connectivity across valleys that are located between blocks of lynx habitat on public lands.

Wolverine

Introduction

When the Forest's assessment was published (April 2014), the USFWS had recently published a proposed rule to list the North American wolverine as a threatened distinct population segment in the contiguous United States (USFWS, 2013a). However, on August 13, 2014, the USFWS withdrew its previous proposal (USFWS, 2014b). On April 14, 2016, the Court remanded the matter to the USFWS for further consideration consistent with order CV 14-246-M-DLC (consolidated with case nos.14-247-M-DLC and 14-250-M-DLC). The wolverine is now listed as a proposed threatened or endangered species for the Flathead National Forest, pending a status review by the USFWS (USFWS, 2016a, 2017e).The USFWS is currently preparing a new species status review to inform its listing determination for the North American wolverine. The species status assessment will incorporate additional information about the species from new studies, as well as new climate modeling results for Glacier National Park (adjacent to the Forest).

Information sources and incomplete or unavailable information

The Forest completed a thorough review of scientific information to inform the planning process, develop plan components, and assess consequences of alternatives, but some information is incomplete or unavailable. The USFWS wolverine status review is not yet available. Some research on the future risks of climate change or the effects of winter recreation on the wolverine population is incomplete. Data and information gaps exist, but the breadth and depth of the available scientific information are sufficient to assess potential effects of alternatives.

Analysis of effects of alternatives on wolverines and their habitat is based upon several models that are designed and updated by researchers. Current wolverine models include persistent spring snow as a factor in modeling habitat suitability, but different models assess and use this factor in different ways. The USFWS initially modeled wolverine habitat across the United States in 2013 (USFWS, 2013a, 2013e, 2014b) incorporating the work of two groups of scientists (Copeland et al., 2010; R. M. Inman et al., 2011). Since that time, Inman produced a more refined model that delineated areas of the western United States predicted to be maternal wolverine habitat (suitable for use by reproductive females), primary wolverine habitat (suitable for survival and use by resident adults), female dispersal habitat (suitable for relatively brief female dispersal movements), and male dispersal habitat (suitable for relatively brief male dispersal movements). This model is based on a resource selection function developed with wolverine telemetry locations from 2001-2010 in the Greater Yellowstone Ecosystem of Montana, Idaho, and Wyoming (Robert M. Inman et al., 2013). The model by Copeland and others used satellite data to classify areas of persistent spring snow based upon coarse-scale satellite data collected over a seven year time period from 2000-2006, in which snow cover varied from year to year. This model displayed the number of years out of seven that a GIS pixel was classified as snow (e.g., seven years out of seven, one year out of seven). Copeland and others studied all known wolverine dens in Norway and Sweden, finding that areas with persistent spring snow at least five years out of seven were preferred (Copeland et al., 2010, p. figure 4). Weaver reported on wolverine habitat on the Forest by producing his own model that combined the model of Copeland and others and the 2013 model of Inman and others. Weaver reported that about 90 percent of the 62 known den sites in North America occurred in areas that had persistent spring snow for at least five years out of seven (Weaver, 2014). Weaver's model ranked wolverine habitat on the Forest as very high (maternal habitat) or high (current or future primary habitat).

Wolverine habitat models may be refined in the future as more scientific information becomes available. As Magoun and others (2017, p. 381) pointed out, "To manage wolverines and their habitat and incorporate persistent spring snow in models of future wolverine habitat, we must understand the relationship of wolverines to snow and measure persistent spring snow at an appropriate resolution and scale that is biologically meaningful for the species." As summarized by Magoun and others (2017), the spatial and temporal coarseness of the model and analysis by Copeland and others (2010) introduced uncertainty regarding the obligatory nature of the relationship between persistent spring snow through May 15 and wolverine habitat. This uncertainty resulted in the USFWS selecting a panel of scientists to review the specific relationship of wolverines to persistent spring snow (Woods, Morey, & Mitchell, 2014). The panel agreed that an obligatory relationship probably exists at the den-site scale but was less certain that a relationship existed at the scale of home range or species distribution. The panel came to no consensus on how much snow is needed for denning or how long it needs to last. Magoun and others (2017) stated: "Use of snow-covered den sites may not be obligatory through 15 May, or may not be obligatory at the scale in Copeland et al. (2010); nevertheless, wolverines may continue to use snow-covered sites as long as they are available" (p. 385). Magoun and others (2017) discuss that at the den-site scale, scattered patches of snow that are not detectable by remote sensing techniques may persist long enough in spring to provide cover for wolverines, even when considering future climates. These authors encouraged more research on the relationship of wolverines to smaller patches of spring snow at the den-site scale to determine if snow is necessary for successful reproduction, if it must be present for the entire denning season, if other structures (such as boulders or down trees) afford protection for wolverine kits near the end of the denning season, if wolverine distribution is tied to factors that have not yet been measured and defined, or if other possible uses of snow are an important component of wolverine habitat.

Snow in wolverine habitat may be affected by changes in climate. For this final EIS, the Forest used a compilation of climate change effects published for the Northern Region Adaptation Partnership (Halofsky et al., in press) that summarizes climate change projections by subregions (see figure 1-05). Downscaled climate models are used to predict the effects of a changing climate. Downscaled winter climate and precipitation models have a higher level of uncertainty than summer climate models (Joyce et al., in press). Future climate uncertainty and anticipated variability is associated with scale. Potential effects of future changes in snow cover and persistence are uncertain or variable due to geographic location, atmospheric circulation patterns (such as the Pacific Decadal Oscillation), and elevation (see sections 3.1.1 and 3.7.4, subsection "High-elevation habitat" for more details). A finer scale model for anticipated changes in wolverine habitat within Glacier and Yellowstone National Parks, considering differences based upon elevation, is currently being developed by NOAA and Colorado University at Boulder, but is not yet available. A new study by Webb and others (2016) found that wolverines in the boreal forest region of northern Alberta were not as closely associated with persistent spring snow as wolverines in the Rocky Mountains and suggested that these two very different habitats should be separated for analysis purposes and for the study of climate change effects.

Methodology and analysis process

The Forest considered the peer-reviewed models of Copeland and others (2010) as well as Inman and others (2013)for analysis of alternatives (USDA, n.d.). The Forest also considered Weaver's analysis, which used both models (2014). The model of primary wolverine habitat (suitable for survival and use by resident adults) from Inman and others (2013) was used to assess effects to wolverine habitat. The model by Copeland and others (2010) was used to assess effects to maternal and natal denning habitat, including areas providing persistent spring snow at least five years out of seven (on average), referred to as "maternal denning habitat" throughout the analysis in this final EIS (see figures 1-18 through 1-21 and Kuennen (2017) for more details). Maternal denning habitat is a smaller area within primary wolverine habitat, which in turn is within dispersal habitat modeled by Inman and others (2013).

Spatial and temporal analysis

The analysis area for indirect effects of the forest plan is the areas of modeled habitat encompassed by the geographic areas of the Forest. Because wolverines are wide-ranging, the analysis of cumulative effects is discussed in the context of the northern Rocky Mountains area identified by the USFWS (see USFWS, 2013e).

Affected environment

Population, life history, and distribution

Wolverines are year-round residents across Alaska and Canada. The southern portion of the species' range extends into high-elevation alpine portions of Washington, Idaho, Montana, Wyoming, California, and Colorado. Wolverines occur at low densities, range widely, inhabit remote and rugged landscapes away from human populations, and are difficult to detect, so conducting research on wolverines is challenging (IDFG, 2014). Wolverine populations in Montana were heavily trapped in the early 1900s and were near extinction by 1920. However, numbers increased in the western part of the state from 1950 to 1980 (Hornocker & Hash, 1981). Wolverine population growth and expansion has been documented in the North Cascades and northern Rocky Mountains (USFWS, 2013a). The Western Association of Fish and Wildlife Agencies is currently conducting a multi-state occupancy study to address conservation of the wolverine including restoring, connecting, and monitoring wolverine populations and their habitat in the U.S. Rocky Mountains and Cascade Mountains. Preliminary results for the 2016/17 monitoring season indicate there were 157 detections of wolverine in grid cells across Montana, Idaho, Wyoming, and Washington, but genetic identification of individuals has not yet been completed.

According to the USFWS (2013a), "Wolverine records from 1995 to 2005 indicate that wolverine populations currently exist in the northern Rocky Mountains and that the bulk of the current population occurs here. Within the area known to currently have wolverine populations, relatively few wolverines can coexist due to their naturally low population densities, even if all areas were occupied at or near carrying capacity. Given the natural limitations on wolverine population density, it is likely that historic wolverine population numbers were also low" (p. 7868).

Wolverine populations fluctuate in response to prey availability, juvenile dispersal, and mortality of adult females. The USFWS stated that the northern Rocky Mountains portion of the North American wolverine distinct population segment is thought to be the largest subpopulation and the most genetically resilient of the current subpopulations within the United States (USFWS, 2013a). Inman and others (2013) estimated the current population as well as the population capacity for regions of the western United States. The Forest is in the Northern Continental Divide region. They estimated that the current population in the Northern Continental Divide region is at its capacity, with the highest capacity in the Bob Marshall Wilderness.

Current information for wolverine occurrence on the Forest is based on (1) reported trapping records; (2) non-invasive monitoring, including remote cameras and DNA analysis of hair or scat; and (3) observations/sightings of either the species or tracks recorded in Forest or State databases (USDA, n.d.). Wolverine detections are distributed across suitable habitats on the Forest (USDA, n.d.). No recent research that would estimate population levels has been conducted for wolverine on the Forest. The Forest and other cooperators detected a minimum of 13 individual wolverines within Forest geographic areas (based upon genetic analysis of samples collected during non-invasive carnivore monitoring in areas accessible by snowmobile from 2012-2015) (Curry et al., 2016; Pilgrim & Schwartz, 2015; Ruby et al., 2016; Swanson, 2017; SWCC, 2014, 2015).

Hornocker and Hash conducted telemetry research on 24 individual wolverines over a five-year period within a study area making up about 1,300 square kilometers of the Flathead National Forest (Hornocker & Hash, 1981). Their study area was primarily located in the South Fork of the Flathead River watershed and, secondarily, portions of the Sun, Swan, and Middle Fork of the Flathead River watersheds. About one half of the study area had timber harvest and a wide variety of types of recreation, and the other half was wilderness. Hornocker and Hash found wolverines at relatively high densities in the South Fork of the Flathead River watershed, and they concluded the population was stable (Hornocker & Hash, 1981). Research on wolverines has been conducted in the last decade or so in Glacier National Park (adjacent to the Forest) (Copeland & Yates, 2006; J. R. Squires, Copeland, Ulizio, Schwartz, & Ruggiero, 2007). Wolverines are constantly on the move and are known to make long-distance movements that are not impeded by topography or deep snow (Copeland & Yates, 2006; J. R. Squires et al., 2007). Copeland and Yates estimated that adult female wolverines have home ranges averaging 55 square miles. Adult males ranged over an even larger area, including lands outside the park, with home ranges that averaged 193 square miles (Copeland & Yates, 2006). Home range boundaries are dynamic, as are population demographics.

Habitat

For wolverine habitat across the western United States, Inman and others (2013) reported that, in general, wolverines are distributed in areas of higher elevation, where there is steeper terrain, more snow, fewer roads, and less human activity and in areas closer to high-elevation talus, tree cover, and snow cover persisting to April 1. Year-round habitat includes rocky alpine habitats, glacial cirque basins, and avalanche chutes that provide food sources such as marmots, voles, and carrion (Copeland et al., 2007; Hornocker & Hash, 1981; Robert M. Inman et al., 2007; Audrey J. Magoun & Copeland, 1998). Wolverines appear to rely on the cold and snow to cache carrion (Robert M. Inman, Magoun, Persson, & Mattisson, 2012). Wolverines also travel through the area where snow persists, and they minimize travel through low-elevation habitat (McKelvey et al., 2011). Persistent spring snow cover is also correlated with gene flow because this is where the wolverine's within-home-range movements and dispersal occur year-round (Michael K. Schwartz et al., 2009). The area modeled by Inman and others (2013) as providing for male dispersal encompasses the whole Forest, whereas the area modeled as providing for female dispersal is more limited.

Magoun and Copeland (1998) described two types of reproductive dens: natal dens where young are born and maternal dens where the mother may move the kits if conditions are no longer suitable at the natal den. Abandonment of natal and maternal dens may be a preemptive strategy that confers an advantage to females if prolonged use of the same den makes a den more evident to predators (USFWS, 2013a). Sites used for maternal dens are often close to the natal den and have a similar structure. Prior to the Glacier National Park study, not much was known about the den sites of reproductive female wolverines in Montana because den sites are often in remote terrain that is very difficult to study. During the first three years of the study, data was collected for 19 wolverines, and information about reproductive dens was obtained for two adult females that raised four offspring (kits). Copeland and others found that dens were excavated in the snow and were on upper slopes in sparse timber beneath downed woody debris or rocks. Dens are typically used through late April or early May. Females used two to three different dens prior to the weaning of kits at six to seven months of age. Kits gather at rendezvous sites that are primarily in boulder, talus, and cliff areas (Copeland et al., 2010). Survival of young was low, even in the national park setting where trapping is not allowed and motorized disturbance does not occur in winter or spring. Wolverine den sites may not occur in the same exact spot year after year, and specific maternal and/or natal den sites on the Forest are unknown.

Primary wolverine habitat is also characterized by low levels of human development (Copeland, 1996; Hornocker & Hash, 1981; Krebs, Lofroth, & Parfitt, 2007; USFWS, 2013a). This negative association with frequent human presence is sometimes interpreted as active avoidance of human disturbance, but it may reflect the wolverine's preference for cold, snowy, and high-elevation habitat that humans do not often develop. The USFWS assessed the effects of a variety of human activities that can affect wolverines and their use of habitat. The USFWS stated:

> Few effects to wolverines from land management actions such as grazing, timber harvest, and prescribed fire have been documented. Wolverines in British Columbia used recently logged areas in the summer and moose winter ranges for foraging (Krebs et al., 2007, pp. 2189-2190). Males did not appear to be influenced strongly by the presence of roadless areas (Krebs et al., 2007, pp. 2189-2190). In Idaho, wolverines used recently burned areas despite the loss of canopy cover (Copeland, 1996). . . .
>
> Intensive management activities such as timber harvest and prescribed fire do occur in wolverine habitat; however, for the most part, wolverine habitat tends to be located at high elevations and in rugged topography that is unsuitable for intensive timber management. . . . Wolverines are not thought to be dependent on specific vegetation or habitat features that might be manipulated by land management activities, nor is there evidence to suggest that land management activities are a threat to the conservation of the species. (USFWS, 2013a, p. 7879)

The USFWS also stated that it is unlikely that wolverines avoid the type of low-use forest roads that generally are found in wolverine habitat. Based on the best available science, the USFWS concluded that wolverines do not avoid human development of the types that occur within suitable wolverine habitat and that there is no evidence that wolverine dispersal is affected by infrastructure development (USFWS, 2013a).

Krebs and others (2007) modeled male vs. female wolverine habitat selection in British Columbia, hypothesizing that food, predation risk, and human disturbance affected habitat selection. Krebs and others based their model on 39 adult wolverines (23 females and 16 males) that were located a total of 2,125 times within two study areas. These authors modeled selection in two time periods: winter and nonwinter. The winter season was defined as the period when there was persistent snow cover at treeline. Human use variables included in the models they tested included those associated with winter recreation activity, roads, and timber harvesting. Winter recreation data included estimates of snowmobile primary use sites, locations of runs for two helicopter skiing companies in the Columbia Mountains study area, and backcountry ski use centered on the Trans-Canada Highway corridor within and adjacent to Mount Revelstoke and Glacier National Parks. These authors stated that extensive timber harvesting had occurred within a large portion of the study area. Krebs and others (2007) concluded that male wolverines were most closely associated with food availability in both summer and winter. Moose winter ranges, valley bottom forests, and avalanche terrain were positively associated with winter male wolverine use. The authors stated:

> Habitat associations of females were more complex; combinations of variables supporting food, predation risk, or human disturbance hypotheses were included in most supported models from both summer and winter in both study areas. Females were associated with alpine and avalanche environments where hoary marmot and Columbia ground squirrel prey are found in summer. Roaded and recently logged areas were negatively associated with female wolverines in summer. In the Columbia Mountains, where winter recreation was widespread, females were negatively associated with helicopter and backcountry skiing. Moose winter ranges within rugged landscapes were positively associated with females during winter. Our analysis suggests wolverines were negatively responding to human disturbance within occupied habitat. The population consequences of these functional habitat relationships will require additional focused research. Our spatially explicit models can be used to support conservation planning for resource extraction and tourism industries operating in landscapes occupied by wolverines. (abstract)

Recreational use in wolverine habitat

The threshold for the amount of human activity that can occur before it affects male and female wolverine habitat selection is unknown. Some scientists have expressed concern about the effects of human activities on female wolverines with young kits during the mid-February to mid-May time period because food resources are scarce for foraging females. As the kits mature, the mother will leave them for longer periods of time to find food, but until the kits are at least 10 weeks old, they cannot travel with their mother. If a female needs to move kits to a new location, or to another den, she must carry them in her mouth. If the female needs to move the kits very far, the probability of kits dying increases. Reproductive females and kits are at risk of predation (Audrey J. Magoun & Copeland, 1998), and, according to Persson in 2005, females are most vulnerable to energetic pressures due to the high cost of lactation during this period (Krebs et al., 2007). The predominant activity in some portions of wolverine habitat during this time period is backcountry recreation.

Winter backcountry recreation opportunities in the northern Rocky Mountains include snowshoeing, snowboarding, skiing, snowcat- or trackster-assisted skiing and snowboarding, snow bikes, and snowmobiling. Heinemeyer and Squires (2015) are investigating winter recreational use (primarily skiing, snowboarding, and snowmobiling) in wolverine habitat in central Idaho and the Yellowstone region of Idaho, Montana, and Wyoming. Heinemeyer and Squires stated that wolverines appear to tolerate many types of winter recreation in their home ranges. Wolverines have been documented to persist and reproduce in habitats with high levels of human use and disturbance, including developed alpine ski areas and areas with motorized snowmobile use (Heinemeyer, 2012; Heinemeyer & Squires, 2013). Heinemeyer and Squires (2014) stated, “Wolverines appear to tolerate winter recreation in their home ranges, including denning females. Based on our preliminary findings, potential wolverine habitats that have even high levels of winter recreation may support resident wolverines despite the potential human disturbance” (p. 4). This suggests that wolverines can survive and reproduce in areas that experience human use and disturbance; however, there is uncertainty with respect to the amount, type, and timing of human recreational use and its effects on female wolverines.

Heinemeyer and Squires (2014) indicated there may be increasing avoidance of winter recreation areas as the amount of an individual wolverine’s home range affected by winter recreation increases. They also noted that the reproductive status of the females may affect their potential response to winter recreation, with reproductive females having higher movement rates when in a high-use recreation zone. In their 2015 annual report, Heinemeyer and Squires (2015) stated that the field data collection for the wolverine winter recreation project was completed and they were focused on analyzing the responses of wolverines to winter recreation (p. 12). The response of individual wolverines to human disturbance is still being analyzed.

The Flathead National Forest has approximately 1.4 to 1.7 million acres of modeled wolverine habitat, depending upon which model is used (USFWS, 2013a, 2014b; Woods et al., 2014). The majority of the modeled habitat occurs in the Bob Marshall Wilderness Complex in the South Fork and Middle Fork geographic areas, with lesser amounts in the Swan and Mission Mountain portions of the Swan Valley geographic area as well as the Whitefish Range portion of the North Fork and Salish Mountains geographic areas. On the Forest, about 59-64 percent of modeled wolverine habitat is in designated wilderness, where motorized uses (including snowmobiling, helicopter-assisted skiing or snowboarding, and trackster-assisted skiing or snowboarding) are not allowed. Nonmotorized uses such as backcountry skiing are not restricted, but because much of the wilderness area on the Forest is large and remote, it is also difficult to access for nonmotorized winter recreation. Wilderness areas provide habitat where the risk of human disturbance to wolverines is very low during the time period when females have dependent young. In addition, about 25 percent of modeled wolverine habitat is in inventoried roadless areas, where road building is not allowed and timber harvest is restricted. Glacier National Park, adjacent to the Forest, provides over 1 million acres that is closed to motorized over-snow vehicle use. In combination with wilderness areas on the Forest to the south, there are over 2 million acres of habitat available to wolverines where there is no motorized over-snow vehicle use allowed and where ungulates are present to provide sources of carrion. I

Some of the modeled wolverine habitat on the Forest has developed recreation and motorized access. Much of Whitefish Mountain Resort is in modeled wolverine habitat and skiers riding the lift observed a wolverine as it fed on carrion. Outside wilderness areas, restrictions on motor vehicle and motorized over-snow vehicle use provide habitat for wolverines with a low risk of human disturbance during time periods when wolverines may be sensitive—particularly in the North Fork geographic area, where use of motorized over-snow vehicles is restricted to specific routes in much of the area (table 94). In areas open to motorized over-snow vehicle use, the amount of use has likely increased over the last few decades due to technical advances in motorized over-snow vehicles and human population growth in the Flathead Valley. Backcountry skiing has also increased in popularity.

Connectivity and wolverine habitat

Inman and others (2013) reported that the U.S. northern Rockies include most of the major core areas, the majority of the current population, and connections to larger populations in Canada. They identified six regions that can likely function as major population cores where primary habitats exist as large blocks of relatively contiguous, publically owned lands that include significant portions of designated wilderness or national park and are capable of supporting 50 or more wolverines. These are the Northern Cascade, Northern Continental Divide, Salmon-Selway, Greater Yellowstone, southern Rockies, and Sierra-Nevada regions. Recent research in Glacier National Park has demonstrated that habitat connectivity between Glacier National Park, the Forest, and Canada currently provides for wolverine movement (Copeland & Yates, 2006).

Key stressors

Land management

Some commenters expressed concern about winter recreation activities in wolverine habitat. As discussed in the "Affected environment" section above, wolverines are adaptable and generally tolerant of human recreation activities, but there is scientific uncertainty about the types of winter recreation activities and the amount of disturbance that may affect female wolverines with young kits (Heinemeyer & Squires, 2015; USFWS, 2013a; Woods et al., 2014). Winter motorized access can also indirectly affect accessibility for trapping.

Trapping

MFWP has authority to set regulations for wolverine trapping. The Forest is within wolverine management unit 1 (northwest Montana), which had a trapping quota of three wolverines (with a maximum of one female) in 2010 and has had a quota of 0 since then (MTFWP, 2017).

Highways

Montana Department of Transportation has authority to manage highways on the Forest. Wolverine mortality from collisions with vehicles has occurred, but at low levels. Wolverines do not usually come into contact with high-traffic-volume roads except in those areas where highways cross over mountain ranges (such as major passes). Wolverines killed on roads in valleys between mountain ranges are likely the result of dispersal attempts by wolverines, but these appear to be rare occurrences (USFWS, 2014b).

Changing climate

The 2013 proposed rule for the North American wolverine identified threats to the long-term persistence of the species. The primary threat at that time was determined to be potential changes in climate (USFWS, 2013a), including effects on connectivity of meta-populations. The USFWS is currently evaluating potential changes in climate within wolverine habitat based upon more refined models.

Key indicators

Coarse-filter plan components addressed in section 3.7.4 provide for habitat diversity that benefits wolverines. The wolverine indicators, plan components, and alternatives were developed after considering key indicators addressed in other sections of the final EIS, key stressors, public comments, and issues identified during scoping. The biological basis for key ecosystem characteristics and impacts of human activities is described in detail in the “Affected environment” section. Key stressors on all lands are discussed in the section on cumulative effects to the wolverine. In addition to the indicators and effects of alternatives on habitat described in section 3.7.4, subsection “High-elevation habitat,” the following species-specific indicator applies to indirect effects of alternatives for the wolverine:

- Risk of human disturbance to female wolverines with young in areas of modeled wolverine maternal denning habitat.

Environmental consequences

Effects common to all alternatives

All alternatives include plan components designed to maintain or restore diverse, resilient vegetation conditions that would provide for wolverine prey species. As described in the “Affected environment” section above, research results suggest that wolverines are generally tolerant of human disturbance associated with recreation developments and activities (Heinemeyer & Squires, 2014, p. 4). The thresholds for the amount of development or human recreational use that individual wolverines will tolerate in their home ranges is unknown but is being investigated. With all alternatives, plan components would support key ecosystem characteristics for wolverines because about 59-64 percent of modeled wolverine habitat is in designated wilderness (the range varies based upon which model is used (as explained in the section on the methodology and analysis process used for wolverine). In designated wilderness, the risk of human disturbance is low because motorized uses and mechanized transport such as snowmobiling, helicopter-assisted skiing or snowboarding, and snow bikes are not allowed. Nonmotorized and non-mechanized transport on the Forest are not restricted, but because much of the designated wilderness area on the Forest is remote, it is difficult to access for nonmotorized and nonmechanized winter recreation.

Summary of modeled alternative consequences

To assess effects of the risk of human disturbance to female wolverines with young, the Forest used the model developed by Copeland and others to model maternal denning habitat (2010). Modeled maternal denning habitat encompasses about 655,000 acres or about 27 percent of all Forest lands. Table 94 displays the consequences of the alternatives resulting from suitability of areas for motorized over-snow vehicle use within modeled maternal denning habitat (see figures 1-18 through 1-21).

Table 94. Modeled wolverine maternal denning habitat by alternative

Motorized over-snow vehicle use suitability in modeled denning habitat with persistent snow at least five years out of seven	Alternative A	Alternative B modified	Alternative C	Alternative D
Acres where motorized over-snow vehicle use is suitable	74,048	71,547	18,051	77,257
Acres where motorized over-snow vehicle use is not suitable	580,644	583, 145	636,641	577,435
percent of total where motorized over-snow vehicle use is suitable	11%	11%	3%	12%

As shown in table 94, alternative C would have the lowest percentage of modeled maternal denning habitat where motorized over-snow vehicle use would be suitable, and alternative D would have a slightly higher percentage. Alternatives A and B modified both maintain the existing percentage but shift where it is located on the Forest (see figures 1-18 through 1-21). Motorized over-snow vehicle use would be suitable on no more than 12 percent of modeled maternal denning habitat under alternative D, 11 percent under alternatives A and B modified, and 3 percent under alternative C.

With alternatives A, B modified, and C recommended wilderness would also be added, contributing to the future percentage of the forest with a low risk of human disturbance in areas of modeled wolverine maternal denning habitat, as discussed in the following sections.

Alternative A

Amendment 24 (USDA, 2006) designated specific routes, areas, and seasons for motorized over-snow vehicle use (Travel Management Rule § 212.81). Motorized over-snow vehicle use would be suitable on no more than 11 percent of modeled maternal denning habitat (see figure 1-18). About 9 percent of modeled maternal denning habitat is in recommended wilderness (management area 1b) and would not be suitable for motorized use, so the risk of disturbance to female wolverines with dependent offspring would be low (see figure 1-01 and section 3.15 for more details).

Alternative B modified

In comparison with alternative A, there would be a slight net decrease in modeled maternal denning habitat that is suitable for motorized over-snow vehicle use (see figure 1-19). Alternative B modified would change an area in Big Creek to suitable for motorized over-snow vehicle use, but the majority of the area added is not in modeled maternal denning habitat. An area in Sullivan Creek would become unsuitable and is in modeled maternal denning habitat.

The forest plan also includes guidelines that would benefit the wolverine by limiting the risk of human activities that might cause disturbance in modeled maternal denning habitat in the future. FW-GDL-WL-04 states, “New projects or activity authorizations involving low-altitude helicopter flights or landings in areas of modeled wolverine maternal denning habitat (identified in cooperation with USFWS and the USFS Rocky Mountain Research Station) should not occur from February 15 to May 15 unless they include strategies or design features to mitigate disturbance to wolverines. Exceptions to this guideline may occur for public health and safety, emergency activities, or other approved administrative activities, such as site maintenance." FW-GDL-REC-04 states, "To limit the risk of cumulative impacts to female wolverines with dependent young, there should be no net increase in percentage of modeled wolverine maternal denning habitat where motorized over-snow vehicle use is identified as suitable on NFS lands at a forestwide scale. Specific locations of routes or areas suitable for motorized over-snow vehicle use are specified in figure B-11."

Under alternative B modified, about 15 percent of modeled wolverine maternal denning habitat is in recommended wilderness (management area 1b) (see figure 1-02), and it would not be suitable for motorized uses or mechanized transport (see section 3.15 for more details).

Alternative C

Under alternative C, three of the areas open to motorized over-snow vehicle use during the time period when female wolverines with offspring may be more sensitive to human disturbance would be virtually eliminated due to changes in suitability and management direction for recommended wilderness (management area 1b) in areas that are currently open (see figure 1-20). This alternative has the largest amount of wolverine maternal denning habitat in recommended wilderness (management area 1b), about 31 percent, which would not be suitable for motorized uses or mechanized transport (see figure 1-03; also see section 3.15 for more details). This alternative has the lowest risk of human disturbance to female wolverines with dependent offspring of all the alternatives.

Alternative D

Under alternative D, changes in areas suitable for motorized over-snow vehicle use would slightly increase the risk of disturbance to female wolverines with dependent offspring as future site-specific decisions are implemented (see figure 1-21). Alternative D has no recommended wilderness (management area 1b) but has more acres in a variety of backcountry management areas (management area 5) (see figure 1-04 and section 3.15 for more details).

In summary, scientific information about the effects of human disturbance indicates that wolverines are generally tolerant of many types of human recreational developments and use, as described in the "Affected environment" section. The thresholds for levels of human disturbance in habitats where female wolverines give birth to and raise dependent offspring are unknown at this time, but plan components for all alternatives would limit the risk of human disturbance.

Cumulative effects

Land management

The majority of wolverine habitat is located in higher-elevation areas that are largely designated wilderness, recommended wilderness and inventoried roadless areas, or lands that are relatively unavailable for development. Forest plan direction for other national forests in the northern Rocky Mountains (for activities such as timber harvest, livestock grazing, and motorized use of forest roads and trails) are not expected to negatively affect wolverines or their habitat. Diverse prey items are available for wolverines throughout the cumulative effects analysis area, so prey should continue to be available. The USFWS concurred with the Northern Region determination that management activities commonly conducted on the national forests would not jeopardize the wolverine (USFWS, 2014e).

Lands managed by the Confederated Salish and Kootenai Tribes include the Mission Mountains Tribal Wilderness Area and the South Fork Jocko Primitive Area. Cumulative adverse effects to the wolverine are not expected as a result of management actions on tribal lands. Private lands are not generally located in modeled wolverine habitat on the Flathead National Forest.

Highways

With respect to connectivity and highways on the Forest, there is one high-elevation paved highway (U.S. Highway 2) along the border between the Forest and Glacier National Park. Since 2011, two wolverines have been killed by vehicles in MFWP Region 1 (T. Thier, MFWP, personal communication, 2016). Squires and others concluded that wolverine movements are unpredictable and are therefore not easy to incorporate in the planning of structural highway mitigation projects (J. R. Squires et al., 2007).

Trapping

In 2008, further analysis tied to the genetic makeup of the Montana wolverine population, the issue of maintaining population connectivity, and recognizing the core population areas of three major ecosystems led to additional regulation changes. These adjustments included delineating four wildlife management units and reducing quotas to a statewide total of five animals, to promote population connectivity among the three major ecosystems in the state where harvest is allowed (Giddings, 2009, pp. 35-39). In December 2012, a state district court judge in Helena granted a temporary restraining order that blocked the opening of Montana's 2012-2013 wolverine trapping season, and it remained closed with a quota of 0 in 2013–2014, 2014–2015, and 2015-2016. The future of wolverine trapping is unknown. The Forest is within wolverine management unit 1 (northwest Montana), which had a quota of three wolverines (with a maximum of one female) in 2010 and has had a quota of 0 since then (MTFWP, 2017). Since trapping was suspended in 2011, there has been one wolverine trapped accidentally (T. Thier, MFWP, personal communication, 2016). Glacier National Park, encompassing about one million acres adjacent to the Forest, is closed to trapping. Access during the winter season (discussed under sections on effects of alternatives) may indirectly affect the area accessible for trapping. Any cumulative effects to the wolverine resulting from trapping and winter recreation access on all lands are not available at this time, but investigations by multiple states in the Rocky Mountains are ongoing.

Changing climate

According to the models used in an assessment by McKelvey and others (2011), northern Montana (including the Forest), the southern Bitterroot Mountains, and the Greater Yellowstone Ecosystem retain significant spring snow in the next 50 years, whereas central Idaho is projected to lose significant spring snow. There are variations in climate models, but models generally indicate earlier snowmelt in the northern Rockies in the future, a pattern that has been ongoing since at least the 1950s. Although wolverines are known to spend the majority of their time at high elevations, the degree to which earlier snowmelt may affect wolverines and the connectivity of metapopulations is uncertain.

At a regionwide scale, the preliminary Northern Rockies Adaptation Partnership risk assessment for the wolverine (NRAP, 2015) states that there is no evidence that wolverines in the northern Rocky Mountains can persist in areas distant from extensive areas of spring snow, and thus their adaptive capacity appears to be low. The authors estimated that the magnitude of effects would be low in 2030 and moderate in 2050, with a high likelihood of effects across all time periods. Across the northern Rockies as a whole, losses of current levels of persistent spring snowpack are estimated to be around 30 percent by mid-century (NRAP, 2015). However, it is likely that snow will persist on some slopes and aspects at higher elevations. Due to the low density of wolverine populations, there may continue to be sufficient snow to meet the needs of the population as a whole. There may be microsites important to wolverines (such as mountain cornices, shaded cirque basins, or talus areas) that retain snow during most years or retain snow longer into the spring than surrounding areas. McKelvey and others (2011) stated: "Although wolverine distribution is closely tied to persistent spring snow cover, we do not know how fine-scale changes in snow patterns within wolverine home range may affect population persistence" (p. 2895). The USFWS concurred with this finding, stating that "an improved understanding of how microclimatic variation alters the habitat associations of wolverines at fine spatial scales is needed" (USFWS, 2014b, p. 47527).

Some members of the public expressed a concern about the cumulative consequences of climate change upon connectivity of wolverine metapopulations. Wolverines are a highly wide-ranging species. Recent research in Glacier National Park has demonstrated that habitat connectivity between Glacier National Park, the Forest, and Canada currently provides for wolverine movement (Copeland & Yates, 2006). Plan components provide for connectivity of wolverine habitat by (1) providing for ecological conditions that meet subsistence and movement needs in connectivity areas, (2) limiting mortality risk through management of motorized access on NFS lands (see section 3.7.5, subsection "Grizzly bear," for more details), and (3) working with adjacent landowners and other interested parties to improve connectivity and linkage opportunities across multiple jurisdictions (e.g., cooperative agreements, highway approaches and crossings, and land consolidations, exchanges, acquisitions, and easements). Some of the key plan components for connectivity are FW-GDL-IFS-12; GA-HH-DC-03, GA-MF-DC-04, GA-NF-DC-06 through 08, GA-SM-DC-03, and GA-SV-DC-09. For example, GA-HH-DC-03 states that the Coram connectivity area provides habitat connectivity for a north-south movement corridor for wide-ranging species (e.g., grizzly bear, Canada lynx, wolverine) moving between the southern and northern watersheds on the Forest. On private lands, increasing residential development along highways that cross wolverine habitat may result in habitat fragmentation. Squires and others suggested that connectivity for wolverines may be facilitated by limiting permanent developments through conservation easements and land purchases (J. R. Squires et al., 2007). The Forest and Montana Department of Natural Resources and Conservation recently completed the Montana Legacy Project land acquisition in the Swan Valley geographic area of the Forest. This acquisition and other conservation easements on private lands may benefit wolverines in the future by limiting the density of permanent human developments and facilitating movement between mountain ranges.

The natural range of variation for persistent spring snowpack on the Forest is unknown, but variation from year to year is common. High-elevation areas with persistent spring snow at least five years out of seven are more likely to retain snow as the climate changes, whereas lower-elevation areas that retain persistent spring snow only one year out of seven are more likely to lose snow in the future as the climate changes. Some members of the public expressed a concern about the cumulative consequences of climate change on the Forest combined with increases in recreational activities. Glacier National Park provides over 1 million acres that is closed to motorized over-snow vehicle use, and much of the Park provides wolverine habitat. In combination, Glacier National Park, wilderness areas on adjacent national forests and tribal lands, and designated wilderness areas on the Flathead National Forest provide over 2 million acres of habitat available to wolverines that is remote and difficult to access by any means during the time periods when wolverines may be sensitive to disturbance.

The 2012 planning rule requires the Forest to determine whether the plan components provide the ecological conditions necessary to conserve proposed and candidate species (§ 219.12(a)(5)(iv). Key ecosystem characteristics for the wolverine, a proposed species, include high elevations with persistent spring snow, habitat for dispersal, and features such as rocky alpine areas, glacial cirque basins, and avalanche chutes that provide food sources such as marmots, voles, and ungulate carrion. Maternal and natal denning habitat with relatively low levels of human development are important, although the thresholds are unknown.

The northern Rocky Mountains portion of the North American wolverine distinct population segment is thought to be the largest subpopulation and the most genetically resilient of the current subpopulations (USFWS, 2013a). Alternative B modified, the preferred alternative, has plan components, including standards and guidelines, to maintain, improve, and restore ecological conditions within the plan area to contribute to maintaining a viable population of the species within its range (2012 planning rule, 36 CFR § 219.9). In their concurrence letter for the programmatic biological assessment on the North American wolverine for the USDA Forest Service Northern Region, the USFWS (2014e) concurred that potential projects routinely conducted on National Forest Service lands are not likely to jeopardize the wolverine. All action alternatives include monitoring items MON-WL-14 and 17, which address the wolverine and its habitat (see chapter 5 of the forest plan for more details). The Forest does not anticipate substantial changes to wolverine maternal or natal denning habitat over the anticipated life of the plan, but if conditions change in the future, or if research or monitoring indicates there is a need to address specific threats that are within Forest Service authority or capability to manage, the forest plan may be amended or revised in the future if necessary.

3.7.6 Wildlife habitat connectivity

Introduction

Connectivity is an important part of the concept of ecological integrity. During the planning process, the distribution and connectivity of ecosystems and associated wildlife was examined at multiple scales, in multiple ways, using multiple models and analyses (see Kuennen, 2017b). Information on connectivity is abundant, but more information is needed to determine the most appropriate use of each publication, model, or data set (T. Graves, Chandler, Royle, Beier, & Kendall, 2014; McClure et al., 2016).

The 2012 planning rule defines connectivity as follows:

> Ecological conditions that exist at several spatial and temporal scales that provide landscape linkages that permit the exchange of flow, sediments, and nutrients; the daily and seasonal movements of animals within home ranges; the dispersal and genetic interchange between populations; and the long distance range shifts of species, such as in response to climate change. (36 CFR § 219.19).

Haber and Nelson (2015) stated that it is useful to think of connectivity as contributing to both the structure and function of ecosystems and landscapes. Structural connectivity is the physical relationship between patches of habitat or other ecological units; functional connectivity is the degree to which landscapes actually facilitate or impede the movement of organisms and processes of ecosystems (Ament, Callahan, McClure, Reuling, & Tabor, 2014).

Connectivity can take several forms, from linear corridors to stepping stones of suitable habitat and from managing for specific linkage areas to managing the landscape as a whole so that movement is facilitated without the need for a “corridor.” As summarized by Haber and Nelson (2015), key terms related to connectivity and wildlife movements are

- **corridor**. A distinct component of the landscape that provides connectivity (such as a linear patch).
- **linkage area or zone**. Broader regions of connectivity important to maintain ecological processes and facilitate the movement of multiple species.

As summarized by Ament and others (2014):

- **permeability**. The degree to which landscapes are conducive to wildlife movement and sustain ecological processes.

Wildlife and natural ecosystem processes occur irrespective of political boundaries. The Flathead National Forest is contiguous with the Kootenai National Forest to the west, Canada to the north, the

Helena-Lewis and Clark National Forest to the east, the Lolo National Forest and tribal lands of the Confederated Salish and Kootenai Tribes to the south, and Glacier National Park to the north and east. On the Flathead National Forest, connectivity has been influenced by natural ecosystem processes as well as by human developments such as road construction, ski area development, timber harvest, utility corridors, and private land development.

As recommended in Haber and Nelson (2015), the Forest's planning process takes connectivity into account by:

- recognizing that sustainability depends in part on how the plan area influences and is influenced by the broader landscape (36 CFR § 219.8(a)(1)(ii) and (iii)) (see cumulative effects and landscape context sections throughout the Forest's assessment (USDA, 2014b); sections 3.7.4 and 3.7.5 and chapter 6 of this final EIS);
- assessing conditions, trends, and sustainability in the context of the broader landscape (36 CFR § 219.5(a)(1)) (see the Forest's assessment; cumulative effects and landscape context sections throughout sections 3.7.4 and 3.7.5 and chapter 6 of this final EIS; and MFWP (2014));
- evaluating system drivers (e.g., climate change) and stressors (e.g., barriers to connectivity) (36 CFR § 219.6 (b)(3) (see sections 3.7.4 and 3.7.5 and appendices 2, 3, and 7; and USDA (2014b, pp. 48-87; 2016d));
- including plan components to coordinate with other land managers relevant to populations of at-risk species (36 CFR § 219.9(b)(2)(ii)) (see forest plan section "Partnerships and Coordination" and chapter 5);
- including plan components that address key characteristics for connectivity, composition, structure, and function (36 CFR § 219.8 (a)(1) (see forest plan sections "Aquatic Ecosystems," "Terrestrial Ecosystems and Vegetation" and "Wildlife"; sections 3.2, 3.3, 3.7.4, and 3.7.5 in this final EIS);
- modeling and assessing the natural range of variation for vegetation on the Forest (36 CFR § 219.19) (the Forest modeled the natural range of variation over the past 1,000 years and modeled the effects of the alternatives for 50 years into the future, considering potential future climate—see sections 3.3, 3.7.4, 3.7.5, and appendices 2 and 3 of this final EIS); and
- assessing the cumulative effects of the plans and land use policies of others (36 CFR § 219.4(b)) (see sections 3.2.12 and 3.3.11 in this final EIS; see the cumulative effects sections throughout 3.7.4 and 3.7.5 and also chapter 6).

Connectivity models and analyses

Several connectivity models and analyses were considered in assessing connectivity (Kuennen, 2017b). A variety of models showed that the same or similar areas were often important for multiple species. The Forest reviewed connectivity models, identified key areas for connectivity, and evaluated where it would be important to provide for habitat connectivity as a conservation strategy to promote population resiliency and adaptability in the face of climate change, considering ecosystems as well as specific species. The natural range of variation analysis is the source for both current and historical conditions related to the evaluation of alternatives upon forest connectivity, which is one aspect of connectivity (see appendices 2 and 3). The Forest also addressed permeability between Forest lands and adjacent lands and assessed the cumulative effects of activities on other land ownerships within the plan area, including permanent developments on private lands and public highways (Kuennen, 2017b) (see also appendices 2, 3, 4, 5, and 7).

Key stressors on connectivity include:

- Vegetation and fire management (e.g., timber harvest, fuels reduction, fire suppression) on NFS lands and other lands
- Access and human disturbance on NFS lands and other lands
- Private land development
- Changing climate

Key indicators for analysis

The effects of vegetation and fire management, access, private land development, and changing climate are discussed throughout sections 3.7.4 and 3.7.5, for key ecosystems as well as for specific species. The following section discusses the results of modeling for connectivity of forest cover.

Environmental consequences

Summary of modeled alternative consequences

Ecosystem Research Group modeled connectivity of forest cover within areas (called polygons) identified and defined by American Wildlands (see appendix 3 for more details). These areas represent about 1.16 million acres, including NFS, State, and other lands. Additionally, changes in mean patch size were modeled to show how disturbances (fire, insects, disease, or human activities) might affect the size of those patches over time.

Recognizing that connectivity for some species is affected by a lack of or loss of habitat components that take a long period of time to restore (Haber & Nelson, 2015), connectivity across the Forest was modeled using the query design for marten because marten is a species that is more limited by the amount and arrangement of mature tree cover. As a means of assessing long-term habitat connectivity and the benefits of permanent cover reserves, sample landscapes at years 2015 and 2065 were compared by acres of marten habitat, average patch size, and percent habitat occurring in 2015 against the modeled habitat that still remained fifty years in the future at 2065 (see appendix 3 for more details). Figure B-30 in the forest plan and figure 2 in appendix 3 display the geographic connectivity areas in the vicinity of the Forest and those selected for this analysis. These areas were selected because they span the valleys where lands managed by the Forest are intermingled with other landownership.

Within the American Wildlands areas used for analysis, NFS lands total about 782,000 acres (about 33 percent of the Forest). Mature forest is currently present on about 35 percent of the connectivity areas at present, and modeling indicates it would drop to about 28 percent in the fifth decade, based upon a worst-case scenario for the combined effects of wildfire and insects and disease. Levels of mature forest cover within the American Wildlands areas declines by about 75,000 acres out of about 400,000 acres by the end of decade 5 for all alternatives. The model predicts that alternatives A, B modified, C, and D provide approximately the same levels of habitat in all decades, indicating that vegetation management activities associated with each alternative play a minor role compared to natural disturbances (see appendix 3 for more details).

In addition, Ecosystem Research Group modeled the number of mature forest patches and the mean patch size within the American Wildlands areas used to assess connectivity of forest cover. These modeled results suggest that the current mix of patch sizes is likely due to a century-long absence of stand-replacing fire, which has allowed stands to reach large or very large size classes and high densities where the boundaries between them become relatively indiscernible. Mean patch size for mature forest cover declines in decades 3 through 5, with a corresponding increase in the number of patches. Declines in patch size, accompanied by an increase in the number of patches, are presumed to have negative effects on some interior forest species (e.g., marten) because patches have more edge where these species may be more vulnerable to predation. Mature forest patch sizes in alternatives B modified, C, and D show little difference between alternatives by the end of the fifth decade. Alternative A shows slightly less of a decline in mature forest patch size, presumably because alternative A was modeled without prescribed burning to match the 1986 forest plan.

Prescribed fire and mixed-severity wildfires often create a small-patch mosaic and are anticipated to be present in the warm-dry and warm-moist potential vegetation types. Modeling indicates that larger, more severe stand-replacing wildfires could result in some very large, even-aged, early seral patches and reduce the size of mature forest patches, especially in the cool-moist and cold potential vegetation types which make up most of the Forest. Modeling suggests that wildfire coverage and severity, as affected by slope, aspect, and fire suppression, often cumulatively result in a small-patch mosaic. Modeling over several decades indicates that disturbances tend to reoccur on previously disturbed acres, which adds additional complexity to existing patterns of forest cover. For instance, severe burns may be followed by re-burns 15-25 years later, after fuels accumulate on the forest floor. Moderate-severity burns are often followed by bark beetle attacks on weakened, surviving trees, which may add to the patchiness of forest patterns. Additionally, most of the area in the American Wildlands areas is in the wildland-urban interface (see figure 1-13). The wildland-urban interface is where vegetation management would be emphasized and where wildfires would be likely to be suppressed. But even if wildfires are suppressed, the model estimates that disease and insect infestations will increase with expected warmer, drier climates. Insects and disease within mixed-species forests tend to create numerous small patches.

Alternative A

Management direction provides for key ecosystem characteristics for wildlife connectivity. Management direction specific to connectivity is included in the lynx standards and guidelines ALL 01, ALL S1, ALL G1, LINK 01, LINK S1, LINK G1, and LINK G2, the old-growth standards, and the riparian habitat conservation area standards.

Alternatives B modified, C, and D

Management direction incorporated throughout the action alternatives provides for key ecosystem characteristics for wildlife connectivity, as discussed in sections 3.7.4 and 3.7.5 and Kuennen (2017b).

In addition to the lynx standards and guidelines, key plan components for alternative B modified are as follows:

- Infrastructure standard FW-STD-IFS-02 limits increases in motorized access, and guideline FW-GDL-IFS-12 specifies that within areas specifically identified as being important for wildlife connectivity across highways (see table 18 in the forest plan), the Forest should cooperate with highway managers and other landowners to design approaches and crossings that contribute to wildlife and public safety.
- Desired condition FW-DC-TE&V-14 provides for connectivity of old-growth forests, and FW-DC-TE&V-19 specifies that forest patterns contribute to the connectivity of habitat for wildlife (e.g., Canada lynx, marten), movement within and between home ranges, and dispersal between populations. FW-STD-TE&V-01 and 03 and guidelines FW-GDL-TE&V-06 through 09 provide for connectivity of old growth, large live trees, snags, and downed woody material. Downed woody material, for example, contributes to habitat connectivity for amphibian and small mammal species.
- Wildlife guideline FW-GDL-WL DIV-06 provides for retention of cover so that connectivity of cover is not severed between areas of forest where cover is lacking (e.g., recent, large stand-replacement fire areas until succession creates new cover).

- Energy and minerals standards FW-STD-E&M-08 and 09 contribute to connectivity. For example, new leases for leasable minerals in the grizzly bear recovery zone/primary conservation area shall include a no surface occupancy stipulation and development is not allowed in areas withdrawn from mineral entry.
- Desired condition FW-DC-LSU-01 specifies that land ownership adjustments, through purchase, donation, exchange, or other authority, improve national forest management by consolidating ownership, reducing wildlife-human conflicts, providing for wildlife habitat connectivity, improving public access to public lands, and retaining or acquiring key lands for wildlife and fish and lands within wild and scenic river corridors.
- Desired condition FW-DC-P&C-01 specifies that the Forest work towards an all-lands approach to management, in cooperation with other land managers, such as by mitigating threats or stressors, providing for wildlife and fish habitat connectivity, and providing social, economic, and ecological conditions that contribute to mutual objectives.
- Several geographic area plan components provide for connectivity, incorporating areas where connectivity across highways is emphasized in several models: GA-HH-DC-03, GA-MF-DC-04, GA-NF-DC-06 and 07, GA-SM-DC-03, and GA-SV-DC-09, GA-MF-OBJ-01, GA-NF-OBJ-03, and GA-SM-OBJ-04.
- Several plan components provide for riparian connectivity (FW-DC-WTR-02 and FW-DC-RMZ-06; FW-STD-RMZ-01, 05, and 06; FW-GDL-RMZ-08 through 15; FW-SUIT-RMZ-01). For example, FW-RMZ-GDL-09 states that if new openings are created in riparian management zones through even-aged regeneration harvest or fuels reduction activities, the created opening's distance to cover (see glossary) should not exceed 350 feet to provide wildlife habitat structural diversity, connectivity, and cover. This guideline is consistent with findings by Squires and others (2013) regarding lynx avoidance of areas more than 364 feet to cover and so would benefit lynx as well as meeting distances to cover for marten.
- Management area suitability also contributes to connectivity. For example, management areas 1a, 1b, 2a, 2b, 4a, 5a, and 5c are not suitable for permanent road construction, wheeled motor vehicles, or timber production (see forest plan table 34).

For key differences between alternatives B modified, C, and D see the sections on individual species.

Cumulative effects

In the southern end of the Salish Mountains and Swan Valley geographic areas, many sections of forest land (a section is one square mile of land, which is 640 acres) that were managed by a private timber company were treated with regeneration harvest during the last few decades, resulting in a high density of roads in those sections and a "checkerboard" pattern of cover and non-cover, reducing connectivity. As discussed in detail in section 3.7.5, subsection "Grizzly bear," the Forest has now acquired thousands of acres of these lands in the Swan Valley through the Montana Legacy Project, so connectivity is anticipated to improve in the future.

In the cool-moist and cold potential vegetation types of the North Fork geographic area, NFS lands as well as adjacent lands in Glacier National Park were regenerated by very large wildfires, also reducing connectivity for species associated with forest cover but in this case in a pattern of much larger openings. Vegetation modeling has shown that these effects will persist for the next one to three decades but that regrowth of cover due to forest succession would then occur and forested connectivity would increase, provided there are not new large stand-replacing wildfires.

The connectivity areas (see figure B-30) include all land ownerships, and the Forest is not able to predict how, when, or where these lands may be affected by vegetation management, road access, or development. However, even if vegetation management activities on all lands are planned to maintain, restore, or improve connectivity, it is not possible to predict exactly where or when wildfires, insect infestations, or disease would occur, or if forest succession (which creates cover for connectivity) would outpace loss of cover due to these factors. For these reasons, connectivity would need to be assessed at the project level at a particular point in time.

The forest plan includes numerous plan components for wildlife connectivity, but as monitoring of forest conditions in recent decades has shown, extensive stand-replacing wildfires, insect infestations, and disease can reduce cover for connectivity across large areas encompassing all lands (USDA, 2014b). Based upon the warmer and drier summer climate predicted by most climate models, large stand-replacing wildfires are likely to continue to occur in the future and can be expected to affect connectivity of forest cover between NFS lands and surrounding lands.

Forestwide desired condition FW-DC-P&C-01 places emphasis on the Forest cooperating with other land managers, including efforts to mitigate threats or stressors, provide for wildlife and fish habitat connectivity, and to promote ecological conditions that contribute to mutual objectives. Where there are willing landowners, the forest plan also emphasizes future connectivity through desired condition FW-DC-LSU-01, which would reduce the risk that private lands in key connectivity areas would be commercially developed or subdivided for residences in the future, which would permanently reduce connectivity. The Forest's desired conditions complement those of other governments and agencies (such as MFWP, Missoula County, and the City of Whitefish), as well as those of non-government organizations and businesses (such as the Flathead Land Trust, The Nature Conservancy, and F. H. Stoltze Land & Lumber Company), that are working together to maintain connectivity in key areas.

Several scientists identified strategies and key locations for highway crossings, eight of which are within Flathead National Forest geographic areas. Because the Forest does not have authority over highways but does manage some lands adjacent to highways, guideline FW-GDL-IFS-12 states that the Forest should cooperate with highway managers and other landowners to design approaches and crossings that contribute to wildlife and public safety within areas specifically identified as being important for wildlife connectivity across highways. These areas are identified in a table under the guideline and include portions of the following highways: U.S. Highway 2, U.S. Highway 93, Montana Highway 83, and Montana Highway 486.

In addition to forestwide and geographic area desired conditions, standards, guidelines, and suitability, the mix of management area allocations for the forest plan provides for long-distance range shifts of species by providing large areas of habitat with relatively low levels of human development and disturbance (such as management areas 1a, 1b, and 5) with linkage to tribal wilderness areas, Glacier National Park, and north into Canada.

In summary, plan components for the Forest, in the context of all lands of the larger landscape, contribute to the ecological conditions of habitats that provide connectivity for animals. Plan components limit road access, help to provide cover for connectivity in a vast network of riparian areas and other key areas of the Forest where present, and promote cooperation with other agencies and landowners on activities such as highway crossings and conservation easements that benefit numerous species. Although the Forest Service does not have authority over all the stressors that affect connectivity, NFS lands would help to promote the connectivity of habitats with tribal lands of the Confederated Salish and Kootenai Tribes, Glacier National Park, Canada, and adjacent national forests.

3.7.7 Summary of key consequences to wildlife from forest plan components associated with other resource programs or management activities

The following section provides a brief summary of the consequences to wildlife from forest plan components associated with other resource programs or management areas. Consequences to key ecosystems, ecosystem characteristics, ecological conditions, and wildlife species are discussed throughout sections 3.7.4, 3.7.5, and 3.7.6.

Consequences from recommended wilderness (management area 1b) and eligible wild and scenic rivers (management area 2b)

Eligible wild and scenic rivers are the same for all action alternatives. In addition to currently designated rivers (management area 2a) eligible rivers would be managed according to Forest Service policy to protect the free-flowing condition of designated wild and scenic rivers and preserve and enhance the values for which they were established. This would be beneficial to wildlife.

In addition to currently designated wilderness (management area 1a) there are differences in alternatives for recommended wilderness management area 1b (see figures 1-01 through 1-04; 1-77 through 1-84):

- Alternative A: there are five recommended wilderness areas totaling about 98,400 acres
- Alternative B modified: there are eight recommended wilderness areas totaling about 190,400 acres
- Alternative C: there are 17 recommended wilderness areas totaling about 507,000 acres
- Alternative D: there are no recommended wilderness areas

Alternative C has the least risk of disturbance to wildlife from motorized travel or mechanized transport Except for the Jewel Basin Hiking Area (which has a high density of hiking trails and is very accessible), most recommended wilderness areas on the Forest do not currently have high levels of nonmotorized recreational use. The Jewel Basin Hiking Area already has prohibitions on stock and pack animals, mechanized transport and motorized uses. These prohibitions would continue regardless of management area 1b allocation. Even though alternative D does not have recommended wilderness, there would be about 290,262 acres of management area 5a where motorized recreational use would not be suitable in any season. There would be 117,650 acres management area 5c where motorized recreational use would be suitable only in winter, limiting effects on wildlife species that are sensitive to motorized disturbance.

Because alternative C has the most management area 1b (recommended wilderness), the expectation is that wildfire would be the primary driver of habitat change under this alternative. Because many wildfires on the Forest in recent decades have been stand-replacing and large (e.g., 10,000-40,000 contiguous acres), this could result in large areas that are in an early-successional stage providing grass/forb/shrub habitats and there could be more acres with snags and downed woody material than under alternatives A, B modified, or D. This would be beneficial for species associated with these key ecosystem characteristics but could be detrimental to species that are associated with old-growth habitat, areas of dense cover, large patches of mature forest, or connectivity provided by forest cover.

Consequences from access, infrastructure, and recreation management

Roads, trails, and other infrastructure can affect some wildlife species through habitat loss, disturbance, or displacement. All action alternatives include (1) standards for riparian management zones that limit roads, (2) standards for grizzly bears that roads are maintained at baseline levels (see glossary), and (3) objectives to decommission or place into intermittent stored service 30 to 60 miles of roads in key areas. Under alternatives A and C, additional roads would be expected to be closed to meet the requirements of amendment 19 or to meet desired conditions for recommended wilderness. Across the Forest, public motorized use is allowed only on designated routes, except in winter. Effects of alternatives were analyzed for key habitats of wildlife species that are sensitive to disturbance in particular areas or during particular time periods (e.g., grizzly bear, mountain goat). Under all alternatives, large blocks of NFS lands have no routes designated for motorized use during the grizzly bear non-denning season (April 1 through November 30). These large areas provide habitat security and reduced risk of mortality for a wide variety of wildlife species as well as protect riparian habitats, old growth, and very large snags.

All alternatives address suitability for motorized over-snow vehicle use. Limits on areas suitable for this use benefit wildlife species that may be sensitive to human disturbance during the winter. Under alternative A, about 19 percent of the Forest is currently open to motorized over-snow vehicle use from Dec. 1 to March 31, about 10 percent is open yearlong (snow conditions permitting), and about 2 percent is open during the time period from April 1 to Nov 30. Three alternatives are considered for specific areas and routes where motorized over-snow vehicle use would be suitable. Alternative C reduces suitable routes and areas the most, alternative D increases them slightly and alternative B modified is in between. If site-specific situations arise, the Forest has the ability to respond on a site-specific basis if monitoring indicates there is a need.

Recreational use is projected to increase in the coming decades under all alternatives. The action alternatives B modified, C, and D include a variety of areas that would be designated as management area 7, management areas suitable for focused recreation. Alternatives B modified and D would increase the areas allocated to management 7, whereas alternatives A and C would have less. Focusing developed recreation in these areas could disturb or displace some wildlife species but could also make areas of high recreational use more predictable, reducing the risk of human-wildlife conflicts. All alternatives include plan components to reduce the risk of human disturbance to wildlife at key time periods in key habitats, if within Forest Service authority. The Forest has two resorts with downhill ski areas. All alternatives maintain the management area allocations consistent with their current special-use permit boundary, and there are also plan components for their management that reduce potential impacts to wildlife species.

Roads can alter aquatic habitat, riparian habitat diversity, and wildlife connectivity, especially if they parallel streams. Forestwide infrastructure standards FW-STD-IFS-02, 05, 06, and 07 benefit wildlife species associated with aquatic, riparian, and wetlands habitats. Forestwide guideline FW-GDL-CNW-01 limits roads within the conservation watershed network. Standard FW-STD-WTR 02 reduces the risk of road impacts to aquatic habitats by specifying that project-specific best management practices (including both Federal and State of Montana best management practices) shall be incorporated in land use and project plans. Forestwide guidelines FW-GDL-RMZ-11 and 14 limit construction of new roads, temporary roads, and landings. These plan components would benefit a variety of wildlife species by helping to maintain habitat quality and connectivity. Recreation developments can also alter riparian diversity and connectivity. Guidelines FW-GDL-REC 02 and FW-GDL-REC 06 provide direction to reduce effects to riparian resources that would benefit wildlife habitat quality and connectivity.

Consequences from vegetation management

Vegetation management can have a positive effect on some wildlife species but not on others. Forestwide standards and guidelines help achieve or maintain desired conditions for wildlife. Desired conditions for wildlife may be met using a variety of active management techniques (e.g., timber harvest, precommercial thinning, planting, prescribed fire) on suitable lands. Four alternatives were considered, including a variety of management areas suitable for timber production to contribute to ecological, economic, and social sustainability (see figures 1-09 through 12). Desired conditions for vegetation are integrated with wildlife habitat needs and biodiversity. Forestwide standards, guidelines, and management area allocations promote the retention and development of key ecosystems and ecosystem characteristics including (but not limited to) riparian vegetation, old growth, very large live trees, snags, large downed woody material, and connectivity. Plan components provide desired conditions to restore historic tree species composition and/or historic structure (e.g., seed-producing whitebark pine, more diverse structure within ponderosa pine/Douglas-fir forest) that is beneficial to wildlife. Vegetation plan components could help make forests more resilient with respect to likely future environments, where feasible within USFS authority and capability of lands. Modeled vegetation and wildlife habitats would stay within the natural range of variation under all alternatives.

The primary differences among the alternatives are due to different combinations of management areas, whether they are suitable for timber production, whether timber harvest is allowable, and the intensity of management that may occur. Under alternative A, about 534,600 acres are suitable for timber production, the most of any alternative (see figure 1-09). Under alternative B modified, about 465,200 acres are suitable for timber production (see figure 1-10). Under alternative C, about 308,200 acres are suitable for timber production, the least of any alternative (see figure 1-11). Under alternative D, about 482,600 acres are suited for timber production (see figure 1-12). Under all the alternatives, about 1.6 million acres of the Forest are lands that are not suitable for timber production because they are in existing wilderness or inventoried roadless areas, which are not suitable for timber production under the 2001 Roadless Area Conservation Rule (see figures B-25 and B-26).

The intensity of management of lands suitable for timber production varies by management area (see the description of timber management in the forest plan for each management area). Alternative C has the highest proportion of lands suitable for timber production that emphasize a medium intensity of management, at 63 percent. About 37 percent of lands suitable for timber production emphasize a high intensity of management. Alternatives B modified and D have similar proportions of intensity in management, with 54 and 50 percent, respectively, of lands suitable for timber production identified for a moderate level of intensity of management and 46 and 50 percent, respectively, identified for more intense management. Because the existing forest plan does not explicitly identify a “medium-intensity” or a “high-intensity” management approach for the management areas, percentages have not been determined for alternative A.

In addition to lands suitable for timber production, timber harvest is allowable on some lands not suitable for timber production for purposes such as salvage, fuels management, insect and disease mitigation, protection or enhancement of wildlife habitat, research or administrative studies, or recreation and scenic-resource management (see section 3.21 for more details). Timber harvest on these lands is not scheduled or managed on a rotation basis. Timber harvest on these lands would have to be consistent with other management direction. For example, old growth is identified at the project level, and old-growth standards restrict timber harvest, regardless of management area. Additionally, in Canada lynx habitat, NRLMD vegetation management standards apply regardless of the management area designated by the Forest. Timber harvest for fuels reduction in the wildland-urban interface may occur if it is consistent with exemptions listed under the lynx standards. The number of acres where timber harvest is allowable on land *not* suitable for timber production are as follows: alternative A = 437,700 acres (18 percent of the Forest); alternative B modified = 447,200 (19 percent of the Forest); alternative C = 403,700 acres (17 percent of the Forest); and alternative D = 522,600 acres (22 percent of the Forest). Under alternatives B modified and D, approximately one half of these acres are comprised of inventoried roadless areas. For alternative C, the largest percentage of these acres are those allocated to management area 6a. With respect to management area 6, it is likely that there would be less intensive harvest of live conifer trees in management area 6a than 6b or 6c over time because management area 6a is not suitable for timber production and does not have scheduled timber harvest. Less intensive or extensive timber harvest would be of greater benefit for species associated with late-successional stages or mature forest cover and would be of lesser benefit for species associated with early-successional stages (see appendix 6 for a list of these species). With respect to lands where timber harvest is allowable, consequences to wildlife are difficult to predict with certainty in a programmatic document such as this because it is unknown where wildfires, insects, or disease will occur. Effects to wildlife would be considered during project implementation. Forestwide standards and guidelines would help achieve or maintain desired conditions for wildlife.

Riparian habitats are not suitable for timber production under any alternative. Under alternative A, mapped riparian habitat conservation areas total about 13 percent of NFS lands on the Forest. Alternative A has approximately 56,000 acres not suitable for timber production because they are within a riparian habitat conservation area, which equates to about a 10 percent reduction in lands suitable for timber production. The mapped riparian management zones under alternatives B modified, C, and D total about 411,000 acres, or about 17 percent of the Forest. All the action alternatives have a similar reduction (18 percent) in lands suitable for timber production due to being within a riparian management zone. Under alternatives B modified and D, this percentage amounts to approximately 103,000 and 105,000 acres, respectively, that are not suitable for timber production because they are within a riparian management zone. Under alternative C, this percentage amounts to approximately 67,000 acres not suitable for timber production because they are within a riparian management zone. Timber harvest is allowable, as are other types of vegetation management, for other purposes as long as it is consistent with other plan components. Timber harvest and other management activities in riparian management zones would be designed to promote desired conditions. Desired conditions for wildlife are integrated with forestwide desired conditions FW-DC-RMZ-01 through 06. These desired conditions support ecological conditions that provide for wildlife biodiversity and habitat integrity within riparian management zones because they emphasize natural composition of flora and fauna, natural processes, and a relatively more diverse structure and composition than areas outside riparian management zones. These desired conditions also emphasize vegetation pattern and cover conditions that contribute to habitat connectivity, benefiting wildlife species. The desired condition to provide for habitat connectivity across the landscape is addressed by forestwide plan component FW-DC-TE&V-19.

Consequences from fire and fuels management

Fire management using prescribed burning and natural, unplanned ignitions to meet resource objectives can have a positive effect on some wildlife species but not on others. Plan components for all action alternatives promote the use of fire as an important tool in moving vegetation towards desired conditions. The action alternatives have plan components that address the value of areas burned by moderate- to high-severity fire for some wildlife species. These alternatives have plan components that address wildlife needs during salvage harvest, including but not limited to wildfire areas. The alternatives also recognize the need to protect human safety and infrastructure and to salvage dead trees to contribute to economic and social sustainability in certain locations. In lands within the wildland-urban interface, particularly near communities, a continued policy of fire suppression is anticipated, as is mechanical treatment to reduce hazardous fuels and trend the vegetation towards desired conditions. This effect is common to all alternatives and could benefit species associated with mature forest or old-growth habitat by reducing stand-replacing wildfire. Species associated with mixed- to high-severity fire would benefit from wildfires that would be more likely to occur in wilderness and/or recommended wilderness, but even in these areas some fires would be actively suppressed (see section 3.3 for more details).

Wildfire can affect riparian diversity and connectivity, depending upon the size and severity of the wildfire. Under all alternatives, a full-suppression approach for wildfire management is most likely to be employed in the Salish Mountains geographic area and in valley portions of the North Fork, Middle Fork, Hungry Horse, and Swan Valley geographic areas where there are intermingled private lands. Under alternative A, fire and fuels management standards and guidelines protect riparian habitat conservation areas by providing strategies to minimize the disturbance of riparian ground vegetation and regulating rehabilitation, the location of facilities and the use of retardant, foam, and additives. Under the action alternatives, guidelines FW-GDL-RMZ-02 through 04 provide similar protections as alternative A, benefiting aquatic, wetland, and riparian wildlife habitats and associated species. FW-GDL-RMZ-05 specifies the use of minimum impact suppression tactics in order to minimize impacts to the riparian management zone and aquatic resources, thus benefiting wildlife. In wilderness (management area 1a) recommended wilderness (management area 1b), and backcountry (management area 5), wildfire is more likely to spread into riparian management zones. This increases the habitat for species associated with riparian shrubs, deciduous trees, grasses, forbs, and snags but reduces habitat and the connectivity of cover for species associated with later successional stages. These effects persist for about 20 years, on average.

With respect to fuels reduction treatments in riparian management zones, standard FW-STD-RMZ-06 allows an exception for mechanical fuels reduction treatments in the wildland-urban interface within 300 feet of private property boundaries (except for fens and peatlands). Although fuels reduction treatments could reduce habitat quality for some wildlife species, analysis indicates that this exception would affect only about 1 percent of the riparian management zone acreage, a minor amount that would have minor effects on wildlife.

Consequences from invasive species management

Herbicides used to control invasive species can affect riparian habitat diversity, depending on the type, extent, and amount of herbicide that is used and the proximity to a waterbody, wetland, or riparian area. Effects to wildlife species may occur due to direct contact if chemical concentrations are high enough. Under the action alternatives, standard FW-STD-RMZ-04 reduces risks to wildlife associated with aquatic, wetland, and riparian habitats. Guideline FW-GDL-NNIP-01 also reduces risks to wildlife because it states that when planning non-native invasive plant treatments within riparian management zones, the use of mechanical, biological, and cultural means of control should be considered before chemical control methods.

Consequences from watershed, soil, riparian, and aquatic habitat management

All alternatives include plan components that protect watershed integrity and soil productivity as well as riparian and aquatic wildlife habitats. Riparian habitat conservation areas (alternative A) or riparian management zones (the action alternatives) provide key wildlife habitats, and these areas are unsuitable for timber management. Under alternative A, mapped riparian habitat conservation areas total about 13 percent of NFS lands on the Forest. Alternative A has approximately 56,000 acres not suitable for timber production because they are within a riparian habitat conservation area, which equates to about a 10 percent reduction in lands suitable for timber production. The mapped riparian management zones under alternatives B modified, C and D total about 411,000 acres, or about 17 percent of the Forest. All the action alternatives have a similar reduction (18 percent) in lands suitable for timber production due to being within a riparian management zone. For alternatives B modified and D, this percentage amounts to approximately 103,000 and 105,000 acres, respectively, not suitable for timber production because they are within a riparian management zone. For alternative C, this percentage amounts to approximately 67,000 acres not suitable for timber production because they are within a riparian management zone. However, timber harvest is allowable in the riparian management zone if it is in conformance with riparian management zone desired conditions, standards, and guidelines. Under the action alternatives, the riparian management zone is broken into two areas, called the inner and outer riparian management zones. Some activities are prohibited or restricted in the inner riparian management zone, whereas more active management is allowable in the outer riparian management zone in some situations. Vegetation management can only occur in the inner riparian management zone when necessary to maintain, restore, or enhance aquatic and riparian-associated resources, with listed exceptions. Plan components for riparian management zones (alternatives B modified, C, and D) or riparian habitat conservation areas (alternative

A) would benefit many aquatic and terrestrial wildlife species. Plan components for the restoration of five Class 2 watersheds would also benefit wildlife by promoting aquatic, riparian, and wetland integrity (see section 3.2 for more details).

Consequences from management of mineral exploration or development

The potential for development of leasable and locatable minerals on the Forest is low. All minerals stipulations are subject to valid existing rights. These activities undergo site-specific NEPA analysis to determine effects and to ensure that required mitigation measures are included in plans of operations and rehabilitation requirements, if needed. Three action alternatives were considered, including standards and guidelines for the grizzly bear that would limit consequences from mineral and energy exploration or development. Plan components for the grizzly bear would also benefit many other wildlife species. Alternatives B modified and C would apply no surface occupancy stipulations to the grizzly bear recovery zone/primary conservation area, reducing the risk of future impacts to wildlife from mineral development. Under alternative A, standards and guidelines for riparian habitat conservation areas state that structures, support facilities, waste facilities, sand and gravel mining and extraction, and roads should be located outside riparian habitat conservation areas unless there is no alternative. Under alternatives B modified, C, and D, guideline FW-GDL-E&M-07 specifies that mineral operations should not be authorized in riparian management zones, and guideline FW-RMZ-06 limits new gravel pits within riparian management zones. These plan components promote riparian habitat diversity, integrity, and connectivity.

Consequences from management of livestock grazing

Livestock grazing has declined on the Forest in the last several decades. The action alternatives (B modified, C, and D) include standards and guidelines for the grizzly bear that limit the risk of conflicts from future livestock grazing. These plan components provide benefits for all wildlife species that may be affected by the reduction of forage in grass/forb/shrub habitats and provide benefits to birds that are susceptible to cowbird nest parasitism or predation within about a mile of livestock concentration areas. Cattle grazing can alter riparian diversity by changing the composition or abundance of grass, forbs, shrubs, and hardwood trees and can spread invasive plants in riparian management zones. Grazing allotments occur in only two of the seven geographic areas: the Swan Valley and Salish Mountains geographic areas. Standards and guidelines for riparian habitat conservation areas address grazing practices, livestock handling facilities, watering facilities, and salting to ensure that they do not adversely affect inland native fish, and this would indirectly benefit aquatic wildlife species. Cattle grazing is a minor activity on the Forest, but the authorization of new grazing allotments would not be restricted under alternative A. Alternatives B modified, C, and D include standard FW-STD-GR-02, which limits the authorization of new cattle grazing allotments in all but the Salish Mountains geographic area. The Swan geographic area has guideline GA-SV-GDL-04 to phase out cattle allotments if opportunities arise with a willing permittee, which would reduce the risk of impacts due to grazing on NFS lands. Livestock grazing plan components FW-DC-GR-03, FW-STD-GR-07 and 08, and FW-GDL-GR-01 through 04 are similar to plan components in alternative A but include additional direction.

Consequences from management of lands and special uses

Land ownership adjustment is one of the tools used to simplify and improve management of NFS lands, including wildlife habitat. Special-use permits authorize the occupancy and use of NFS land by private individuals or companies for a wide variety of activities, such as roads, utility corridors, communication sites, and other private or commercial uses. All alternatives have plan components for special uses that are designed to coordinate special uses with the needs of wildlife.

Consequences from management of other ecosystem services, other multiple uses, and partnerships

Development of all alternatives and plan components considers ecosystem services and multiple uses provided by NFS lands. Plan components integrated throughout the action alternatives are intended to manage for social and economic sustainability and multiple uses in ways that are compatible with ecological sustainability and the needs of wildlife. Partnerships are vital to an all-lands approach to management. Cooperation with other Federal agencies, tribes, State agencies, counties, universities, non-government organizations, and the public helps to increase knowledge of the Forest's wildlife and their needs, promotes sustainable wildlife populations and habitats, helps mitigate threats or stressors, and helps provide social, economic, and ecological conditions that contribute to multiple objectives.

3.7.8 Terrestrial invertebrates

Introduction

Invertebrates are animals without a backbone. They are cold-blooded, meaning their body temperature depends upon the temperature of their surrounding environment. They include such animal groups as insects, mollusks, crustaceans, and arachnids (i.e., spiders). There are a lot of unknowns with regard to invertebrate populations; in many areas, invertebrate populations have not been surveyed or have not been surveyed recently (see also the section specific to pollinators below). The Montana Natural Heritage Program prepared a comprehensive field guide for snails and land slugs of Montana (Hendricks, 2012), which states that the species richness of Montana land mollusks is higher west of the Continental Divide than east and includes 42 known native mollusks.

Key Indicators for analysis for most terrestrial invertebrates

The needs of most terrestrial invertebrates would be met by the plan components for diverse ecosystems and key ecosystem characteristics, as described in sections 3.2, 3.3, 3.7.4, and 3.7.5. In addition, the following indicator applies to the carinate mountainsnail, an invertebrate species that is endemic to the Forest:

- Reduce the risk of activities that may impact talus habitats with known populations of the carinate mountainsnail.

Affected environment

Two endemic invertebrate species are known to occur on the Forest: the carinate mountainsnail (*Oreohelix elrodi)* and the alpine mountainsnail (*Oreohelix alpina*) (Kuennen, 2013b). According to the Montana Natural Heritage Program database (MNHP-MTFWP, 2016a, 2016b), known locations of these mountainsnails on the Forest have been surveyed from 1974-2010, and these species are persisting in those locations. The alpine mountainsnail is known from six sites in four counties west of or near the Continental Divide, ranging from 7,200 to 9,700 feet. On the Forest, the alpine mountainsnail is known to occur only at high elevations within wilderness areas where there are no known threats. In Montana, there are 29 records of the carinate mountainsnail from five sites west of or near the Continental Divide in two counties (most are from Lake County), ranging from 3,600 to 8,000 feet in elevation.

Many mollusks, including the mountainsnails, are found under woody debris, within the talus under or on rocks, or in accumulations of duff or leaf and needle litter. Downed trees and other woody material are used by many invertebrates, such as ants and beetles. Long, large-diameter wood is generally most important because it can be used by a greater range of species and provides a stable and persistent structure as well as better protection from weather extremes.

Talus sites with mountainsnail populations may lack forest canopy altogether or occur under an open mixed conifer canopy that includes Douglas-fir, western larch, ponderosa pine, and western red cedar (near streams), with aspen, paper birch, and mock orange scattered along the margins of talus slopes. They may occur at higher elevations in drier habitat where snowbanks and seeps keep soil moist. Other habitat requirements and food habits are poorly understood (Hendricks, 2012).

Key stressors

Talus areas inhabited by mollusks are subject to very few stressors. The talus areas occupied by the carinate mountainsnail may be negatively affected by activities that destabilize talus or by activities adjacent to talus areas such as timber harvest, fire, or weed spraying (Hendricks, 2003).

Environmental consequences

Alternative A

The 1986 forest plan did not have management direction for invertebrates, but management direction for soils and downed woody material helps to protect mollusk habitat.

Alternatives B modified, C, and D

Plan components to maintain ecosystem diversity and key ecosystem characteristics would meet the needs of most invertebrates on the Forest, including the mountainsnails. In addition, alternatives B modified, C, and D include one guideline to protect known locations of the carinate mountainsnail. Guideline GA-SV-GDL-02 states that, in order to protect this invertebrate species, talus slopes with known populations of the carinate mountainsnail should not be used as a gravel or ornamental rock source and immediately adjacent vegetation should not be harvested or sprayed for non-native invasive weeds.

Cumulative effects

This species is also known to occur in the Mission Range, within the Mission Mountains Tribal Wilderness of the Confederated Salish and Kootenai Tribes, where there are no known threats other than a nonmotorized trail (Hendricks, 2003).

3.7.9 Pollinators

Introduction

Pollinators include bees, beetles, bats, birds, butterflies, flies, moths, and wasps. At the national level, a Federal strategy to promote the health of pollinators was initiated by a presidential memorandum in June of 2014 (The White House, 2014) that recognized the importance of pollinators to the economy of the United States and the serious declines of some pollinator species in recent years. Pollinators face several stressors. Although researchers have not determined the specific cause of pollinator decline, they have developed a list of pressures that are thought to cause individual illness and population crashes (see the Forest assessment for more details), which include habitat conversion on private lands, malnutrition, pests, and pathogens.

Affected environment

There have not been any research studies specifically on pollinators in the Flathead Valley and surrounding areas (see the Forest assessment for more details).

The Forest Service has responded to the required accomplishments outlined in the May 18, 2015, release from the White House regarding the national strategy to promote the health of honey bees and other pollinators (USDA, 2015d). The Forest Service response included documents identifying and prioritizing native plant species that are most beneficial to pollinators for consideration in native plant restoration activities and for integration into seed collection programs (USDA, 2015d). This guidance is incorporated into the native plant species programs of the Flathead National Forest.

Key stressors

Land management

USFS land management activities that may affect pollinators include ground disturbance and the use of pesticides and herbicides for the control of invasive species. Ground disturbance that occurs during vegetation management activities can disturb or remove pollinators' ground nests and tree or snag nests.

Pests and pathogens

Pollinators have their own pests and diseases. For example, the well-publicized colony collapse disorder has affected honeybee hives in recent years. Several possible causes have been identified, but none have been determined to be the definitive cause of the decline. There is evidence that honeybee colonies go through cycles of collapse without known causes. Current collapses are in the 30 to 40 percent range, which is significant. Mites have been introduced from Europe, as well as gut fungus and viruses, and these have contributed to further declines. The mites are thought to spread viruses between hosts. Although these effects are seen in apiaries, wild bees can also be infected when they intermix with mites.

Climate change

Climate change can affect the range of pollinators, the range of their food (native plants), the timing of their food, e.g., the phenology, or periodic life cycle, of wildflowers shifting to earlier in the season). There is some debate as to whether pollinators shift with their key plant species. Plant species have been observed over the past couple of decades shifting spatially toward the poles as well as flowering earlier in the growing season. Some habitats are more affected than others, depending on abiotic factors such as precipitation, photoperiodicity, and temperature.

Environmental consequences

Alternative A

The 1986 forest plan did not have management direction for pollinators, but management direction for soils and snags would protect pollinator habitat.

Alternatives B modified, C, and D

The action alternatives are built on the principle that by restoring and maintaining the key ecosystem characteristics, conditions, and functionality of native ecosystems and managing for additional needs of key species, the Forest will be able to maintain and improve ecosystem diversity and integrity, provide for the habitat needs of diverse plant and animal species on the Forest, and support the persistence of native species. This coarse-filter approach focuses on providing the range of vegetation and habitat conditions consistent with the natural range of variation, with the expectation that the needs and functional capacity of most organisms and processes would be fulfilled by managing key ecosystems/characteristics and ecological conditions at the landscape scale. There is little information related to specific types, conditions, or needs for pollinator species on the Flathead. The coarse-filter plan components in the terrestrial vegetation section of the plan are based upon an estimated natural range of variation and are expected to provide for the habitat needs of native invertebrate species, including pollinators. Ecosystem plan components would meet the needs of pollinator species.

In addition, alternatives B modified, C, and D include a desired condition to provide for pollinators. All action alternatives include desired condition FW-DC-POLL-01: "Ecological processes create vegetation conditions and patterns across the Forest that are consistent with the natural range of variation. These processes support plant communities composed of a diverse mix of native grass, forb, shrub, and tree species, providing foraging habitat for native pollinator species such as butterflies, bees, and hummingbirds."

Introduced, invasive plant species can displace rare species through competitive displacement. Indirect impacts include herbicide spraying and mechanical ground disturbance to control noxious weeds once they gain a foothold. Competition from invasive non-native species and noxious weeds can result in loss of habitat or loss of pollinators. Few studies have been done on the effects of herbicides to pollinators. Even though herbicides are sprayed on the Forest for the sole purpose of controlling invasive plants, they may also affect native vegetation that is in the path of the herbicide if it is not carefully applied, which reduces insect forage. Herbicide spraying can indirectly kill populations of native pollinators by contaminating nesting materials and pollen resources. Much of the chemical treatment on the Forest is restricted to roadsides, gravel pits, landings, trails and campgrounds, so any potential effects are localized to these areas.

Regarding the risk of weed invasion and control of populations, the alternatives differ in some ways. All the action alternatives contain forestwide desired conditions that address invasive plant species and their treatment and control (see the forest plan section titled "Non-Native Invasive Plants/Noxious Weeds"). Integrated pest management approaches would be used, including best management practices that limit the introduction, intensification, and spread of non-native invasive plants due to management activities. Areas requiring revegetation would use locally adapted, native plant species where feasible and appropriate. Desired condition FW-DC-P&C-17 states, "Cooperation and coordination occurs with adjacent landowners to identify and manage non-native invasive weeds." Because roads and machinery can be vectors for weeds, alternatives A, B modified, and D, with their emphasis on a higher level and rate of vegetation management that would involve the use of roads and machinery, would be expected to require the highest level of effort to control weeds. Alternative C would likely require the least effort.

Standards and guidelines for limiting soil disturbance during vegetation management activities would also be beneficial to ground-nesting pollinator species by limiting ground disturbance (see the "Soils and Geology" section in chapter 2 of the plan). Forest plan direction associated with snag and downed wood retention would be beneficial to pollinator species that nest in snags and dead wood by maintaining levels of snags and downed wood within desired ranges (see FW-STD-TE&V-03 and associated standards within each geographic area).

Cumulative effects

Pollinators are in decline nationwide due to a combination of threats, including the introduction of non-native species or pathogens, loss of habitat (decline of quality or quantity), pesticides, and climate change. Commercially reared bumble bees used to pollinate crops and plants in greenhouses are infected with parasites that have been imported from other countries. The spread of non-native mites and virus species has severely compromised honeybee colonies and may spread to native pollinators on NFS lands from nearby communities.

Non-native plants grown on private lands, as well as non-native invasive species found on all lands, can also decrease pollinator habitat quality. Although the conversion of native plant communities to agricultural lands benefits some native pollinators, it can decrease the habitat quality for others. Pesticides used to protect seeds or kill tree-killing insects, as well as the drift of pesticides sprayed on crops on private lands, can kill pollinators directly. Precautions are taken during Forest pesticide application to limit the drift of spray in order to limit direct mortality of pollinators. Pesticides or herbicides can also be harmful in sublethal amounts by impeding pollinator foraging ability. Chemicals that do not quickly break down in the environment can be especially harmful.

Climate change is expected to change the composition of pollinator communities, but the nature of the effects and whether the pollinators can adapt to these changes are uncertain. Anecdotal observations have shown that some bee species adapted to warm climates are expanding their ranges northward (Great Pollinator Project, 2014).

References

Adams, L. (1959). An analysis of a population of snowshoe hares in northwestern Montana. *Ecological Monographs, 29*(2), 141-170. Retrieved from <Go to ISI>://WOS:A1959WV72100003, http://www.jstor.org/stable/1942201?origin=crossref, http://www.jstor.org/stable/1942201?origin=JSTOR-pdf.

Ake, K. (2015a). *Modeling for alternative A: Fully meets 19-19-68 for BMU subunits with more than 75% NFS lands [Flathead National Forest]*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00172.

Ake, K. (2015b). *Summary of Rick Mace's 2014 grizzly bear denning grids*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00175.

Ake, K. (2017a). *2015 NCDE motorized access monitoring report for Grizzly Bear Conservation Strategy*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00673.

Ake, K. (2017b). *Background information on methods used to calculate numbers from GIS data: Flathead National Forest revised plan*. Kalispell, MT: F. N. F. USDA Forest Service. Planning record exhibit # 00616.

Ake, K. (2017c). *Documentation of draft 2016 amendment 19 report*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00668.

Ake, K., & Kuennen, R. (2017). *Background information on NCDE Grizzly Bear Conservation Strategy allowable increase in route density and decrease in core for projects, 5-3-2*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00669.

Ament, R., Callahan, R., McClure, M., Reuling, M., & Tabor, G. (2014). *Wildlife connectivity: Fundamentals for conservation action*. Bozeman, MT: Center for Large Landscape Conservation. Retrieved from http://largelandscapes.org/library/, http://largelandscapes.org/media/publications/Wildlife-Connectivity-Fundamentals-for-Conservation-Action.pdf.

Anderson, A., & Turnock, B. (2012). *Black swift (Cypseloides niger) surveys in northwest Montana 2012*. Kalispell, MT: Montana Fish, Wildlife and Parks. Planning record exhibit # 00350.

Anderson, C. R., Ternent, M. A., & Moody, D. S. (2002). Grizzly bear-cattle interactions on two grazing allotments in northwest Wyoming. *Ursus, 13*, 247-256. Retrieved from http://www.bearbiology.com/index.php?id=ursvol13_10, http://www.bearbiology.com/fileadmin/tpl/Downloads/URSUS/Vol_13/Anderson_13.pdf.

Anderson, S. (2009). *Biological assessment for terrestrial wildlife species: Forest plan amendment #19, allowable sale quantity and objectives and standards for grizzly bear habitat management; Revised implementation schedule*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00344.

Aubry, K. B., Koehler, G. M., & Squires, J. R. (1999). Ecology of Canada lynx in southern boreal forests. In L. F. Ruggiero, K. B. Aubry, S. W. Buskirk, G. M. Koehler, C. J. Krebs, K. S. McKelvey, & J. R. Squires (Eds.), *Ecology and Conservation of Lynx in the United States, General Technical Report RMRS-GTR-30WWW.* (pp. 373-396): USDA, Forest Service, Rocky Mountain Research Station. Retrieved from https://www.fs.fed.us/rm/pubs/rmrs_gtr030.html, https://www.treesearch.fs.fed.us/pubs/4546.

Aubry, K. B., & Raley, C. M. (2002). The pileated woodpecker as a keystone habitat modifier in the Pacific Northwest. In W. F. Laudenslayer, Jr., P. J. Shea, B. E. Valentine, C. P. Weatherspoon, & T. E. Lisle (Eds.), *Proceedings of the symposium on the ecology and management of dead wood in western forests, 1999 November 2-4, Reno, Nevada. General Technical Report PSW-181* (pp. 257-274). Albany, CA: USDA Forest Service, Pacific Southwest Station. Retrieved from http://www.fwspubs.org/doi/suppl/10.3996/042013-JFWM-031/suppl_file/042013-jfwm-031r-s04.pdf, http://www.treesearch.fs.fed.us/pubs/6718.

Aune, K., & Kasworm, W. (1989). *Final report: East Front grizzly studies*. Helena, MT: Montana Fish, Wildlife and Parks. Planning record exhibit # 00573.

Ballensky, J. (2011). *Caves of Montana survey*. Planning record exhibit # 00171.

Bartlein, P. J., Whitlock, C., & Shafter, S. L. (1997). Future climate in the Yellowstone National Park region and its potential impact on vegetation. *Conservation Biology, 11*(3), 782-792. doi:10.1046/j.1523-1739.1997.95383.x. Retrieved from <Go to ISI>://WOS:A1997XD39400025, http://www.jstor.org/stable/2387438?seq=1#page_scan_tab_contents.

Bate, L. (2014a, August 4, 2014). [E-mail re: harlequin ducks]. Planning record exhibit # 00393.

Bate, L. (2014b). *Harlequin duck surveys along upper McDonald Creek, Glacier National Park, May-September 2014*.U.S. Department of the Interior, Glacier National Park, Division of Science and Resources Management. Planning record exhibit # 00375.

Bate, L. (2015, April 14, 2015). [E-mail from Lisa J. Bate, Glacier National Park, to Reed Kuennen, Flathead National Forest]. Planning record exhibit # 00392.

Bate, L. J. (1995). *Monitoring woodpecker abundance and habitat in the central Oregon Cascades.* (MS thesis), University of Idaho, Moscow. Planning record exhibit # 00531.

Bate, L. J. (2013). *Harlequin duck surveys along upper McDonald Creek, Glacier National Park, May-September 2013*.U.S. Department of the Interior, Glacier National Park, Division of Science and Resources Management.

Bate, L. J. (2015, April 7, 2015). [E-mail from Lisa J. Bate, Glacier National Park, to Reed Kuennen, Flathead National Forest, re: black swift colonies in Montana]. Planning record exhibit # 00091.

Beechie, T., Imaki, H., Greene, J., Wade, A., Wu, H., Pess, G., . . . Mantua, N. (2013). Restoring salmon habitat for a changing climate. *River Research and Applications, 29*(8), 939-960. doi:10.1002/rra.2590. Retrieved from <Go to ISI>://WOS:000325469700001.

Bell, H., Broderdorp, K., Cummings, J., Holt, B., McCollough, M., Parkin, M., . . . Zelenak, J. (2016). *Canada lynx expert elicitation workshop*. Bloomington, MN: U.S. Fish and Wildlife Service. Retrieved from https://www.fws.gov/mountain-prairie/es/species/mammals/lynx/SSA2016/Appendices/2016%2004%2018%20FINAL%20Lynx%20SSA%20EE%20Workshop%20Report%202%20jzeds.pdf.

Bertram, T. M. (2007). *Biological assessment (revised) of the northern Rockies lynx amendment on threatened, endangered and proposed vertebrate and invertebrate species (revision of BA dated November 18, 2005)*. Missoula, MT: USDA Forest Service, Northern Region. Planning record exhibit # 00340.

BHSCC. (2013). *HOBO data logger deployment, soil sampling, and bat roost observations for 6 caves in the Trail Creek drainage, Flathead National Forest, Flathead County, Montana*. Bigfork, MT: Bigfork High School Cave Club. Planning record exhibit # 00225.

BHSCC. (2014). *Bat roost and bat sign observations for three caves near Spotted Bear Ranger Station, Flathead National Forest, Montana*. Bigfork, MT: Bigfork High School Cave Club. Planning record exhibit # 00221.

Biggins, D. E. (1975). *Seasonal habitat selection and movements of the Spotted Bear elk herd.* (MS thesis), University of Montana. Retrieved from http://scholarworks.umt.edu/etd/6487/.

Blanchard, B. M., & Knight, R. R. (1996). Effects of wildfire on grizzly bear movements and foraging strategies. In J. M. Greenlee (Ed.), *Proceedings of the second biennial scientific conference on the Greater Yellowstone Ecosystem.* (pp. 117-122). Fairfield, WA: International Association of Wildland Fire.

Bond, J. C., Iverson, S. A., Maccallum, N. B., Smith, C. M., Bruner, H. J., & Esler, D. (2009). Variation in breeding season survival of female harlequin ducks. *Journal of Wildlife Management, 73*(6), 965-972. doi:10.2193/2008-236. Retrieved from http://dx.doi.org/10.2193/2008-236.

Boulanger, J., & Stenhouse, G. B. (2014). The impact of roads on the demography of grizzly bears in Alberta. *PLoS ONE, 9*(12), 22. doi:10.1371/journal.pone.0115535. Retrieved from <Go to ISI>://WOS:000348845100074, http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0115535.

Boyd-Heger, D. K. (1997). *Dispersal, genetic relationships, and landscape use by colonizing wolves in the central Rocky Mountains.* (PhD dissertation), University of Montana, Missoula, MT. Retrieved from http://scholarworks.umt.edu/cgi/viewcontent.cgi?article=11548&context=etd.

Bradley, L., Gude, J., Lance, N., Laudon, K., Messer, A., Nelson, A., . . . Steuber, J. (2014). *Montana gray wolf conservation and management: 2013 annual report*. Helena, MT: Montana Fish, Wildlife and Parks. Retrieved from http://fwp.mt.gov/wolf, http://fwp.mt.gov/fishAndWildlife/management/wolf/.

Bradley, L., Gude, J., Lance, N., Laudon, K., Messner, A., Nelson, A., . . . Vore, J. (2015). *Montana gray wolf conservation and management: 2014 annual report*. Helena, MT: Montana Fish, Wildlife and Parks. Retrieved from http://fwp.mt.gov/fishAndWildlife/management/wolf/.

Braithwaite, N. T., & Mallik, A. U. (2012). Edge effects of wildfire and riparian buffers along boreal forest streams. *Journal of Applied Ecology, 49*(1), 192-201. doi:10.1111/j.1365-2664.2011.02076.x. Retrieved from <Go to ISI>://WOS:000299153800023.

Brewer, L. T., Bush, R., Canfield, J. E., & Dohmen, A. R. (2009). *Northern goshawk Northern Region overview: Key findings and project considerations*. Missoula, MT: USDA Forest Service, Northern Region, Northern Goshawk Working Group. Retrieved from http://fsweb.r1.fs.fed.us/wildlife/wwfrp/TESnew.htm.

Broderdorp, K. (2016). *2016 lynx vehicle mortalities in Colorado, Minnesota, Maine, Montana, Idaho, and Washington*. Planning record exhibit # 00444.

Brown, J. (2006). *Moose management in northwest Montana: Region One annual report July 1 2005-June 30, 2006*.Montana Fish, Wildlife and Parks. Planning record exhibit # 00527.

Bull, E. L. (2006). Sexual differences in the ecology and habitat selection of western toads (*Bufo Boreas*) in northeastern Oregon. *Herpetological Conservation and Biology, 1*(1), 27-38. Retrieved from https://www.treesearch.fs.fed.us/pubs/viewpub.jsp?index=27199, https://www.fs.fed.us/pnw/pubs/journals/pnw_2006_bull001.pdf.

Bull, E. L., & Holthausen, R. S. (1993). Habitat use and management of pileated woodpeckers in northeastern Oregon. *Journal of Wildlife Management, 57*(2), 335-345. doi:10.2307/3809431. Retrieved from <Go to ISI>://WOS:A1993LA01200018, http://www.jstor.org/stable/3809431, http://www.jstor.org/stable/pdf/3809431.pdf.

Bull, E. L., Nielsen-Pincus, N., Wales, B. C., & Hayes, J. L. (2007). The influence of disturbance events on pileated woodpeckers in northeastern Oregon. *Forest Ecology and Management, 243*(2-3), 320-329. doi:10.1016/j.foreco.2007.03.031. Retrieved from <Go to ISI>://WOS:000247113400016, http://www.sciencedirect.com/science/article/pii/S0378112707002460, http://ac.els-cdn.com/S0378112707002460/1-s2.0-S0378112707002460-main.pdf?_tid=97048870-ceab-11e5-9fed-00000aab0f01&acdnat=1454967387_50651d92cd28b6367254a852b5034e53.

Bunnell, F. L., & Houde, I. (2010). Down wood and biodiversity--Implications to forest practices. *Environmental Reviews, 18*, 397-421. doi:10.1139/A10-019. Retrieved from <Go to ISI>://WOS:000285680400021.

Bunnell, F. L., Wind, E., & Wells, R. (2002). *Dying and dead hardwoods: Their implications to management*. Albany, CA: PSW Research Station. Retrieved from https://www.fs.fed.us/psw/publications/documents/gtr-181/052_BunnellWind.pdf.

Bureau, M. J. (1992). *Mortality and seasonal distribution of elk in an area recently recolonized by wolves.* (MS thesis), University of Montana. Retrieved from http://scholarworks.umt.edu/etd/7000/.

Bush, R., & Lundberg, R. (2008). *Wildlife habitat estimate updates for the Region One conservation assessment*. Missoula, MT: USDA Forest Service, Region One, Forest and Range Management. Retrieved from https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5130739.pdf.

Buskirk, S. W., & Powell, R. A. (1994). Habitat ecology of fishers and American martens. In S. W. Buskirk, A. S. Harestad, M. G. Raphael, & R. A. Powell (Eds.), *Martens, sables, and fishers: Biology and conservation.* (pp. 283-396). Ithaca, NY: Cornell University Press.

Buskirk, S. W., & Ruggiero, L. F. (1994). American marten. In L. F. Ruggiero, K. B. Aubry, S. W. Buskirk, L. J. Lyon, & W. J. Zielinski (Eds.), *The scientific basis for conserving forest carnivores, American marten, fisher, lynx, and wolverine in the western United States. General Technical Report RM-254* (pp. 7-37). Fort Collins, CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Retrieved from https://www.fs.fed.us/rm/pubs_rm/rm_gtr254.pdf.

Byrd, A., Kneeland, M., Persico, C., & Evers, D. (2015). *Montana common loon (Gavia immer): Summary report, 2014*. Portland, ME: Biodiversity Research Institute. Retrieved from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwiowbLkqIzLAhUC7mMKHcI3ArMQFggcMAA&url=http%3A%2F%2Ffwp.mt.gov%2FfwpDoc.html%3Fid%3D69419&usg=AFQjCNF-486qaQDOoqjou1azLF-mLu1cNw&bvm=bv.114733917,d.cGc.

Camel-Means, W. (2016). [Email to R. Kuennen Sept. 20, 2016, re: updated survey information or reports on various wildlife species]. Planning record exhibit # 00405.

Canfield, J. E., Lyon, L. J., Hillis, J. M., & Thompson, M. J. (1999). Ungulates. In G. Joslin & H. Youmans (Eds.), *Effects of recreation on Rocky Mountain wildlife: A review for Montana.* (pp. 6.1-6.25): Committee on Effects of Recreation on Wildlife, Montana Chapter of the Wildlife Society. Retrieved from http://www.montanatws.org/, http://www.montanatws.org/pages/page4.html, http://www.montanatws.org/pages/page4a.html.

Carey, A. B. (1996). Interactions of Northwest forest canopies and arboreal mammals. *Northwest Science, 70*, 72-78. Retrieved from <Go to ISI>://WOS:A1996VG98200011.

Casey, D. (2000). *Partners in flight bird conservation plan Montana*. Kalispell, MT: American Bird Conservancy. Planning record exhibit # 00351.

Casey, D. (2004). *Coordinated bird monitoring in Montana: Special species monitoring--Black swift*. Kalispell, MT: American Bird Conservancy.

Casey, D. (2004). *Potential nesting waterfalls of black swifts*. Planning record exhibit # 00217.

Casey, D., Altman, B., & Stringer, D. (2013). *Land manager's guide to cavity-nesting bird habitat and populations in ponderosa pine forests of the Pacific Northwest*. Retrieved from http://www.sfiprogram.org/files/pdf/ponderosapinebirdguidepdf/.

Casey, D., Bissell, G. N., & Batts, J. (2016). *Raptor migration monitoring in the Jewel Basin autumn 2015: Annual report*. Kalispell, MT: USDA Forest Service, Flathead National Forest, and Flathead Audubon Society. Planning record exhibit # 00216.

Cassirer, E. F., & Groves, C. R. (1994). *Ecology of harlequin ducks in northern Idaho*. Boise, ID: Idaho Department of Fish and Game. Retrieved from https://fishandgame.idaho.gov/ifwis/idnhp/cdc_pdf/U94CAS01.pdf.

Cassirer, E. F., Reichel, J. D., Wallen, R. L., & Atkinson, E. C. (1996). *Harlequin duck (Histrionicus histrionicus) conservation assessment and strategy for the U.S. Rocky Mountains*. Lewiston, ID: Idaho Department of Fish and Game, Nongame and Endangered Wildlife Program. Retrieved from https://ia600204.us.archive.org/23/items/harlequinduckhis00cassrich/harlequinduckhis00cassrich.pdf.

Chadde, S. W., Shelly, J. S., Bursik, R. J., Moseley, R. K., Evenden, A. G., Mantas, M., . . . Heidel, B. (1998). *Peatlands on national forests of the northern Rocky Mountains: Ecology and conservation*. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station. Retrieved from https://www.fs.fed.us/rm/pubs/rmrs_gtr011.pdf, https://www.treesearch.fs.fed.us/pubs/32030.

Chadwick, D. H. (1977). Ecology of the Rocky Mountain goat in Glacier National Park and the Swan Mountains, Montana: Final report. Glacier National Park. Retrieved from http://www.npshistory.com/publications/glac/chadwick/index.htm#characteristics).

Cheng, E., Hodges, K., & Mills, L. (2015). Impacts of fire on snowshoe hares in Glacier National Park. *Fire Ecology, 11*(2), 119-136. Retrieved from https://research.cnr.ncsu.edu/sites/millslab/wp-content/uploads/sites/13/2015/10/Cheng-et-al-Glacier-FIRE-ecology.pdf.

Chew, J. D., Moeller, K., & Stalling, C. (2012). *SIMPPLLE Version 2.5 user's guide*. Fort Collins, CO: USDA Forest Servie, Rocky Mountain Research Station. Retrieved from https://www.treesearch.fs.fed.us/pubs/40241.

Choate, T. S. (1963). Habitat and population dynamics of white-tailed ptarmigan in Montana. *Journal of Wildlife Management, 27*(4), 684-699. doi:10.2307/3798485. Retrieved from http://www.jstor.org/stable/3798485, http://www.jstor.org/stable/pdf/3798485.pdf. Planning record exhibit # 00352.

Christensen, A. G., Lyon, L. J., & Unsworth, J. W. (1993). *Elk management in the Northern Region: Considerations in forest plan updates or revisions*. Ogden, UT: USDA Forest Service, Intermountain Research Station. Retrieved from https://www.fs.fed.us/rm/pubs_int/int_gtr303.pdf.

Cilimburg, A. (2006). *Northern Region Landbird Monitoring Program: 2005 flammulated owl surveys*. Missoula, MT: University of Montana, Avian Science Center,, Division of Biological Sciences. Planning record exhibit # 00391.

Clarkson, P. (1992). *A preliminary investigation into the status and distribution of harlequin ducks in Jasper National Park*. Planning record exhibit # 00353.

Clevenger, A. P., & Waltho, N. (2005). Performance indices to identify attributes of highway crossing structures facilitating movement of large mammals. *Biological Conservation*, *121*(3), 453-464. doi:10.1016/j.biocon.2004.04.025. Retrieved from <Go to ISI>://WOS:000224662100013, http://www.sciencedirect.com/science/article/pii/S0006320704002319.

Clough, L. T. (2000). *Nesting habitat selection and productivity of northern goshawks in west-central Montana.* (MS thesis), University of Montana, Missoula, MT. Planning record exhibit # 00354.

Coleman, K., & Kuennen, R. (2013). *Terrestrial animal species that may occur on the Flathead National Forest: Initial assessment of potential SCC status, June 6, 2013*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00182.

Conway, L., & Hanvey, G. (2017). *Biological assessment for Canada lynx designated critical habitat: Northern Rockies Lynx Management Direction, with updated appendices 2 and 3*. Missoula, MT: USDA Forest Service, Northern Region. Planning record exhibit # 00644.

Cook, R. C. (2011). *A multi-regional evaluation of nutritional condition and reproduction in elk.* (PhD dissertation), Washington State University. Planning record exhibit # 00132.

Copeland, J. P. (1996). *Biology of the wolverine in central Idaho.* University of Idaho, Moscow, ID. Retrieved from https://www.researchgate.net/profile/Jeffrey_Copeland/publication/34538098_Biology_of_the_wolverine_in_Central_Idaho/links/00463529a13d401802000000.pdf.

Copeland, J. P., McKelvey, K. S., Aubry, K. B., Landa, A., Persson, J., Inman, R. M., . . . May, R. (2010). The bioclimatic envelope of the wolverine (*Gulo gulo*): Do climatic constraints limit its geographic distribution? *Canadian Journal of Zoology*, *88*(3), 233-246. doi:10.1139/Z09-136. Retrieved from http://www.nrcresearchpress.com/doi/abs/10.1139/Z09-136#.Vpff0nLUhLN.

Copeland, J. P., Peek, J. M., Groves, C. R., Melquist, N. E., Mckelvey, K. S., Mcdaniel, G. W., . . . Harris, C. E. (2007). Seasonal habitat associations of the wolverine in central Idaho. *Journal of Wildlife Management*, *71*(7), 2201-2212. doi:10.2193/2006-559. Retrieved from http://www.bioone.org/doi/abs/10.2193/2006-559, http://dx.doi.org/10.2193/2006-559

Copeland, J. P., & Yates, R. E. (2006). *Wolverine population assessment in Glacier National Park*. The Ecology and Management of Wildlife and Habitats, RWU 4201. Missoula, MT: USDA Forest Service, Rocky Mountain Research Station. Planning record exhibit # 00355.

COSEWIC. (2010). *Assessment and status report on the flammulated owl (Otus flammeolus) in Canada*. Ottawa, Canada: Committee on the Status of Endangered Wildlife in Canada. Retrieved from http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr_Flammulated%20Owl_0810_e.pdf.

Costello, C. M., Mace, R. D., & Roberts, L. L. (2016). *Grizzly bear demographics in the Northern Continental Divide Ecosystem, Montana: Research results (2004–2014) and suggested techniques for management of mortality*. Helena, MT: Montana Department of Fish, Wildlife and Parks. Retrieved from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0ahUKEwiy_cb7oO7NAhUQ5GMKHXE4B-cQFggiMAE&url=http%3A%2F%2Ffwp.mt.gov%2FfwpDoc.html%3Fid%3D75547&usg=AFQjCNFdVMLXWJsfWn6RksuSEgnNZ9VdBw&bvm=bv.126130881,d.cGc.

Craighead, J. J., & Mitchell, J. A. (1982). Grizzly bear. In J. A. Chapman & G. A. Feldhamer (Eds.), *Wild mammals of North America.* (pp. 515-556). Baltimore, MD: The Johns Hopkins University Press.

CSKT. (2013). *Confederated Salish and Kootenai Tribes of the Flathead Reservation: Climate change strategic plan*. Retrieved from http://nrd.csktribes.org/component/rsfiles/download?path=EP%252FCSKT.Climate.Change.Adaptation.Plan.pdf.

Curry, J., Holmquist, L., Jacobs, A., Kuennen, R., Reichenberg, S., Ruby, M., & Yates, R. (2016). *Flathead National Forest, Northwest Crown of the Continent forest carnivore inventory progress report, 2013-2016*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00456.

Cushman, S. A., McKelvey, K. S., Flather, C. H., & McGarigal, K. (2008). Do forest community types provide a sufficient basis to evaluate biological diversity? *Frontiers in Ecology and the Environment, 6*(1), 13-17. doi:10.1890/070039. Retrieved from http://www.esajournals.org/doi/abs/10.1890/070039, http://dx.doi.org/10.1890/070039.

DeCesare, N., & Newby, J. (2016). *Vital rates, limiting factors and monitoring methods for moose in Montana: Annual report, September 1, 2016*. Helena, MT: Montana Fish, Wildlife and Parks. Retrieved from http://fwp.mt.gov/fishAndWildlife/diseasesAndResearch/research/moose/populationsMonitoring/ . Planning record exhibit # 00528.

DeCesare, N. J., Smucker, T. D., Garrott, R. A., & Gude, J. A. (2014). Moose status and management in Montana. *Alces, 50*, 35-51. Retrieved from http://alcesjournal.org/index.php/alces/issue/view/11, http://alcesjournal.org/index.php/alces/article/view/123.

Devineau, O., Shenk, T. M., White, G. C., Doherty, P. F., Lukacs, P. M., & Kahn, R. H. (2010). Evaluating the Canada lynx reintroduction programme in Colorado: Patterns in mortality. *Journal of Applied Ecology, 47*(3), 524-531. doi:10.1111/j.1365-2664.2010.01805.x. Retrieved from <Go to ISI>://WOS:000277168000003, http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2664.2010.01805.x/epdf.

Dixon, R. D., & Saab, V. A. (2000). Black-backed woodpecker (*Picoides arcticus*). In A. Poole (Ed.), *The birds of North America online*. Ithaca, NY: The Birds of North America, Inc. and Cornell Lab of Ornithology. Retrieved from http://bna.birds.cornell.edu/bna/species/509/articles/introduction, http://www.allaboutbirds.org/guide/Black-backed_Woodpecker/lifehistory.

Dudley, J. G., & Saab, V. A. (2007). Home range size of black-backed woodpeckers in burned forests of southwestern Idaho. *Western North American Naturalist, 67*(4), 593-600. Retrieved from http://www.rmrs.nau.edu/publications/dudley_saab_2007/dudley_saab_2007.pdf, http://www.jstor.org/stable/41717640.

Dusek, G., Wood, A., Hoekman, S., Sime, C., & Morgan, J. (2006). *White-tailed deer studies in the Salish Mountains, northwest Montana*. Helena, MT: Montana Fish, Wildlife & Parks. Retrieved from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwi70cLx-57QAhUBDywKHfH7A6gQFggbMAA&url=http%3A%2F%2Ffwp.mt.gov%2FfwpDoc.html%3Fid%3D57851&usg=AFQjCNHywLZXMq8spU2ZFzsv2BQZbLyCiA&bvm=bv.138169073,d.bGg.

Esler, D., Bowman, T. D., Trust, K. A., Ballachey, B. E., Dean, T. A., Jewett, S. C., & O'Clair, C. E. (2002). Harlequin duck population recovery following the 'Exxon Valdez' oil spill: Progress, process and constraints. *Marine Ecology Progress Series, 241*, 271-286. doi:DOI 10.3354/meps241271. Retrieved from <Go to ISI>://WOS:000179145900024.

Evers, D. C. (2014). *Conserve the call: Identifying and managing environmental threats to the common loon*. Portland, ME: Biodiversity Research Institute. Retrieved from http://www.briloon.org/uploads/Library/item/266/file/ConserveTheCall.pdf.

Fagre, D. B., Peterson, D. L., & Hessl, A. E. (2003). Taking the pulse of mountains: Ecosystem responses to climatic variability. *Climatic Change, 59*(1-2), 263-282. doi:10.1023/A:1024427803359. Retrieved from <Go to ISI>://WOS:000183702700013, http://link.springer.com/article/10.1023%2FA%3A1024427803359.

Fayt, P., Machmer, M. M., & Steeger, C. (2005). Regulation of spruce bark beetles by woodpeckers--A literature review. *Forest Ecology and Management, 206*(1-3), 1-14. Retrieved from <Go to ISI>://WOS:000226569200001.

Fellers, G. M., & Pierson, E. D. (2002). Habitat use and foraging behavior of Townsend's big-eared bat (*Corynorhinus townsendii*) in coastal California. *Journal of Mammalogy, 83*(1), 167-177.

doi:10.1644/1545-1542(2002)083<0167:Huafbo>2.0.Co;2. Retrieved from <Go to ISI>://WOS:000174042000017, http://www.bioone.org/doi/abs/10.1644/1545-1542%282002%29083%3C0167%3AHUAFBO%3E2.0.CO%3B2, http://www.bioone.org/doi/full/10.1644/1545-1542%282002%29083%3C0167%3AHUAFBO%3E2.0.CO%3B2.

Festa-Bianchet, M., Urquhart, M., & Smith, K. B. (1994). Mountain goat recruitment: Kid production and survival to breeding age. *Canadian Journal of Zoology*, *72*, 22-27. doi:10.1139/z94-004. Retrieved from http://www.nrcresearchpress.com/doi/abs/10.1139/z94-004#.WEA-5nK7qAY.

Fiedler, C. E., & McKinney, S. T. (2014). Forest structure, health, and mortality in two Rocky Mountain whitebark pine ecosystems: Implications for restoration. *Natural Areas Journal*, *34*(3), 290-299. doi:http://dx.doi.org/10.3375/043.034.0305. Retrieved from <Go to ISI>://WOS:000342875900005.

Finch, D. M. (1991). *Population ecology, habitat requirements, and conservation of neotropical migratory birds*. GTR-RM-205. Fort Collins, CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Retrieved from https://www.fs.fed.us/rm/pubs_rm/rm_gtr205.pdf.

Fisher, J. T., Anholt, B., Bradbury, S., Wheatley, M., & Volpe, J. P. (2013). Spatial segregation of sympatric marten and fishers: The influence of landscapes and species-scapes. *Ecography, 36*, 240-248. doi:10.1111/j.1600-0587.2012.07556.x. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/j.1600-0587.2012.07556.x/full.

Fisher, J. T., & Wilkinson, L. (2005). The response of mammals to forest fire and timber harvest in the North American boreal forest. *Mammal Review, 35*(1), 51-81. doi:10.1111/j.1365-2907.2005.00053.x. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2907.2005.00053.x/abstract;jsessionid=E1B6389B2FF9F31D56BA7526F6D8D716.f03t03, http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2907.2005.00053.x/epdf.

Forristal, C. D. (2009). *Influence of postfire salvage logging on black-backed woodpecker nest-site selection and nest survival.* (MS thesis), Montana State University, Bozeman, MT. Retrieved from http://scholarworks.montana.edu/xmlui/bitstream/1/1269/1/ForristalC0509.pdf.

Fortin, J. K., Rode, K. D., Hilderbrand, G. V., Wilder, J., Farley, S., Jorgensen, C., & Marcot, B. G. (2016). Impacts of human recreation on brown bears (*Ursus arctos*): A review and new management tool. *PLoS ONE*, *11*(1). doi:10.1371/journal.pone.0141983. Retrieved from <Go to ISI>://WOS:000367801400003.

Foster, B. R., & Rahs, E. Y. (1983). Mountain goat response to hydroelectric exploration in northwestern British Columbia. *Environmental Management, 7*(2), 189-197. doi:10.1007/Bf01867280. Retrieved from http://link.springer.com/article/10.1007/BF01867280.

Franklin, J. F., Spies, T. A., Van Pelt, R., Carey, A. B., Thornburgh, D. A., Berg, D. R., . . . Chen, J. (2002). Disturbances and structural development of natural forest ecosystems with silvicultural implications, using Douglas-fir forests as an example. *Forest Ecology and Management, 155*(1-3), 399-423. doi:10.1016/S0378-1127(01)00575-8. Retrieved from http://www.sciencedirect.com/science/article/pii/S0378112701005758.

Franklin, J. R., Berg, D. R., Thorburgh, D. A., & Tappeiner, J. C. (1997). Alternative silvicultural approaches to timber harvesting: Variable retention harvest systems. In K. A. Kohrm & J. F. Franklin (Eds.), *Creating a forestry for the 21st century*. (pp. 111-139). Washington, DC: Island Press.

Fuller, P. R. (1976). *Browse production and utilization on Spotted Bear Mountain winter range and seasonal movements of the Spotted Bear elk herd.* (MS thesis), University of Montana, Missoula, MT. Retrieved from http://scholarworks.umt.edu/etd/6476/.

Gage, E., & Cooper, D. J. (2013). *Historical range of variation assessment for wetland and riparian ecosystems, U.S. Forest Service Rocky Mountain Region*. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. Retrieved from https://www.treesearch.fs.fed.us/pubs/43268, https://www.fs.fed.us/rm/pubs/rmrs_gtr286.pdf.

Garner, T. W. J., Perkins, M. W., Govindarajulu, P., Seglie, D., Walker, S., Cunningham, A. A., & Fisher, M. C. (2006). The emerging amphibian pathogen *Batrachochytrium dendrobatidis* globally infects introduced populations of the North American bullfrog, *Rana catesbeiana*. *Biology*

Letters, 2(3), 455-459. doi:10.1098/rsbl.2006.0494. Retrieved from <Go to ISI>://WOS:000241863400037.

Genter, D. L., & Jurist, K. A. (1995). *Bats of Montana*. Helena, MT: Montana Natural Heritage Program, Montana Department of State Lands, Abandoned Mine Reclamation Bureau. Retrieved from http://mtnhp.org/Reports.asp?key=7, http://mtnhp.org/animal/reports/mammals/batsummary.pdf.

Gibeau, M., & Stevens, S. (2005). Grizzly bear response to human use. In S. Herrero (Ed.), *Biology, demography, ecology and management of grizzly bears in and around Banff National Park and Kananaskis Country: Final report of the Eastern Slopes Grizzly Bear Project 2005.* (pp. 181-192). Calgary, AB: University of Calgary, Faculty of Environmental Design. Retrieved from http://www.canadianrockies.net/grizzly/final_report.html.

Gibeau, M. L., Clevenger, A. P., Herrero, S., & Wierzchowski, J. (2002). Grizzly bear response to human development and activities in the Bow River watershed, Alberta, Canada. *Biological Conservation*, *103*(2), 227-236. doi:10.1016/S0006-3207(01)00131-8. Retrieved from <Go to ISI>://WOS:000173089600011.

Giddings, B. (2009). *Furbearer program statewide harvest and management report 2008-09, Montana*. Helena, MT: Montana Fish, Wildlife and Parks. Retrieved from http://fwp.mt.gov/hunting/trapping/default.html.

Giddings, B. (2012). *Flathead National Forest fisher trapping records 1982-2011*. Helena, MT: Montana Fish, Wildlife and Parks. Planning record exhibit # 00189.

Glacier National Park. (1999). *General management plan: Glacier National Park, a portion of Waterton-Glacier International Peace Park, Flathead and Glacier Counties, Montana*.USDI National Park Service, Glacier National Park. Retrieved from https://www.nps.gov/features/glac/plans.htm. Planning record exhibit # 00623.

Glacier National Park. (2013). *2013 black swift surveys, Glacier National Park*. MT: U.S. Department of the Interior, Glacier National Park. Planning record exhibit # 00374.

Gordon, S. M., & Wilson, S. F. (2004). Effect of helicopter logging on mountain goat behaviour in coastal British Columbia. *Biennial Symposium Northern Wild Sheep and Goat Council, 14*, 49-63. Planning record exhibit # 00642.

Graves, T., Chandler, R. B., Royle, J. A., Beier, P., & Kendall, K. C. (2014). Estimating landscape resistance to dispersal. *Landscape Ecology, 29*(7), 1201-1211. doi:10.1007/s10980-014-0056-5. Retrieved from <Go to ISI>://WOS:000339831300009.

Graves, T. A., Royle, J. A., Kendall, K. C., Beier, P., Stetz, J. B., & Macleod, A. C. (2012). Balancing precision and risk: Should multiple detection methods be analyzed separately in N-mixture models? *PLoS ONE, 7*(12). doi:10.1371/journal.pone.0049410. Retrieved from <Go to ISI>://WOS:000313236200015.

Great Pollinator Project. (2014, April 15, 2014). Major threats to pollinators. Retrieved from http://greatpollinatorproject.org/conservation/major-threats-to-pollinators.

Green, P., Joy, J., Sirucek, D., Hann, W., Zack, A., & Naumann, B. (2011). *Old-growth forest types of the Northern Region (1992, with errata through 2011)*. Missoula, MT: USDA Forest Service, Northern Region. Retrieved from http://fsweb.r1.fs.fed.us/forest/inv/project/old_growth.shtml. Planning record exhibit # 00504.

Greenwald, D. N., Crocker-Bedford, D. C., Broberg, L., Suckling, K. F., & Tibbitts, T. (2005). A review of northern goshawk habitat selection in the home range and implications for forest management in the western United States. *Wildlife Society Bulletin, 33*(1), 120-128.

Griffin, P. C. (2004). *Landscape ecology of snowshoe hares in Montana.* (PhD dissertation), University of Montana, Missoula, MT. Planning record exhibit # 00386.

Griffin, P. C., & Mills, L. S. (2007). Precommercial thinning reduces snowshoe hare abundance in the short term. *Journal of Wildlife Management, 71*(2), 559-564. doi:http://dx.doi.org/10.2193/2004-007. Retrieved from <Go to ISI>://WOS:000246250600031, http://www.bioone.org/doi/abs/10.2193/2004-007, http://www.bioone.org/doi/full/10.2193/2004-007.

Gruver, J. C., & Keinath, D. A. (2006). *Townsend's big-eared bat (Corynorhinus townsendii): A technical conservation assessment.*USDA Forest Service, Rocky Mountain Region. Retrieved from https://www.fs.fed.us/r2/projects/scp/assessments/townsendsbigearedbat.pdf, https://www.fs.usda.gov/detail/r2/landmanagement/?cid=stelprdb5177128.

Guscio, C. G., Hossack, B. R., Eby, L. A., & Corn, P. S. (2008). Post-breeding habitat use by adult boreal toads (*Bufo boreas*) after wildfire in Glacier National Park, USA. *Herpetological Conservation and Biology, 3*(1), 55-62. Retrieved from <Go to ISI>://WOS:000207806900006, http://www.fs.fed.us/rm/pubs_other/rmrs_2008_guscio_g001.pdf.

Habeck, J. R. (1990). Old-growth ponderosa pine western larch forests in western Montana: Ecology and management. *Northwest Environmental Journal, 6*(2), 271-292. Retrieved from <Go to ISI>://WOS:A1990EP07000003.

Haber, J., & Nelson, P. (2015). *Planning for connectivity: A guide to connecting and conserving wildlife within and beyond America's national forests*.Center for Large Landscape Conservation, Defenders of Wildlife, Wildlands Network, and Yellowstone to Yukon Conservation Initiative. Retrieved from http://www.defenders.org/publication/planning-connectivity.

Halofsky, J. E., Peterson, D. L., Dante-Wood, S. K., Hoang, L., Ho, J. J., & Joyce, L. A. (Eds.). (in press). *Climate change vulnerability and adaptation in the northern Rocky Mountains*. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station.

Hamann, B., Hohnston, H., Gobielle, J., Hillis, M., Johnson, S., Kelly, L., & McClelland, P. (1999). Birds. In G. Joslin & H. Youmans (Eds.), *Effects of recreation on Rocky Mountain wildlife: A review for Montana.* (pp. 3.1-3.34): Committee on Effects of Recreation on Wildlife, Montana Chapter of the Wildlife Society. Retrieved from http://www.montanatws.org/pages/page4a.html.

Hamer, D., & Herrero, S. (1987). Wildfire's influence on grizzly bear feeding ecology in Banff National Park, Alberta. *Bears: Their Biology and Management, 7*, 179-186. doi:10.2307/3872624.

Hammond, C. (2016, Sept. 15, 2016). [E-mail to Reed Kuennen]. Planning record exhibit # 00402.

Hammond, C. A. M. (2009). *Conservation plan for the common loon in Montana*. Kalispell, MT: Montana Department of Fish, Wildlife and Parks, Montana Common Loon Working Group. Retrieved from http://fwp.mt.gov/fishAndWildlife/management/commonLoon/.

Hammond, C. A. M., Mitchell, M. S., & Bissell, G. N. (2012). Management and conservation: Territory occupancy by common loons in response to disturbance, habitat, and intraspecific relationships. *The Journal of Wildlife Management, 76*(3), 645–651. doi:10.1002/jwmg.298. Retrieved from http://onlinelibrary.wiley.com/doi/10.1002/jwmg.298/full.

Hann, W. J., Jones, J. L., Karl, M. G. S., Hessburg, P. F., Keane, R. E., Long, D. G., . . . Smith, B. G. (1997). Landscape dynamics of the Basin. In T. M. Quigley & S. J. Arbelbide (Eds.), *An assessment of ecosystem components in the interior Columbia Basin and portions of the Klamath and Great Basins. General Technical Report PNW-GTR-405* (Vol. 2, pp. 338-1055). Portland, OR: USDA Forest Service, Pacific Northwest Research Station. Retrieved from http://www.icbemp.gov/spatial/metadata/aux_pdf/rxs_veg.pdf.

Hansen, W. K. (2014a). *Causes of annual reproductive variation and anthropogenic disturbance in harlequin ducks breeding in Glacier National Park, Montana.* (MS thesis), University of Montana, Missoula, MT. Retrieved from http://scholarworks.umt.edu/cgi/viewcontent.cgi?article=5313&context=etd.

Hansen, W. K. (2014b). HADU figures (Harlequin duck PowerPoint presentation). Planning record exhibit # 00218.

Hanvey, G. (2016). *Regional Office review: Canada lynx habitat mapping for the Flathead National Forest land and resource management plan revision*. Missoula, MT: USDA Forest Service, Northern Region. Planning record exhibit # 00234.

Harding, L., & Nagy, J. A. (1980). Responses of grizzly bears to hydrocarbon exploration on Richards Island, Northwest Territories, Canada. In C. J. Martinka & K. L. McArthur (Eds.), *Bears--Their biology and management : A selection of papers from the Fourth International Conference on Bear Research and Management, held at Kalispell, Montana, USA, February 1977. Bear Biology AssociationCconference Series No. 3* (pp. 277-280). Tonto Basin, AZ: Bear Biology Association. Retrieved from http://www.arlis.org/docs/vol1/Susitna/27/APA2731_excerpt.pdf.

Haroldson, M. A., Ternent, M. A., Gunther, K. A., & Schwartz, C. C. (2002). Grizzly bear denning chronology and movements in the Greater Yellowstone Ecosystem. *Ursus, 13*, 29-37. Retrieved from http://www.jstor.org/stable/3873184, http://www.jstor.org/stable/pdf/3873184.pdf?_=1466097792641.

Harris, R. B. (1999). *Abundance and characteristics of snags in western Montana forests*. General technical report RMRS-GTR-31. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station. Retrieved from https://www.treesearch.fs.fed.us/pubs/6047. Planning record exhibit # 00503.

Hauer, F. R., Locke, H., Dreitz, V. J., Hebblewhite, M., Lowe, W. H., Muhlfeld, C. C., . . . Rood, S. B. (2016). Gravel-bed river floodplains are the ecological nexus of glaciated mountain landscapes. *Science Advances, 2*(6). doi:10.1126/sciadv.1600026. Retrieved from <Go to ISI>://WOS:000380073800017.

Hayward, G. D., & Escano, R. E. (1989). Goshawk nest-site characteristics in western Montana and northern Idaho. *The Condor, 91*(2), 476-479. doi:10.2307/1368330. Retrieved from http://www.jstor.org/stable/1368330?origin=crossref, http://www.jstor.org/stable/1368330.

Hayward, G. D., & Verner, J. (1994). *Flammulated, boreal, and great gray owls in the United States: A technical conservation assessment*. Fort Collins, CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Retrieved from https://www.treesearch.fs.fed.us/pubs/28773, https://www.fs.fed.us/rm/pubs_rm/rm_gtr253.pdf.

Heffernan, L. (2015, Jan. 23). Updated white-nose syndrome map January 23, 2015. white-nose syndrome.org. Planning record exhibit # 00656.

Hegg, S. J., Murphy, K., & Bjornlie, D. (2010). Grizzly bears and snowmobile use: A summary of monitoring a grizzly bear den on Togwotee Pass. *Yellowstone Science, 18*(2), 23-28. Retrieved from http://www.nps.gov/yell/learn/yellowstone-science-issues.htm.

Heinemeyer, K. (2012). *Central Idaho wolverine and winter recreation research study, February, 2012, project update*. Salt Lake City, UT: Round River Conservation Studies.

Heinemeyer, K., & Squires, J. (2015). *Wolverine-winter recreation research project: Investigating the interactions between wolverines and winter recreation: 2015 progress report*. Salt Lake City, UT: Round River Conservation Studies. Retrieved from http://wolverinefoundation.org/resources/research-reports. Planning record exhibit # 00400.

Heinemeyer, K., & Squires, J. R. (2013). *Wolverine-winter recreation research project: Investigating the interactions between wolverines and winter recreation, 2013 progress report*. Salt Lake City, UT: Round River Conservation Studies. Retrieved from http://wolverinefoundation.org/wp-content/uploads/2014/03/Final-Idaho-Wolverine-Winter-Recreation-Project-2013-Progress-Report-16Nov13.pdf.

Heinemeyer, K., & Squires, J. R. (2014). *Wolverine-winter recreation research project: Investigating the interactions between wolverines and winter recreation, 2014 progress report*. Salt Lake City, UT: Round River Conservation Studies. Retrieved from http://wolverinefoundation.org/wp-content/uploads/2015/01/Wolverine-Winter-Recreation-Project-2014-Progress-Report-Final.pdf. Planning record exhibit # 00399.

Hejl, S. J., Newlon, K. R., McFadzen, M. E., Young, J. S., & Ghalambor, C. K. (2002). Brown creeper. In A. Poole & F. Gill (Eds.), *The birds of North America, no. 669.* Philadelphia, PA: The Birds of North America.

Hendricks, P. (2003). *Status and conservation management of terrestrial mollusks of special concern in Montana*. Helena, MT: Montana Natural Heritage Program. Planning record exhibit # 00593.

Hendricks, P. (2005). *Surveys for animal species of concern in northwestern Montana*. Helena, MT: Montana Natural Heritage Program. Retrieved from http://mtnhp.org/Reports.asp?key=9, https://archive.org/details/60AD4B1E-A917-4BBC-BA59-887AAA9C3B7E.

Hendricks, P. (2012). *A guide to the land snails and slugs of Montana*. Helena, MT: Montana Natural Heritage Program. Retrieved from http://mtnhp.org/Reports_OLD.asp?key=6, http://mtnhp.org/reports/MolluscFieldGuide.pdf.

Hendricks, P., & Maxell, B. A. (2005). *Bat surveys on USFS Northern Region lands in Montana: 2005*. Helena, MT: Montana Natural Heritage Program. Retrieved from http://mtnhp.org/Reports.asp?key=7, https://archive.org/details/C26F4981-9BB9-40DA-AA60-B3369E23F6CA, http://www.biodiversitylibrary.org/bibliography/57344#/summary.

Henjum, M. G. (1996). Maintaining ecological integrity of inland forest ecosystems in Oregon and Washington. *Wildlife Society Bulletin*, *24*(2), 227-232. Retrieved from <Go to ISI>://WOS:A1996VA17500010.

Herrero, J., & Herrero, S. (2000). *Management options for the Moraine Lake Highline Trail: Grizzly bears and cyclists*. Banff, AB: Parks Canada, Banff National Park. Planning record exhibit # 00446.

Herrero, S. (1985). *Bear attacks: Their causes and avoidance.* New York, NY: Nick Lyons Books/Winchester Press.

Herrero, S., & Higgins, A. (1999). Human injuries inflicted by bears in British Columbia: 1960-97. *Ursus, 11*, 209-218. Planning record exhibit # 00464.

Hessburg, P. F., Smith, B. G., Kreiter, S. D., Miller, C. A., Salter, R. B., McNicoll, C. H., & Hann, W. J. (1999). *Historical and current forest and range landscapes in the interior Columbia River Basin and portions of the Klamath and Great Basins. Part 1: Linking vegetation patterns and landscape vulnerability to potential insect and pathogen disturbances*. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. Retrieved from https://www.fs.fed.us/pnw/publications/pnw_gtr458/, https://www.treesearch.fs.fed.us/pubs/29638.

Hessburg, P. F., Smith, B. G., Salter, R. B., Ottmar, R. D., & Alvarado, E. (2000). Recent changes (1930s-1990s) in spatial patterns of interior northwest forests, USA. *Forest Ecology and Management*, *136*(1-3), 53-83. doi:10.1016/S0378-1127(99)00263-7. Retrieved from <Go to ISI>://WOS:000089165600005, http://www.sciencedirect.com/science/article/pii/S0378112799002637, http://ac.els-cdn.com/S0378112799002637/1-s2.0-S0378112799002637-main.pdf?_tid=c74375c8-3479-11e4-9752-00000aab0f01&acdnat=1409866016_af4de519632826d4cbafc11d328686f7.

Hillis, J. M., & Lockman, D. (2003). *American marten assessment*. Missoula, MT: Planning record exhibit # 00385.

Hillis, J. M., Thompson, M. J., Canfield, J. E., Lyon, L. J., Marcum, C. L., Dolan, P. M., & McCleerey, D. W. (1991). Defining elk security: The Hillis paradigm. In A. G. Christensen, L. J. Lyon, & T. N. Lonner (Eds.), *Proceedings of a symposium on elk vulnerability.* (pp. 38-43). Bozeman, MT: Montana Department of Fish, Wildlife and Parks.

Hirshman, S. E., Gunn, C., & Levad, R. G. (2007). Breeding phenology and success of black swifts in Box Canyon, Ouray, Colorado. *Wilson Journal of Ornithology, 119*(4), 678-685. doi:http://dx.doi.org/10.1676/06-112.1. Retrieved from http://dx.doi.org/10.1676/06-112.1, http://www.bioone.org/doi/abs/10.1676/06-112.1, http://www.bioone.org/doi/pdf/10.1676/06-112.1.

Hodges, K. E. (2000). Ecology of snowshoe hares in southern boreal and montane forests. In L. F. Ruggiero, K. B. Aubry, S. W. Buskirk, G. M. Koehler, C. J. Krebs, K. S. McKelvey, & J. R. Squires (Eds.), *Ecology and conservation of lynx in the United States. General Technical Report RMRS-30WWW* (pp. 163-206). Fort Collins, CO: USDA Forest Service,, Rocky Mountain Research Station. Retrieved from https://www.treesearch.fs.fed.us/pubs/50630, https://www.treesearch.fs.fed.us/pubs/4546, https://www.fs.fed.us/rm/pubs/rmrs_gtr030/rmrs_gtr030_163_206.pdf.

Holmquist, L. (2015). [Email to R. Kuennen re: Flathead National Forest Canada lynx detections 2010-2015, March 4]. Planning record exhibit # 00240.

Hornocker, M. G., & Hash, H. S. (1981). Ecology of the wolverine in northwestern Montana. *Canadian Journal of Zoology*, *59*(7), 1286-1301. doi:10.1139/z81-181. Retrieved from http://www.nrcresearchpress.com/doi/pdf/10.1139/z81-181, http://www.nrcresearchpress.com/toc/cjz/59/7.

Hoyt, J. S. (2000). Habitat associations of black-backed *Picoides arcticus* and three-toed *P. tridactylus* woodpeckers in the northeastern boreal forest of Alberta. In R. D. Dixon & V. A. Saab (Eds.), *Black-backed woodpecker (Picoides arcticus), The birds of North America online (A. Poole, Ed.).* Ithaca, NY: Cornell Lab of Ornithology. Retrieved from http://bna.birds.cornell.edu/bna/species/509/articles/introduction, http://bna.birds.cornell.edu/bna/species/509.

Hunter, W. F., & Baldwin, P. H. (1962). Nesting of the black swift in Montana. *The Wilson Bulletin, 74*(4), 409-416. Retrieved from https://sora.unm.edu/sites/default/files/journals/wilson/v074n04/p0409-p0416.pdf, http://www.jstor.org/stable/4159102.

Hunter, W. F., & Baldwin, P. H. (1972). Black swift nest in Glacier National Park. *The Murrelet, 53*(3 Sep.-Dec., 1972), 50-51. Retrieved from http://www.jstor.org/stable/3535234.

Hutto, R. L. (1995). Composition of bird communities following stand-replacement fires in northern Rocky-Mountain (USA) conifer forests. *Conservation Biology, 9*(5), 1041-1058. doi:10.1046/j.1523-1739.1995.9051041.x. Retrieved from <Go to ISI>://WOS:A1995TB44900018, http://hs.umt.edu/dbs/labs/hutto/publications.php, http://hs.umt.edu/dbs/labs/hutto/documents/pubs-pdfs/41_1995-Hutto-conbiol-fire.pdf.

Hutto, R. L., Bond, M. L., & DellaSala, D. A. (2015). Using bird ecology to learn about the benefits of severe fire. In D. A. DellaSala & C. T. Hanson (Eds.), *The ecological importance of mixed-severity fires: Nature's phoenix*. (pp. 55-88): Elsevier, Inc. Retrieved from http://hs.umt.edu/dbs/labs/hutto/publications.php, http://hs.umt.edu/dbs/labs/hutto/documents/pubs-pdfs/Huttoetal2015.pdf.

Hutto, R. L., & Gallo, S. M. (2006). The effects of postfire salvage logging on cavity-nesting birds. *Condor, 108*(4), 817-831. doi:10.1650/0010-5422(2006)108[817:Teopsl]2.0.Co;2. Retrieved from <Go to ISI>://WOS:000241976200007, http://www.bioone.org/doi/abs/10.1650/0010-5422%282006%29108%5B817%3ATEOPSL%5D2.0.CO%3B2, http://hs.umt.edu/dbs/labs/hutto/publications.php, http://hs.umt.edu/dbs/labs/hutto/documents/pubs-pdfs/71_2006-Hutto-Gallo-condor.pdf.

Hutto, R. L., Keane, R. E., Sherriff, R. L., Rota, C. T., Eby, L. A., & Saab, V. A. (2016). Toward a more ecologically informed view of severe forest fires. *Ecosphere, 7*(2). doi:10.1002/ecs2.1255. Retrieved from <Go to ISI>://WOS:000374896300008.

Hutto, R. L., & Young, J. S. (1999). *Habitat relationships of landbirds in the Northern Region, USDA Forest Service*. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station. Retrieved from https://www.treesearch.fs.fed.us/pubs/37402, https://www.fs.fed.us/rm/pubs/rmrs_gtr032.pdf. Planning record exhibit # 00582.

IDFG. (2014). *Management plan for the conservation of wolverines in Idaho*. Boise, ID: Retrieved from http://fishandgame.idaho.gov/public/wildlife/?getPage=249, http://fishandgame.idaho.gov/public/wildlife/planWolverine.pdf.

IGBC. (1986). *Interagency grizzly bear guidelines [appendix OO to the Flathead National Forest 1986 forest plan]*.Interagency Grizzly Bear Committee. Retrieved from https://www.nps.gov/yell/learn/nature/upload/IGB_Guidelines.pdf.

IGBC. (1998). *Interagency Grizzly Bear Committee taskforce report (revised from 1994)*.Interagency Grizzly Bear Committee. Retrieved from http://www.igbconline.org/index.php/historical-documents, http://www.igbconline.org/index.php/who-we-are/about-the-igbc.

ILBT. (2013). *Canada lynx conservation assessment and strategy (3rd ed.)*. Missoula, MT: USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service (Interagency Lynx Biology Team - ILBT). Retrieved from https://www.fs.fed.us/biology/resources/pubs/wildlife/index.html.

Inman, R. M., Brock, B. L., Inman, K. H., Sartorius, S. S., Aber, B. C., Giddings, B., . . . Chapron, G. (2013). Developing priorities for metapopulation conservation at the landscape scale: Wolverines in the western United States. *Biological Conservation, 166*, 276-286. doi:10.1016/j.biocon.2013.07.010. Retrieved from http://www.sciencedirect.com/science/article/pii/S0006320713002425, http://ac.els-cdn.com/S0006320713002425/1-s2.0-S0006320713002425-main.pdf?_tid=151e5b3e-7f05-11e4-a7d6-00000aab0f6b&acdnat=1418062233_e96b91337a2e347a11fe7bc2f80f8336.

Inman, R. M., Magoun, A. J., Persson, J., & Mattisson, J. (2012). The wolverine's niche: Linking reproductive chronology, caching, competition, and climate. *Journal of Mammology, 93*(3), 634-644. Retrieved from http://jmammal.oxfordjournals.org/content/93/3/634, http://dx.doi.org/10.1644/11-MAMM-A-319.1.

Inman, R. M., Magoun, A. J., Persson, J., Pedersen, D., Mattisson, J., & Bell, J. K. (2007). Wolverine reproductive chronology. In Wildlife Conservation Society (Ed.), *Greater Yellowstone Wolverine Study: Cumulative report, May 2007.* (pp. 55-64). Ennis, MT: Wildlife Conservation Society, North America Program. Retrieved from http://www.wcsnorthamerica.org/AboutUs/Publications/tabid/3437/Default.aspx.

Inman, R. M., Packila, M. L., Inman, K. H., Mccue, A. J., White, G. C., Persson, J., . . . Sartorius, S. S. (2011). Spatial ecology of wolverines at the southern periphery of distribution. *Journal of Wildlife Management, 76*(4), 778-792. doi:10.1002/jwmg.289. Retrieved from <Go to ISI>://WOS:000302998300013.

Jacobs, A. (2005). *Biological assessment for terrestrial wildlife species, grizzly bear management direction outside the Northern Continental Divide Ecosystem recovery zone, Flathead National Forest*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00334.

Jacobs, A. H. (2013). *2012 biological opinion term and condition report, Flathead National Forest*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00229.

Jimenez, M. (2014). *Report to regional director, Region 6, Denver, CO: Service review of the 2013 wolf population in the NRM DPS*. Denver, CO: U.S. Fish and Wildlife Service. Planning record exhibit # 00378.

Johnson, P. T. J., Lunde, K. B., Thurman, E. M., Ritchie, E. G., Wray, S. N., Sutherland, D. R., . . . Blaustein, A. R. (2002). Parasite (*Ribeiroia ondatrae*) infection linked to amphibian malformations in the western United States. *Ecological Monographs, 72*(2), 151-168. doi:10.1890/0012-9615(2002)072[0151:Proilt]2.0.Co;2. Retrieved from http://www.jstor.org/stable/3100022, http://www.jstor.org/stable/pdf/3100022.pdf.

Jones, J. L. (1991). *Habitat use of fisher in north-central Idaho.* (MS thesis), University of Idaho, Moscow, ID. Retrieved from https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3847276.pdf.

Jones, T., & Cresswell, W. (2010). The phenology mismatch hypothesis: Are declines of migrant birds linked to uneven global climate change? *Journal of Animal Ecology, 79*(1), 98-108. doi:10.1111/j.1365-2656.2009.01610.x. Retrieved from <Go to ISI>://WOS:000272656600012, http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2656.2009.01610.x/epdf.

Jope, K. L. (1985). Implications of grizzly bear habituation to hikers. *Wildlife Society Bulletin, 13*(1), 32-37. Retrieved from <Go to ISI>://WOS:A1985ACT9100004, http://www.jstor.org/stable/3781944, http://www.jstor.org/stable/pdf/3781944.pdf?_=1466106254720.

Joyce, L. A., Talbert, M., Sharp, D., Morissette, J., & Stevenson, J. (in press). Historical and projected climate in the Northern Rockies Adaptation Partnership Region. In J. E. Halofsky, D. L. Peterson, S. K. Dante-Wood, L. Hoang, J. J. Ho, & L. A. Joyce (Eds.), *Climate change vulnerability and adaptaiton in the northern Rocky Mountains. General technical report RMRS-GTR-xxx* (pp. 58-65). Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. Retrieved from http://adaptationpartners.org/nrap/docs/NRAPFinalDraft_2016.07.25.pdf.

Kasworm, W. F., & Manley, T. L. (1990). Road and trail influences on grizzly bears and black bears in northwest Montana. *Bears: Their Biology and Management, 8*, 79-84. doi:10.2307/3872905. Retrieved from http://www.jstor.org/stable/3872905.

Keane, R. E., Bollenbacher, B. L., Manning, M. E., Loehman, R. A., Jain, T. B., Holsinger, L. M., . . . Webster, M. M. (in press). Climate change effects on forest vegetation. In J. E. Halofsky, D. L. Peterson, S. K. Dante-Wood, L. Hoang, J. J. Ho, & L. A. Joyce (Eds.), *Draft Climate change vulnerability and adaptation in the northern Rocky Mountains.* Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. Retrieved from http://adaptationpartners.org/nrap/docs/NRAPFinalDraft_2016.07.25.pdf.

Keane, R. E., & Parsons, R. A. (2010). Restoring whitebark pine forests of the northern Rocky Mountains, USA. *Ecological Restoration, 28*(1), 56-70. Retrieved from https://www.fs.fed.us/rm/pubs_other/rmrs_2010_keane_r002.pdf.

Keane, R. E., Tomback, D. F., Aubrey, C. A., Bower, A. D., Campbell, E. M., Cripps, C. L., . . . Smith, C. M. (2012). *A range-wide restoration strategy for whitebark pine (Pinus albicaulis)*. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. Retrieved from https://www.treesearch.fs.fed.us/pubs/40884.

Kendall, C. N. (2014). *Index scores of stream habitat in reference and managed catchments, Flathead National Forest*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00360.

Kendall, K. C. (1986). *Grizzly and black bear feeding ecology in Glacier National Park, Montana*. West Glacier, MT: Science Center, Glacier National Park. Retrieved from http://ecoshare.info/uploads/ccamp/synthesis_paper_tools/huckleberry/Kendall_1986.pdf.

Kendall, K. C., & Arno, S. F. (1990). Whitebark pine--An important but endangered wildlife resource. In W. C. Schmidt & K. J. McDonald (Eds.), *Proceedings: Symposium on whitebark pine ecosystems: Ecology and management of a high-mountain resource, Bozeman, MT, March 29-31, 1989. General Technical Report INT-270*. Odgen, UT: USDA Forest Service, Intermountain Research Station. Retrieved from http://www.treesearch.fs.fed.us/pubs/42418, http://www.fs.fed.us/rm/pubs_int/int_gtr270.pdf.

Kendall, K. C., & Keane, R. E. (2001). Whitebark pine decline: Infection, mortality, and population trends. In D. F. Tomback, S. F. Arno, & R. E. Keane (Eds.), *Whitebark pine communities: ecology and restoration.* (pp. 221-242). Washington, DC: Island Press.

Kendall, K. C., Stetz, J. B., Boulanger, J., Macleod, A. C., Paetkau, D., & White, G. C. (2009). Demography and genetic structure of a recovering grizzly bear population. *Journal of Wildlife Management, 73*(1), 3-17. doi:10.2193/2008-330. Retrieved from http://www.bioone.org/doi/abs/10.2193/2008-330, http://dx.doi.org/10.2193/2008-330, http://www.bioone.org/doi/full/10.2193/2008-330.

Kennedy, P. L. (2003). *Northern goshawk (Accipiter gentilis atricapillus): A technical conservation assessment*.USDA Forest Service, Rocky Mountain Region. Retrieved from https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5182005.pdf.

Kerns, B. K., Alexander, S. J., & Bailey, J. D. (2004). Huckleberry abundance, stand conditions, and use in western Oregon: Evaluating the role of forest management. *Economic Botany, 58*, 668-678. doi:http://dx.doi.org/10.1663/0013-0001(2004)058[0668:HASCAU]2.0.CO;2. Retrieved from http://www.bioone.org/doi/abs/10.1663/0013-0001(2004)058%5B0668:HASCAU%5D2.0.CO%3B2?prevSearch=.

Klaver, R. W., Claar, J. J., Rockwell, D. B., Mays, H. R., Acevedo, F., Contreras, G. P., & Evans, K. E. (1986). Grizzly bears, insects, and people: Bear management in the McDonald Peak region, Montana. In G. P. Contreras & K. E. Evans (Eds.), *Proceedings--Grizzly bear habitat symposium.* (pp. 204-211). Ogden, UT: USDA Forest Service.

Knight, R. R., Blanchard, B. M., & Mattson, D. J. (1988). *Yellowstone grizzly bear investigations: Snnual report of the Interagency Study Team, 1987*. Bozeman, MT: USDI, National Park Service. Retrieved from http://www.nrmsc.usgs.gov/products/IGBST.

Knight, R. R., & Judd, S. L. (1983). Grizzly bears that kill livestock. *Bears: Their Biology and Management, 5*, 186-190. doi:10.2307/3872537. Retrieved from http://www.jstor.org/stable/3872537.

Koehler, G. M. (1990). Population and habitat characteristics of lynx and snowshoe hares in north central Washington. *Canadian Journal of Zoology-Revue Canadienne De Zoologie, 68*(5), 845-851. doi:10.1139/z90-122. Retrieved from http://www.nrcresearchpress.com/doi/abs/10.1139/z90-122#.V0cowHJf0bw, http://www.nrcresearchpress.com/doi/pdf/10.1139/z90-122.

Koehler, G. M., & Brittell, J. D. (1990). Managing spruce-fir habitat for lynx and snowshoe hares. *Journal of Forestry, 88*(10), 10-14. Retrieved from http://www.ingentaconnect.com/contentone/saf/jof/1990/00000088/00000010/art00005, http://docserver.ingentaconnect.com/deliver/connect/saf/00221201/v88n10/s5.pdf?expires=1464282486&id=87058382&titleid=3830&accname=National+Forest+Service+Library&checksum=46A4CA7763D422EC98C7633E8D38B0B2.

Koehler, G. M., & Hornocker, M. G. (1977). Fire effects on marten habitat in Selway-Bitterroot Wilderness. *Journal of Wildlife Management, 41*(3), 500-505. doi:10.2307/3800522. Retrieved from http://www.jstor.org/stable/3800522?origin=crossref&seq=1#page_scan_tab_contents, http://www.jstor.org/stable/3800522.

Koehler, G. M., Hornocker, M. G., & Hash, H. S. (1979). Lynx movements and habitat use in Montana. *Canadian Field Naturalist, 93*(4), 441-442. Retrieved from http://www.biodiversitylibrary.org/item/89186#page/467/mode/1up, http://biodiversitylibrary.org/page/28063768, http://canadianfieldnaturalist.ca/index.php/cfn.

Kolbe, J. A., Squires, J. R., & Parker, T. W. (2003). An effective box trap for capturing lynx. *Wildlife Society Bulletin, 31*(4), 980-985. Retrieved from http://www.jstor.org/stable/3784442.

Kolbe, J. A., Squires, J. R., Pletscher, D. H., & Ruggiero, L. F. (2007). The effect of snowmobile trails on coyote movements within lynx home ranges. *Journal of Wildlife Management, 71*(5), 1409-1418. Retrieved from http://www.bioone.org/doi/abs/10.2193/2005-682, http://dx.doi.org/10.2193/2005-682.

Kosterman, M. K. (2014). *Correlates of Canada lynx reproductive success in northwestern Montana.* (MS thesis), Wildlife Biology, University of Montana, Missoula, MT. Retrieved from http://scholarworks.umt.edu/cgi/viewcontent.cgi?article=5406&context=etd (Paper 4363).

Kotliar, N. B. (2007). *Olive-sided flycatcher (Contopus cooperi): A technical conservation assessment*. Fort Collins, CO: USDA Forest Service, Rocky Mountain Region. Retrieved from https://www.fs.fed.us/r2/projects/scp/assessments/olivesidedflycatcher.pdf, https://www.fs.usda.gov/detail/r2/landmanagement/?cid=stelprdb5201278, https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5182039.pdf.

Kowalski, S. (2006a). *Frequency of northern goshawk presence in the Northern Region 2005 survey*. Missoula, MT: USDA Forest Service, Northern Region. Planning record exhibit # 00186.

Kowalski, S. (2006b). *Northern goshawk detection survey 2005: Results [map]*. Missoula, MT: USDA Forest Service, Northern Region. Planning record exhibit # 00187.

Krebs, J., Lofroth, E. C., & Parfitt, I. (2007). Multiscale habitat use by wolverines in British Columbia, Canada. *Journal of Wildlife Management, 71*(7), 2180-2192. doi:10.2193/2007-099. Retrieved from http://onlinelibrary.wiley.com/doi/10.2193/2007-099/abstract.

Kuchel, C. R. (1977). *Some aspects of the behavior and ecology of harlequin ducks breeding in Glacier National Park, Montana.* (MS thesis), University of Montana, School of Forestry, Wildlife Biology Program, Montana, MT. Retrieved from http://scholarworks.umt.edu/etd/6948/.

Kuennen, R. (2013a). Flathead National Forest amphibian assessment: Boreal toad. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00035.

Kuennen, R. (2013b). Flathead National Forest bird assessment: Black-backed woodpecker. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00036.

Kuennen, R. (2013c). Flathead National Forest bird assessment: Black swift. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00037.

Kuennen, R. (2013d). Flathead National Forest bird assessment: Boreal chickadee. Kalispell, MT. Planning record exhibit # 00038.

Kuennen, R. (2013e). Flathead National Forest bird assessment: Boreal owl. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00039.

Kuennen, R. (2013f). Flathead National Forest bird assessment: Brown creeper. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00041.

Kuennen, R. (2013g). Flathead National Forest bird assessment: Cassin's finch. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00043.

Kuennen, R. (2013h). Flathead National Forest bird assessment: Clark's nutcracker, summer and winter. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00044.

Kuennen, R. (2013i). Flathead National Forest bird assessment: Common loon breeding pairs. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00045.

Kuennen, R. (2013j). Flathead National Forest bird assessment: Flammulated owl. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00047.

Kuennen, R. (2013k). Flathead National Forest bird assessment: Goshawk observations, Swan Valley geographic area. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00048.

Kuennen, R. (2013l). Flathead National Forest bird assessment: Gray-crowned rosy finch. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00049.

Kuennen, R. (2013m). Flathead National Forest bird assessment: Olive-sided flycatcher. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00051.

Kuennen, R. (2013n). Flathead National Forest bird assessment: Pileated woodpecker. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00052.

Kuennen, R. (2013o). Flathead National Forest bird assessment: Veery. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00056.

Kuennen, R. (2013p). Flathead National Forest bird assessment: White-tailed ptarmigan. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00057.

Kuennen, R. (2013a). *MNHP birdpod data: Bird observations and status for NFS lands and half-mile buffer within the Flathead National Forest geographic area boundaries, with summary of S1 and S2 birds*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00213.

Kuennen, R. (2013b). Montana Natural Heritage Program observations of carinate mountainsnail and alpine mountainsnail on the Flathead National Forst. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00066.

Kuennen, R. (2013c). Montana Natural Heritage Program observations of fisher on the Flathead National Forest. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00068.

Kuennen, R. (2013d). Montana Natural Heritage Program observations of hoary marmot on the Flathead National Forest. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00069.

Kuennen, R. (2013e). Montana Natural Heritage Program observations of mountain goat on the Flathead National Forest. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00070.

Kuennen, R. (2013f). Montana Natural Heritage Program observations of northern bog lemming on the Flathead National Forest. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00071.

Kuennen, R. (2013g). Montana Natural Heritage Program observations of pika on the Flathead National Forest. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00075.

Kuennen, R. (2013h). Montana Natural Heritage Program observations of Townsend's big-eared bat on the Flathead National Forest. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00072.

Kuennen, R. (2013q). *Summary--Flathead NF bat species--2013*. Planning record exhibit # 00223.

Kuennen, R. (2015a, May 1, 2015). [E-mail from R. Kuennen to R. Mace re: notes on USFS-FWP meeting April 30, 2015]. Planning record exhibit # 00247.

Kuennen, R. (2015b, Sept. 16, 2015). [E-mail from Reed Kuennen to Nancy Warren re: conversation with Lori Roberts of MFWP on connectivity for and movement of grizzly bears]. Planning record exhibit # 00173.

Kuennen, R. (2016). *Migratory bird analysis*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00214.

Kuennen, R. (2017a). *Alternative B modified: Areas suitable for motorized over-snow use and modelled lynx habitat--South and North Fork geographic areas, Flathead National Forest*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00478.

Kuennen, R. (2017b). *Flathead National Forest wildlife connectivity summary*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00515.

Kuennen, R. (2017c). *How RMZs and their plan components address BASI for wildlife*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00529.

Kuennen, R. (2017d). *Planning record documentation of Canada lynx radio-telemetry locations on the Flathead National Forest*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00588.

Kuennen, R., Van Eimeren, P., & Trechsel, H. (2017). *Biological assessment for threatened, endangered, and proposed species: Revised land and resource management plan for the Flathead National*

Forest. Kalispell, MT: USDA Forest Service, Flathead National Forest. Retrieved from www.fs.usda.gov/goto/flathead/fpr. Planning record exhibit # 00550.

Kuennen, R., & Warren, N. (2015). *Documentation of methods to establish and calculate density of motorized roads or routes to achieve the desired conditions for grizzly bears: Northern Continental Divide Ecosystem*.USDA Forest Service, Flathead National Forest. Planning record exhibit # 00191.

Kunkel, K., & Pletscher, D. H. (1999). Species-specific population dynamics of cervids in a multipredator ecosystem. *Journal of Wildlife Management, 63*(4), 1082-1093. doi:10.2307/3802827. Retrieved from <Go to ISI>://WOS:000083330600003, http://www.jstor.org/stable/3802827?origin=crossref, http://www.jstor.org/stable/pdfplus/3802827.pdf?&acceptTC=true&jpdConfirm=true.

Lee, P., Smyth, C., & Boutin, S. (2004). Quantitative review of riparian buffer width guidelines from Canada and the United States. *Journal of Environmental Management*, *70*(2), 165-180. doi:10.1016/j.jenvman.2003.11.009. Retrieved from <Go to ISI>://WOS:000189328200008.

LeFranc Jr., M. N., Moss, M. B., Patnode, K. A., & Sugg III, W. C. (1987). *Grizzly bear compendium*. Washington, DC: National Wildlife Federation. Retrieved from https://archive.org/details/grizzlybearcompe1987lefr.

Lehmkuhl, J. F., Burger, E. D., Drew, E. K., Lindsey, J. P., Haggard, M., & Woodruff, K. Z. (2007). Breeding birds in riparian and upland dry forests of the Cascade Range. *Journal of Wildlife Management, 71*(8), 2632-2643. doi:10.2193/2007-004. Retrieved from <Go to ISI>://WOS:000250853000019.

Leptich, D. J., & Zager, P. (1991). Road access management effects on elk mortality and population dynamics. In A. G. Christensen, L. J. Lyon, & T. N. Lonner (Eds.), *Proceedings of elk vulnerability: A symposium.* (pp. 126-130). Bozeman, MT: Montana Department of Fish, Wildlife and Parks and Montana Chapter of The Wildlife Society.

Levad, R. G., Potter, K. M., Shultz, C. W., Gunn, C., & Doerr, J. G. (2008). Distribution, abundance, and nest-site characteristics of Black Swifts in the Southern Rocky Mountains of Colorado and New Mexico. *Wilson Journal of Ornithology*, *120*(2), 331-338. Retrieved from http://www.bioone.org/doi/full/10.1676/07-049.1
http://dx.doi.org/10.1676/07-049.1.

Lidicker, W. Z., & Koenig, W. D. (1996). Responses of terrestrial vertebrates to habitat edges and corridors. In D. R. McCullough (Ed.), *Metapopulations and wildlife conservation.* Washington, D.C.: Island Press.

Linkhart, B. D., & McCallum, D. A. (2013). Flammulated owl (*Psiloscops flammeolus*). *The birds of North America.* Cornell Lab of Ornithology. Retrieved from https://birdsna.org/Species-Account/bna/species/flaowl

Linkhart, B. D., Reynolds, R. T., & Ryder, R. A. (1998). Home range and habitat of breeding flammulated owls in Colorado. *Wilson Bulletin, 110*(3), 342-351. Retrieved from http://www.jstor.org/stable/4163958.

Linnell, J. D. C., Swenson, J. E., Andersen, R., & Barnes, B. (2000). How Vulnerable are Denning Bears to Disturbance? *Wildlife Society Bulletin*, *28*(2), 400-413. Retrieved from http://www.jstor.org/stable/3783698.

Lofroth, E. C., Raley, C. M., Higley, J. M., Truex, R. L., Yaeger, J. S., Lewis, J. C., . . . Brown, R. N. (2011). *Conservation of fishers (Martes pennanti) in south-central British Columbia, western Washington, western Oregon, and California--Volume II: Key findings from fisher habitat studies in British Columbia, Montana, Idaho, Oregon, and California.* Denver, CO: U.S. Department of the Interior, Bureau of Land Management. Retrieved from http://www.fwspubs.org/doi/suppl/10.3996/012012-JFWM-002/suppl_file/10.3996_012012-jfwm-002.s5.pdf?code=ufws-site.

Lorenz, T. J., Aubry, C., & Shoal, R. (2008). *A review of the literature on seed fate in whitebark pine and the life history traits of Clark's nutcracker and pine squirrels*. Gen. Tech. Rep. PNW-GTR-742. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. Retrieved from https://www.treesearch.fs.fed.us/pubs/29647, .

Lowe, S. J., Patterson, B. R., & Schaefer, J. A. (2010). Lack of behavioral responses of moose (*Alces alces*) to high ambient temperatures near the southern periphery of their range. *Canadian Journal of Zoology, 88*(10), 1032-1041. doi:10.1139/Z10-071. Retrieved from http://dx.doi.org/10.1139/Z10-071, http://www.nrcresearchpress.com/doi/abs/10.1139/Z10-071#.VsYU5HJf2pp.

Lyon, L. J., Lonner, T. N., Weigand, J. P., Marcum, C. L., Edge, W. D., Jones, J. D., . . . Hicks, L. L. (1985). *Coordinating elk and timber management: Final report of the Montana Cooperative Elk-Logging Study, 1970-1985*. Planning record exhibit # 00453.

Mace, R. (2014). [E-mail from R. Mace to R. Kuennen and K. Ake, May 13, 2014, re: grizzly bear den attributes]. Planning record exhibit # 00228.

Mace, R. D., Carney, D. W., Chilton-Radandt, T., Courville, S. A., Haroldson, M. A., Harris, R. B., . . . Wenum, E. (2012). Grizzly bear population vital rates and trend in the Northern Continental Divide Ecosystem, Montana. *The Journal of Wildlife Management, 76*(1), 119-128. doi:10.1002/jwmg.250. Retrieved from http://dx.doi.org/10.1002/jwmg.250.

Mace, R. D., & Jonkel, C. J. (1986). Local food habits of the grizzly bear in Montana. *Ursus, 6*, 105-110. Retrieved from http://fwp.mt.gov/fishAndWildlife/management/grizzlyBear/monitoring.html, http://www.bearbiology.com/ursus/ursusvol00/ursvol6.html, http://www.bearbiology.com/fileadmin/tpl/Downloads/URSUS/Vol_6/Mace_Jonkel_Vol_6.pdf.

Mace, R. D., & Roberts, L. L. (2011). *Northern Continental Divide Ecosystem grizzly bear monitoring team annual report, 2009-2010*. Kalispell, MT: Montana Fish, Wildlife and Parks. Retrieved from http://fwp.mt.gov/fishAndWildlife/management/grizzlyBear/monitoring.html.

Mace, R. D., & Roberts, L. L. (2012). *Northern Continental Divide Ecosystem grizzly bear monitoring team annual report, 2012*. Kalispell, MT: Montana Fish, Wildlife & Parks. Retrieved from http://fwp.mt.gov/fishAndWildlife/management/grizzlyBear/monitoring.html.

Mace, R. D., & Roberts, L. L. (2013). *Northern Continental Divide Ecosystem grizzly bear monitoring team annual report, 2013*. Kalispell, MT: Montana Fish, Wildlife and Parks. Retrieved from http://fwp.mt.gov/fishAndWildlife/management/grizzlyBear/monitoring.html.

Mace, R. D., & Waller, J. S. (1996). Grizzly bear distribution and human conflicts in Jewel Basin Hiking Area, Swan Mountains, Montana. *Wildlife Society Bulletin, 24*(3), 461-467. Retrieved from http://fwp.mt.gov/fishAndWildlife/management/grizzlyBear/monitoring.html, http://fwp.mt.gov/fwpDoc.html?id=52073.

Mace, R. D., & Waller, J. S. (1997). *Final report: Grizzly bear ecology in the Swan Mountains, Montana*. Helena, MT: Montana Fish, Wildlife and Parks. Retrieved from http://fwp.mt.gov/fwpDoc.html?id=52073, http://fwp.mt.gov/fishAndWildlife/management/grizzlyBear/monitoring.html.

Mace, R. D., Waller, J. S., Manley, T. L., Ake, K., & Wittinger, W. T. (1999). Landscape evaluation of grizzly bear habitat in western Montana. *Conservation Biology, 13*(2), 367-377. doi:10.1046/j.1523-1739.1999.013002367.x. Retrieved from <Go to ISI>://WOS:000079472000020, http://onlinelibrary.wiley.com/doi/10.1046/j.1523-1739.1999.013002367.x/abstract;jsessionid=2A9513C8CCB4B8D95863696C693E0549.f02t02, http://fwp.mt.gov/fishAndWildlife/management/grizzlyBear/monitoring.html.

Mace, R. D., Waller, J. S., Manley, T. L., Lyon, L. J., & Zuuring, H. (1996). Relationships among grizzly bears, roads and habitat in the Swan Mountains, Montana. *Journal of Applied Ecology, 33*(6), 1395-1404. doi:10.2307/2404779. Retrieved from <Go to ISI>://WOS:A1996WH51600015, http://www.jstor.org/stable/2404779.

MacHutchon, A. G. (2014). *Human-bear interaction risk assessment for the July 2014 Moose-Wilson Corridon Management Plan alternatives*. Moose, WY: USDI Grand Teton National Park. Planning record exhibit # 00483.

Mackie, R. J., Pac, D. F., Hamlin, K. L., & Dusek, G. L. (1998). *Ecology and management of mule deer and white-tailed deer in Montana*. Helena, MT: Wildlife Division, Montana Fish, Wildlife and Parks. Retrieved from http://fwp.mt.gov/fwpDoc.html?id=50732.

Magoun, A. J., & Copeland, J. P. (1998). Characteristics of wolverine reproductive den sites. *Journal of Wildlife Management, 62*(4), 1313-1320. doi:10.2307/3801996. Retrieved from <Go to ISI>://WOS:000076722900016, http://www.jstor.org/stable/3801996?origin=crossref.

Magoun, A. J., Robards, M. D., Packila, M. L., & Glass, T. W. (2017). Detecting snow at the den-site scale in wolverine denning habitat. *Wildlife Society Bulletin, 41*(2), 381-387. doi:10.1002/wsb.765. Retrieved from <Go to ISI>://WOS:000404380200026.

Mahr, M., & Jones, K. (2005). *Bird biodiversity in the Flathead River Basin: A conservation hotspot in the Yellowstone to Yukon Corridor*. Canmore, AB: Flathead Lakers and Flathead Chapter of The Audubon Society, Yellowstone to Yukon Conservation Initiative. Retrieved from http://y2y.net/publications/copy_of_technical-reports, http://y2y.net/publications/technical-reports/505mahrbirdbiodiversityintheflatheadriverbasin.pdf.

Mann, J. (2013, November 13, 2013). Article about elk in the *Daily Inter Lake*, Nov. 13, 2013. Planning record exhibit # 00384.

Marcot, B. G., Pope, K. L., Slauson, k., Welsh, H. H., Wheeler, C. A., & Reilly, M. J. (in press). Other species and biodiversity of older forests. In p. A. Stine & T. A. Spies (Eds.), *Draft Synthesis of science to inform land management within the Northwest Forest Plan area*. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. Retrieved from https://www.fs.fed.us/pnw/research/science-synthesis/chapter-listing.shtml.

Marczak, L. B., Sakamaki, T., Turvey, S. L., Deguise, I., Wood, S. L. R., & Richardson, J. S. (2010). Are forested buffers an effective conservation strategy for riparian fauna? An assessment using meta-analysis. *Ecological Applications, 20*(1), 126-134. doi:10.1890/08-2064.1. Retrieved from <Go to ISI>://WOS:000275358100010.

Marin, M. (1997). Some aspects of the breeding biology of the black swift. *Wilson Bulletin, 109*(2), 290-306. Retrieved from <Go to ISI>://WOS:A1997XC71900011, http://www.jstor.org/stable/4163812.

Marks, J., & Casey, D. (2005). Monitoring black swifts in Montana: 2004 annual report. In P. Hendricks (Ed.), *Surveys for animal species of concern in northwestern Montana.* (pp. 19-30). Helena, MT: Report to Montana Department of Fish, Wildlife, and Parks, State Wildlife Grants Program, Helena, Montana. Retrieved from http://archive.org/stream/60AD4B1E-A917-4BBC-BA59-887AAA9C3B7E/60AD4B1E-A917-4BBC-BA59-887AAA9C3B7E_djvu.txt.

Marks, J. S., Hendricks, P., & Casey, D. (2016). *Birds of Montana.* Arrington, VA: Buteo Books. Planning record exhibit # 00590.

Marten, L. M. (2016, April 20, 2016). [Letter from regional forester (Northern Region) to Michael Garrity, Alliance for the Wild Rockies]. Planning record exhibit # 00168.

Martinka, C. J., & Kendall, K. C. (1986). Grizzly bear habitat research in Glacier National Park, Montana. *Proceedings: Grizzly bear habitat symposium. General Technical Report INT-207* (pp. 19-23). Ogden, UT: USDA Forest Service, Intermountain Research Station. Retrieved from https://www.fort.usgs.gov/sites/default/files/products/publications/286/286.pdf.

Matchett, M. R. (1985). Habitat selection by moose in the Yaak River drainage, northwestern Montana. *Alces, 21*, 161-189. Retrieved from http://flash.lakeheadu.ca/~arodgers/Alces/vol21_1985.html, http://flash.lakeheadu.ca/~arodgers/Alces/Vol21/Alces21_161.pdf.

Mattson, D. J., Blanchard, B. M., & Knight, R. R. (1991). Food-habits of Yellowstone grizzly bears, 1977-1987. *Canadian Journal of Zoology, 69*(6), 1619-1629. doi:10.1139/Z91-226. Retrieved from <Go to ISI>://WOS:A1991GH35200024, http://www.nrcresearchpress.com/doi/abs/10.1139/z91-226.

Mattson, D. J., Knight, R. R., & Blanchard, B. M. (1987). The effects of developments and primary roads on grizzly bear habitat use in Yellowstone National Park, Wyoming. *International Association for Bear Research and Management, 7*, 259-273. doi:10.2307/3872633. Retrieved from http://www.jstor.org/stable/3872633.

Mattson, M. (1996). *Franz Xaver Kroetz: The construction of a political aesthetic.* Oxford ; Washington, D.C.: Berg.

Maxell, B. (2014). *Harlequin duck summary: Historical survey data*. Planning record exhibit # 00397.

Maxell, B., Hilty, S., Hanauska-Brown, L., Shovlain, A., Chaffin, J., Servheen, C., . . . Grotto, N. R. M. (Producer). (2015, 2015-2016). Montana's winter bat roost and white-nose syndrome surveillance efforts. [slide show] Retrieved from http://mtnhp.org/animal/presentations/Maxell_Bat_Roost_Surveillance_20150226.pdf.

Maxell, B. A. (2000). *Management of Montana's amphibians: A review of factors that may present a risk to population viability and accounts on the identification, distribution, taxonomy, habitat use, natural history, and the status and conservation of individual species*. Missoula, MT: University of Montana, Wildlife Biology Program. Retrieved from http://www.isu.edu/~petechar/iparc/Maxell_Mgmnt.pdf.

Maxell, B. A. (2015). *Montana's bats: Distribution, conservation status, and roost site overview*.Montana Natural Heritage Program. Retrieved from http://mtnhp.org/animal/presentations/Montana_Bats_Distribution_Status_and_Roost_Overview_20150224.pdf. Planning record exhibit # 00222.

Maxell, B. A., Hokit, G., Miller, J., & Werner, K. (2004). *Detection of (Batrachochytrium dendrobatidis), the Chytrid fungus associated with global amphibian declines, in Montana amphibians*. Helena, MT: Montana Natural Heritage Program. Retrieved from http://mtnhp.org/animal/presentations/021904_chytrid_fungus.pdf.

MBDC. (2012). *P. D. Skaar's Montana bird distribution.* (7 ed.). Helena, MT: Montana Bird Distribution Committee. Planning record exhibit # 00416.

MBEWG. (2010). *Montana bald eagle management guidelines: An addendum to Montana Bald Eagle Management Plan, 1994*. Helena, MT: Montana Fish, Wildlife and Parks, Montana Bald Eagle Working Group (MBEWG). Retrieved from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CB4QFjAA&url=http%3A%2F%2Ffwp.mt.gov%2FfwpDoc.html%3Fid%3D44181&ei=IiCGVP6xDMPvoATX3oDYAQ&usg=AFQjCNHwrFUlJtBGJYlhUdV9Yy8mRF8A5g.

McCallum, D. A. (1994). Review of technical knowledge: Flammulated owls. In G. D. Hayward & J. Verner (Eds.), *Flammulated, boreal, and great gray owls in the United States: A technical conservation assessment. General Technical Report RM-253*. Fort Collins, CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Retrieved from https://www.treesearch.fs.fed.us/pubs/28780, https://www.treesearch.fs.fed.us/pubs/28773.

McClelland, B. R., Frissell, S. S., Fischer, W. C., & Halvorson, C. H. (1979). Habitat management for hole-nesting birds in forests of western larch and Douglas-fir. *Journal of Forestry, 77*(8), 480-483. Retrieved from https://www.fs.fed.us/rm/pubs_exp_forests/coram/rmrs_1979_mcclelland_b001.pdf.

McClure, M. L., Hansen, A. J., & Inman, R. M. (2016). Connecting models to movements: Testing connectivity model predictions against empirical migration and dispersal data. *Landscape Ecology, 31*(7), 1419-1432. doi:10.1007/s10980-016-0347-0. Retrieved from <Go to ISI>://WOS:000382906500002.

McKelvey, K. S., Aubry, K. B., & Ortega, Y. K. (1999). History and distribution of lynx in the contiguous United States. In L. F. Ruggiero, K. B. Aubry, S. W. Buskirk, G. M. Koehler, C. J. Krebs, K. S. McKelvey, & J. R. Squires (Eds.), *Ecology and conservation of lynx in the United States. General Technical Report RMRS-30WWW* (pp. 207-264). Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. Retrieved from https://www.treesearch.fs.fed.us/pubs/4546, https://www.fs.fed.us/rm/pubs/rmrs_gtr030.pdf.

McKelvey, K. S., & Buotte, P. C. (in press). Climate change and wildlife in the northern Rocky Mountains. In J. E. Halofsky, D. L. Peterson, S. K. Dante-Wood, L. Hoang, J. J. Ho, & L. A. Joyce (Eds.), *Climate change vulnerability and adaptation in the northern Rocky Mountains.* (pp. 383-434). Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. Retrieved from http://adaptationpartners.org/nrap/docs/NRAPFinalDraft_2016.07.25.pdf.

McKelvey, K. S., Copeland, J. P., Schwartz, M. K., Littell, J. S., Aubry, K. B., Squires, J. R., . . . Mauger, G. S. (2011). Climate change predicted to shift wolverine distributions, connectivity, and dispersal corridors. *Ecological Applications, 21*(8), 2882-2897. doi:10.1890/10-2206.1. Retrieved from <Go to ISI>://WOS:000299166300004, http://www.esajournals.org/doi/abs/10.1890/10-2206.1, http://dx.doi.org/10.1890/10-2206.1.

McKinney, S. T., Fiedler, C. E., & Tomback, D. F. (2009). Invasive pathogen threatens bird-pine mutualism: Implications for sustaining a high-elevation ecosystem. *Ecological Applications, 19*(3), 597-607. doi:10.1890/08-0151.1. Retrieved from <Go to ISI>://WOS:000264309500010, http://www.esajournals.org/doi/abs/10.1890/08-0151.1, http://www.jstor.org/stable/27646002, http://dx.doi.org/10.1890/08-0151.1.

McLellan, B. N. (1994). Density dependent population regulation of brown bears. In M. Taylor (Ed.), *Density dependent population regulation in black, brown, and polar bears: 9th International Conference on Bear Research and Management. Monograph Series No. 3.* (pp. 15-24). Portland, OR: International Association for Bear Research and Management. Planning record exhibit # 00361.

McLellan, B. N., & Hovey, F. W. (1995). The diet of grizzly bears in the Flathead River drainage of southeastern British Columbia. *Canadian Journal of Zoology, 73*(4), 704-712. doi:10.1139/z95-082. Retrieved from http://dx.doi.org/10.1139/z95-082, http://www.nrcresearchpress.com/doi/pdf/10.1139/z95-082.

McLellan, B. N., & Shackleton, D. M. (1988). Grizzly bears and resource-extraction industries: Effects of roads on behavior, habitat use and demography. *Journal of Applied Ecology, 25*(2), 451-460. doi:10.2307/2403836. Retrieved from http://www.jstor.org/stable/2403836?origin=crossref&seq=1#page_scan_tab_contents, http://www.jstor.org/stable/2403836.

McLellan, B. N., & Shackleton, D. M. (1989). Grizzly bears and resource-extraction industries: Habitat displacement in response to seismic exploration, timber harvesting and road maintenance. *Journal of Applied Ecology, 26*, 371-380. doi:10.2307/2404067.

McRae, B., Popper, K., Jones, A., Schindel, M., Buttrick, S., Hall, K., . . . Platt, J. (2016). *Conserving nature's stage: Mapping omnidirectional connectivity for resilient terrestrial landscapes in the Pacific Northwest*. Porltand, OR: The Nature Conservancy. Retrieved from http://nature.org/resilienceNW.

Meyer, R. (2011, March 23). *Martes pennanti*. *Fire effects information system.* USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Retrieved from http://www.fs.fed.us/database/feis/. Planning record exhibit # 00510.

MFWP (2013a). Flathead National Forest elk winter habitat by geographic area. Helena, MT: Montana Fish, Wildlife and Parks. Planning record exhibit # 00061.

MFWP (2013b). Flathead National Forest moose winter habitat by geographic area. Helena, MT: Montana Fish, Wildlife and Parks. Planning record exhibit # 00062.

MFWP (2013c). Flathead National Forest mule deer winter habitat by geographic area. Helena, MT: Montana Fish, Wildlife and Parks. Planning record exhibit # 00064.

MFWP. (2014). *Montana connectivity project: A statewide analysis*. Helena, MT: W. Montana Fish, and Parks, in cooperation with the Wildlife Conservation Society and the National Fish and Wildlife Foundation. Planning record exhibit # 00638.

MFWP. (2015a). *2015 White-tailed deer status*. Planning record exhibit # 00417.

MFWP. (2015b). *Montana's statewide wildlife action plan*. Helena, MT: Montana Fish, Wildlife and Parks. Retrieved from http://fwp.mt.gov/fishAndWildlife/conservationInAction/swap2015Plan.html.

MFWP. (2016a). *Incidental lynx take 2000-2015--Montana*.Montana Fish, Wildlife and Parks. Planning record exhibit # 00445.

MFWP. (2016b). Summary of statewide Crucial Areas Assessment data layers. Montana Fish, Wildlife and Parks. Planning record exhibit # 00026.

MHP-MTFWP. (2013). *Sorted ecological systems in Flathead geographic areas*. Helena, MT: Montana Fish, Wildlife and Parks and Montana Natural Heritage Program. Planning record exhibit # 00030.

Mikle, N., Graves, T. A., Kovach, R., Kendall, K. C., & Macleod, A. C. (2016). Demographic mechanisms underpinning genetic assimilation of remnant groups of a large carnivore. *Proceedings of the Royal Society B-Biological Sciences, 283*(1839). doi:10.1098/rspb.2016.1467. Retrieved from <Go to ISI>://WOS:000386489200014.

Millar, C. I., & Westfall, R. D. (2010). Distribution and climatic relationships of the American pika (*Ochotona princeps*) in the Sierra Nevada and western Great Basin, U.S.A.: Periglacial landforms as refugia in warming climates. *Arctic Antarctic and Alpine Research, 42*(1), 76-88. doi:10.1657/1938-4246-42.1.76. Retrieved from http://apps.webofknowledge.com/InboundService.do?product=WOS&SID=3AJjtPMBs6x4X3mH3ic&UT=WOS%3A000275560500008&SrcApp=EndNote&DestFail=http%3A%2F%2Fwww.webofknowledge.com&action=retrieve&Init=Yes&SrcAuth=ResearchSoft&Func=Frame&customersID=ResearchSoft&IsProductCode=Yes&mode=FullRecord.

Miller, C. R., & Waits, L. P. (2003). The history of effective population size and genetic diversity in the Yellowstone grizzly (*Ursus arctos*): Implications for conservation. *Proceedings of the National Academy of Sciences of the United States of America*, *100*(7), 4334-4339. doi:10.1073/pnas.0735531100. Retrieved from <Go to ISI>://WOS:000182058400142, http://www.pnas.org/content/100/7/4334, http://www.pnas.org/content/100/7/4334.full.pdf.

Mills, L. S., Griffin, P. C., Hodges, K. E., McKelvey, K., Ruggiero, L., & Ulizio, T. J. (2005). Pellet count indices compared to mark-recapture estimates for evaluating snowshoe hare density. *Journal of Wildlife Management*, *69*(3), 1053-1062. doi:10.2193/0022-541x(2005)069[1053:Pcictm]2.0.Co;2. Retrieved from http://www.bioone.org/doi/abs/10.2193/0022-541X%282005%29069%5B1053%3APCICTM%5D2.0.CO%3B2, http://www.bioone.org/doi/full/10.2193/0022-541X%282005%29069%5B1053%3APCICTM%5D2.0.CO%3B2, http://dx.doi.org/10.2193/0022-541X(2005)069[1053:PCICTM]2.0.CO;2.

Mills, L. S., & Johnson, H. E. (2013). Wildlife population dynamics. In P. R. Krausman & J. W. Cain III (Eds.), *Wildlife management and conservation: Contemporary principles and practices.* (pp. 360). Baltimore, MD: The Wildlife Society and Johns Hopkins University Press. Retrieved from https://jhupbooks.press.jhu.edu/content/wildlife-management-and-conservation.

MNHP-MTFWP. (2013). Fisher (*Pekania pennanti*). *Montana field guide.* Montana Natural Heritage Program and Montana Fish, Wildlife and Parks. Retrieved from http://fieldguide.mt.gov/speciesDetail.aspx?elcode=AMAJF01020.

MNHP-MTFWP. (2015a). Northern bog lemming (*Synaptomys borealis*). *Montana field guide.* Montana Natural Heritage Program and Montana Fish, Wildlife and Parks. Retrieved from http://FieldGuide.mt.gov/speciesDetail.aspx?elcode=AMAFF17020.

MNHP-MTFWP. (2015b). Peregrine falcon (*Falco peregrinus*). Montana Natural Heritage Program and Montana Fish, Wildlife and Parks. Retrieved from http://FieldGuide.mt.gov/speciesDetail.aspx?elcode=ABNKD06070.

MNHP-MTFWP. (2015c). Pika (*Ochotona princeps*). *Montana field guide.* Montana Natural Heritage Program and Montana Fish, Wildlife and Parks. Retrieved from http://fieldguide.mt.gov/speciesDetail.aspx?elcode=AMAEA01020.

MNHP-MTFWP. (2015d). Townsend's big-eared bat (*Corynorhinus townsendii*). *Montana field guide.* Montana Natural Heritage Program and Montana Fish, Wildlife and Parks. Retrieved from http://fieldguide.mt.gov/speciesDetail.aspx?elcode=AMACC08010.

MNHP-MTFWP. (2015e). Western toad (*Anaxyrus boreas*). *Montana field guide.* Montana Natural Heritage Program and Montana Fish, Wildlife and Parks. Retrieved from http://fieldguide.mt.gov/speciesDetail.aspx?elcode=AAABB01030.

MNHP-MTFWP. (2016a). Alpine mountainsnail (*Oreohelix alpina*). *Montana field guide.* Montana Natural Heritage Program and Montana Fish, Wildlife and Parks. Retrieved from http://fieldguide.mt.gov/speciesDetail.aspx?elcode=IMGASB5010.

MNHP-MTFWP. (2016b). Carinate mountainsnail (*Oreohelix elrodi*). *Montana field guide.* Montana Natural Heritage Program and Montana Fish, Wildlife and Parks. Retrieved from http://fieldguide.mt.gov/speciesDetail.aspx?elcode=IMGASB5090.

MNHP. (2010). *Metadata for Montana Natural Heritage Program 2010 land cover data*. Helena, MT: Montana Natural Heritage Program. Planning record exhibit # 00028.

MNHP. (2013a). *Montana field guide: Ecological systems of Montana*. Helena, MT: Montana Natural Heritage Program. Planning record exhibit # 00027.

MNHP. (2013b). Montana Natural Heritage map viewer. Montana Natural Heritage Program. Retrieved from http://mtnhp.org/MapViewerIE/.

MNHP. (2013c). *Summary report: Winter 2012–2013 (updated from report submitted HOBO data logger deployment and bat roost observations for Columbia Mountain cave (Cave ID 225), Flathead*

County, Montana.Montana Natural Heritage Program, U.S. Forest Service, and Bigfork High School Cave Club. Planning record exhibit # 00224.

Morgan, J. T. (1993). *Summer habitat use of white-tailed deer on the Tally Lake Ranger District, Flathead National Forest.* (PhD dissertation), Montana State University, Bozeman, MT. Retrieved from http://scholarworks.montana.edu/xmlui/bitstream/handle/1/7253/31762102084744.pdf?sequence=1.

Moskoff, W. (1995 (revised 2005)). Veery (*Catharus fuscescens*). In A. Poole & F. Gill (Eds.), *The birds of North America*. Washington DC: Academy of Natural Sciences and The American Ornithologists Union. Retrieved from http://bna.birds.cornell.edu/bna/, http://bna.birds.cornell.edu/bna/species/142/articles/introduction.

MPI. (2017). Montana peregrine falcon population. Montana Peregrine Institute (MPI). Retrieved from http://www.montanaperegrine.org/index.html, http://www.montanaperegrine.org/Populations.html, http://www.montanaperegrine.org/Peregrine-Watch.html.

MT-CLWG. (2013). *Status of the common loon for the Flathead National Forest's LRMP revision effort*. Bull Lake, MT: Planning record exhibit # 00090.

MTDNRC. (2011). *Record of decision, forested state trust lands final habitat conservation plan and environmental impact statement*. Helena, MT: Montana Department of Natural Resources and Conservation, Forestry Division. Retrieved from http://dnrc.mt.gov/divisions/trust/docs/forest-management/hcp.

MTFWP. (2003). *Final EIS gray wolf conservation and management plan*. Helena, MT: Montana Fish, Wildlife, and Parks. Retrieved from http://fwp.mt.gov/fishAndWildlife/management/wolf/management.html, http://fwp.mt.gov/fishAndWildlife/management/wolf/finalWolfEIS.html.

MTFWP. (2004). *Amended record of decision, Montana gray wolf conservation and management plan, May 2004*.Montana Fish, Wildlife and Parks. Retrieved from http://fwp.mt.gov/fishAndWildlife/management/wolf/management.html.

MTFWP. (2015a). *Montana's 2015 state wildlife action plan final*. Helena, MT: Montana Fish, Wildlife and Parks. Retrieved from http://fwp.mt.gov/fishAndWildlife/conservationInAction/actionPlan.html, http://fwp.mt.gov/fishAndWildlife/conservationInAction/swap2015Plan.html.

MTFWP. (2015b). *Vital rates, limiting factors and monitoring methods for moose in Montana*. Missoula, MT: Montana Fish, Wildlife and Parks. Retrieved from http://fwp.mt.gov/fishAndWildlife/diseasesAndResearch/research/moose/populationsMonitoring/default.html.

MTFWP. (2017). Furbearer/trapping guide. Montana Fish, Wildlife and Parks. Retrieved from http://fwp.mt.gov/hunting/planahunt/huntingGuides/furbearer/.

Mundinger, J. G. (1984). Biology of the white-tailed deer in the coniferous forest of northwestern Montana. In W. R. Meehan, J. Merrell, T. R., & T. A. Hanley (Eds.), *Fish and wildlife relationships in old-growth forests: Proceedings of a symposium held in Juneau, Alaska, 12-15 April 1982*. (pp. 275-284). Juneau, AK: American Institute of Fishery Research Biologists, Alaska District. Retrieved from http://agris.fao.org/agris-search/search.do?recordID=US8830464.

Murray, D. L., & Boutin, S. (1991). The influence of snow on lynx and coyote movements: Does morphology affect behavior? *Oecologia, 88*(4), 463-469. Retrieved from <Go to ISI>://WOS:A1991GU19000002, http://link.springer.com/article/10.1007%2FBF00317707.

Murray, D. L., Boutin, S., & O'Donoghue, M. (1994). Winter habitat selection by lynx and coyotes in relation to snowshoe hare abundance. *Canadian Journal of Zoology-Revue Canadienne De Zoologie, 72*(8), 1444-1451. doi:10.1139/z94-191. Retrieved from <Go to ISI>://WOS:A1994PV94000012, http://www.nrcresearchpress.com/doi/pdf/10.1139/z94-191.

Nappi, A., & Drapeau, P. (2009). Reproductive success of the black-backed woodpecker (*Picoides arcticus*) in burned boreal forests: Are burns source habitats? *Biological Conservation, 142*(7), 1381-1391. doi:10.1016/j.biocon.2009.01.022. Retrieved from <Go to

ISI>://WOS:000266752500014, http://www.sciencedirect.com/science/article/pii/S0006320709000718.
NatureServe. (2015a, October). *Corynorhinus townsendii*/Townsend's big-eared bat. Retrieved from http://explorer.natureserve.org/servlet/NatureServe?searchName=Corynorhinus%20townsendii.
NatureServe. (2015b, October). *Falco peregrinus*/peregrine falcon. Retrieved from http://explorer.natureserve.org/servlet/NatureServe?searchName=falco+peregrinus.
NatureServe. (2015c, October). *Histrionicus histrionicus*/harlequin duck. Retrieved from http://explorer.natureserve.org/servlet/NatureServe?searchName=Histrionicus+histrionicus.
Naylor, L. M., Wisdom, M. J., & Anthony, R. G. (2009). Behavioral responses of North American elk to recreational activity. *Journal of Wildlife Management, 73*(3), 328-338. doi:10.2193/2008-102. Retrieved from <Go to ISI>://WOS:000265032100004.
NEPA. (2013). *Draft NEPA guidance for bats*. Planning record exhibit # 00396.
Newlon, K. R., & Burns, M. D. (2010). *Wetlands of the Flathead Valley: Change and ecological functions*. Helena, MT: Montana Natural Heritage Program. Retrieved from http://mtnhp.org/Reports/Flathead_Change_Revised.pdf.
Nielsen, S. E., Cattet, M. R. L., Boulanger, J., Cranston, J., McDermid, G. J., Shafer, A. B. A., & Stenhouse, G. B. (2013). Environmental, biological and anthropogenic effects on grizzly bear body size: Temporal and spatial considerations. *BMC ecology, 13*(1). doi:10.1186/1472-6785-13-31. Retrieved from http://bmcecol.biomedcentral.com/articles/10.1186/1472-6785-13-31.
Nielsen, S. E., Munro, R. H. M., Bainbridge, E. L., Stenhouse, G. B., & Boyce, M. S. (2004). Grizzly bears and forestry: II. Distribution of grizzly bear foods in clearcuts of west-central Alberta, Canada. *Forest Ecology and Management, 199*(1), 67-82. Retrieved from http://dx.doi.org/10.1016/j.foreco.2004.04.015.
Northrup, J. M., Stenhouse, G. B., & Boyce, M. S. (2012). Agricultural lands as ecological traps for grizzly bears. *Animal Conservation, 15*(4), 369-377. doi:10.1111/j.1469-1795.2012.00525.x. Retrieved from <Go to ISI>://WOS:000306480000008, http://onlinelibrary.wiley.com/doi/10.1111/j.1469-1795.2012.00525.x/epdf.
NRAP. (2015). *Northern Rockies Adaptation Partnership: Vulnerability assessment summaries (draft)*.Northern Rockies Adaptation Partnership (NRAP). Retrieved from http://adaptationpartners.org/nrap/va_ap.php, http://adaptationpartners.org/nrap/docs/NRAP_vulnerability_assessment.pdf.
Nussbaum, R. A., Brodie, E. D., & Storm, R. M. (1983). *Amphibians and reptiles of the Pacific Northwest.* Moscow: University Press of Idaho.
NWSGC. (1998). Northern Wild Sheep and Goat Council: Proceedings from the November 1998 symposium in Whitefish, Montana. Retrieved from http://www.nwsgc.org/contents/1998contents.html.
Oakleaf, J. K., Murray, D. L., Oakleaf, J. R., Bangs, E. E., Mack, C. M., Smith, D. W., . . . Niemeyer, C. C. (2006). Habitat selection by recolonizing wolves in the northern Rocky Mountains of the United States. *Journal of Wildlife Management, 70*(2), 554-563. doi:10.2193/0022-541x(2006)70[554:Hsbrwi]2.0.Co;2. Retrieved from <Go to ISI>://WOS:000237714100027.
Olson, D. H., & Burton, J. I. (2014). Near-term effects of repeated-thinning with riparian buffers on headwater stream vertebrates and habitats in Oregon, USA. *Forests, 5*(11), 2703-2729. doi:10.3390/f5112703. Retrieved from <Go to ISI>://WOS:000345531000007.
Olson, L. E. (2015). [E-mail to R. Kuennen, Flathead National Forest, June 22, 2015 re: Canada lynx]. Planning record exhibit # 00239.
Olson, L. E., Sauder, J. D., Albrecht, N. M., Vinkey, R. S., Cushman, S. A., & Schwartz, M. K. (2014). Modeling the effects of dispersal and patch size on predicted fisher (*Pekania [Martes] pennanti*) distribution in the U.S. Rocky Mountains. *Biological Conservation, 169*, 89-98. doi:10.1016/j.biocon.2013.10.022. Retrieved from <Go to ISI>://WOS:000333574400011, http://www.sciencedirect.com/science/article/pii/S0006320713003777, http://ac.els-cdn.com/S0006320713003777/1-s2.0-S0006320713003777-main.pdf?_tid=13fe5ee8-0e99-11e4-b164-00000aacb360&acdnat=1405701315_6690b292a7305be4f0a2af294f56d7fe.
Orme, M. L., & Williams, R. G. (1986). Coordinating livestock and timber management with the grizzly bear in Situation 1 Habitat, Targhee National Forest. In G. P. Contreras & K. E. Evans (Eds.),

Proceedings: Grizzly Bear Habitat Symposium, April 30 - May 2, 1985. General Technical Report INT-207 (pp. 195-203). Ogden, UT: USDA Forest Service, Intermountain Research Station. Retrieved from https://archive.org/details/CAT86869131, https://ia902602.us.archive.org/28/items/CAT86869131/CAT86869131.pdf.

Pearson, S. F., & Manuwal, D. A. (2001). Breeding bird response to riparian buffer width in managed Pacific Northwest Douglas-fir forests. *Ecological Applications*, *11*(3), 840-853. doi:10.1890/1051-0761(2001)011[0840:Bbrtrb]2.0.Co;2. Retrieved from <Go to ISI>://WOS:000169456900016.

Pfister, R. D., Kovalchik, B. L., Amo, S. F., & Presby, R. C. (1977). *Forest habitat types of Montana*. Ogden, UT: USDA Forest Service, Intermountain Forest and Range Experiment Station. Retrieved from https://www.fs.fed.us/rm/pubs_int/int_gtr034.pdf.

Pierson, E. D., Wackenhut, M. C., Altenbach, J. S., Bradley, P., Call, P., Genter, D. L., . . . Welch, L. (1999). Species conservation assessment and conservation strategy for the Townsend's big-eared bat: (*Corynorhinus townsendii townsendii* and *Corynorhinus townsendii pallescens*). Idaho Conservation Effort, Idaho Department of Fish and Game. Retrieved from http://wbwg.org/western-bat-species/.

Pilgrim, K., & Schwartz, M. (2015). *Flathead National Forest carnivore survey 2015: Report on 191 hair samples*. Missoula, MT: USDA Forest Service, Rocky Mountain Research Station, National Genomics Center for Wildlife and Fish Conservation. Planning record exhibit # 00184.

Plum Creek et al. (1997). *Amended and restated conservation agreement among Plum Creek Timber company, L.P., and Montana Department of Natural Resources and Conservation and U.S.D.A. Forest Service, Flathead National Forest and United States Fish and Wildlife Service [Swan Valley conservation agreement]*. Planning record exhibit # 00202.

Pollock, M. M., Lewallen, G., Woodruff, K., Jordan, C. E., & Castro, J. M. (2015). *The beaver restoration guidebook: Working with beaver to restore streams, wetlands, and floodplains (version 1.0)*. Portland, OR: U.S. Fish and Wildlife Service. Retrieved from http://www.fws.gov/oregonfwo/promo.cfm?id=177175812.

Proctor, M. F. (2015). Grizzly bear connectivity map for Flathead National Forest. Transborder Grizzly Bear Project. Planning record exhibit # 00438.

Proctor, M. F., Nielsen, S. E., Kasworm, W. F., Servheen, C., Radandt, T. G., Machutchon, A. G., & Boyce, M. S. (2015). Grizzly bear connectivity mapping in the Canada-United States trans-border region. *Journal of Wildlife Management, 79*(4), 544-558. doi:10.1002/jwmg.862. Retrieved from <Go to ISI>://WOS:000353217100004.

Proffitt, K. M., Hebblewhite, M., Peters, W., Hupp, N., & Shamhart, J. (2016). Linking landscape-scale differences in forage to ungulate nutritional ecology. *Ecological Applications*, *26*(7), 2156-2174. doi:10.1002/eap.1370. Retrieved from <Go to ISI>://WOS:000385623900015.

Quinn, M., & Chernoff, G. (2010). *Mountain biking: A review of the ecological effects; A literature review for Parks Canada--National office (Visitor Experience Branch)*. Gatineau, QC: Parks Canada, National Office. Planning record exhibit # 00463.

Raine, R. M. (1983). Winter habitat use and responses to snow cover of fisher (*Martes pennanti*) and marten (*Martes americana*) in southeastern Manitoba. *Canadian Journal of Zoology, 61*, 25-34. doi:10.1139/z83-002. Retrieved from http://www.nrcresearchpress.com/doi/abs/10.1139/z83-002#.WFg1WHK7qAY.

Raley, C. M., Lofroth, E. C., Truex, R. L., Yaeger, J. S., & Higley, J. M. (2012). Habitat ecology of fishers in western North America. In K. B. Aubry, W. J. Zielinski, M. G. Raphael, G. Proulx, & S. W. Buskirk (Eds.), *Biology and conservation of martens, sables, and fishers: A new synthesis.* (pp. 231-254). Ithaca, NY: Cornell University Press. Planning record exhibit # 00532.

Rancourt, S. J., Rule, M. I., & O'Connell, M. A. (2005). Maternity roost site selection of long-eared myotis, *Myotis evotis*. *Journal of Mammalogy, 86*(1), 77-84. doi:10.1644/1545-1542(2005)086<0077:Mrssol>2.0.Co;2. Retrieved from http://apps.webofknowledge.com/InboundService.do?SID=3AJjtPMBs6x4X3mH3ic&product=WOS&UT=WOS%3A000227097200011&SrcApp=EndNote&DestFail=http%3A%2F%2Fwww.webofknowledge.com&action=retrieve&Init=Yes&SrcAuth=ResearchSoft&customersID=ResearchSoft&Func=Frame&IsProductCode=Yes&mode=FullRecord.

Reeves, G. H., Pickard, B. R., & Johnson, K. N. (2016). *An initial evaluation of potential options for managing riparian reserves of the Aquatic Conservation Strategy of the Northwest Forest Plan*. General Technical Report PNW-GTR-937. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. Retrieved from https://www.fs.fed.us/pnw/pubs/pnw_gtr937.pdf.

Reichel, J. D., & Beckstrom, S. G. (1994). *Northern bog lemming survey: 1993*. Helena, MT: Montana Natural Heritage Program. Retrieved from http://mtnhp.org/animal/reports/mammals/NBL_survey_1993.pdf, http://mtnhp.org/Reports.asp?key=7.

Reichel, J. D., & Corn, J. G. (1997). *Northern bog lemmings: Survey, population parameters, and population analysis*. Helena, MT: Retrieved from http://mtnhp.org/animal/reports/mammals/NBLSurvey_pop_parm_anly.pdf.

Reichel, J. D., & Genter, D. L. (1996). *Harlequin duck surveys in western Montana: 1995*. Helena, MT: Montana Natural Heritage Program. Retrieved from https://ia902308.us.archive.org/24/items/harleoct1996quinducksurreicrich/harleoct1996quinducksurreicrich.pdf, https://archive.org/details/harleoct1996quinducksurreicrich.

Reynolds, P. E., Reynolds, H. V., & Follmann, E. H. (1986). Responses of grizzly bears to seismic surveys in northern Alaska. In P. E. Zager & D. L. Garshelis (Eds.), *Bears--Their biology and management: Proceedings of the Sixth International Conference on Bear Research and Management, held at Grand Canyon, AZ, USA.* (pp. 169-175). Madison, WI: International Association for Bear Research and Management.

Reynolds, R. T., Graham, R. T., & Boyce Jr., D. A. (2008). Northern goshawk habitat: An intersection of science, management, and conservation. *Journal of Wildlife Management, 72*(4), 1047-1055. Retrieved from <Go to ISI>://WOS:000255304700026, http://www.bioone.org/doi/pdf/10.2193/2007-131, http://dx.doi.org/10.2193/2007-131.

Reynolds, R. T., Graham, R. T., & Reiser, M. H. (1992). *Management recommendations for the northern goshawk in the southwestern United States*. Fort Collins, CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Retrieved from https://www.treesearch.fs.fed.us/pubs/6420, https://www.fs.fed.us/rm/pubs_rm/rm_gtr217.pdf.

Roy, K. D. (1991). *Ecology of reintroduced fishers in the Cabinet Mountains of northwest Montana.* (MS thesis), University of Montana, Missoula, MT.

Ruby, M. (2014). *Evaluation of grizzly bear (Ursus arctos) movement and habitat use in relationship to human development in the Swan-Clearwater Valleys, Montana.* (MS thesis), University of Montana, Missoula, MT. Retrieved from http://scholarworks.umt.edu/do/search/?q=ruby%20grizzly&start=0&context=4678273, http://scholarworks.umt.edu/etd/4344/ (Paper 4344).

Ruby, M., Baty, R., & Kloetzel, S. (2016). *2015 Swan Valley Grizzly Bear Conservation Agreement monitoring report*. Planning record exhibit # 00420.

Ruediger, B., Claar, J., Mighton, S., Naney, B., Rinaldi, T., Wahl, F., . . . Lewis, L. (2000). *Canada lynx conservation assessment and strategy*. U.S. Fish and Wildlife Service. Retrieved from http://digitalcommons.unl.edu/usfwspubs/197/.

Ruggiero, L. F., Aubry, K. B., Buskirk, S. W., Koehler, G. M., Krebs, C. J., McKelvey, K. S., & Squires, J. R. (1999). *Ecology and conservation of lynx in the United States*. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. Retrieved from https://www.fs.fed.us/rm/pubs/rmrs_gtr030.html, https://www.treesearch.fs.fed.us/pubs/4546.

Ruggiero, L. F., Aubry, K. B., Buskirk, S. W., Lyon, L. J., & Zielinski, W. J. (1994). *The scientific basis for conserving forest carnivores: American marten, fisher, lynx, and wolverine in the western United States*. Fort Collins, CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Retrieved from https://www.fs.fed.us/rm/pubs_rm/rm_gtr254.pdf, https://www.treesearch.fs.fed.us/pubs/6421.

Running, S. (2016). [Email from S. Running to R. Kuennen Sept. 23 re: time frame for climate change]. Planning record exhibit # 00403.

Saab, V. A., Dudley, J., & Thompson, W. L. (2004). Factors influencing occupancy of nest cavities in recently burned forests. *Condor, 106*(1), 20-36. doi:10.1650/7485. Retrieved from <Go to

ISI>://WOS:000188861500003, http://www.bioone.org/doi/abs/10.1650/7485, http://dx.doi.org/10.1650/7485, http://www.bioone.org/doi/full/10.1650/7485.

Saab, V. A., & Dudley, J. G. (1998). *Responses of cavity-nesting birds to stand-replacement fire and salvage logging in ponderosa pine/Douglas-fir forests of southwestern Idaho*. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station. Retrieved from https://www.treesearch.fs.fed.us/pubs/23853, https://www.fs.fed.us/rm/pubs/rmrs_rp011.pdf.

Saab, V. A., Russell, R. E., & Dudley, J. G. (2007). Nest densities of cavity-nesting birds in relation to postfire salvage logging and time since wildfire. *The Condor, 109*, 97-108. Retrieved from https://www.treesearch.fs.fed.us/pubs/27685, https://www.fs.fed.us/rm/pubs_other/rmrs_2007_saab_v001.pdf.

Samson, F. B. (2006a). *A conservation assessment of the northern goshawk, black-backed woodpecker, flammulated owl, and pileated woodpecker in the Northern Region, U.S. Department of Agriculture, Forest Service*. Missoula, MT: USDA Forest Service, Northern Region. Planning record exhibit # 00383.

Samson, F. B. (2006b). *Habitat estimates for maintaining viable populations of the northern goshawk, black-backed woodpecker, flammulated owl, pileated woodpecker, American marten, and fisher*.USDA Forest Service. Planning record exhibit # 00401.

Sanders, T. A., & Edge, W. D. (1998). Breeding bird community composition in relation to riparian vegetation structure in the western United States. *Journal of Wildlife Management, 62*(2), 461-473. doi:10.2307/3802320. Retrieved from <Go to ISI>://WOS:000073175200003.

Sauder, J. D. (2014). *Landscape ecology of fishers (Pekania pennanti) in north-central Idaho.* (PhD dissertation), University of Idaho, Moscow, ID. Planning record exhibit # 00534.

Sauder, J. D., & Rachlow, J. L. (2014). Both forest composition and configuration influence landscape-scale habitat selection by fishers (*Pekania pennanti*) in mixed coniferous forests of the northern Rocky Mountains. *Forest Ecology and Management, 314*, 75-84. doi:10.1016/j.foreco.2013.11.029. Retrieved from <Go to ISI>://WOS:000331851100009, http://www.sciencedirect.com/science/article/pii/S0378112713007846.

Savoy, L. (2004). *Summary of capture and banding efforts and methylmercury exposure to Montana's breeding common ;oon population, 1996-97, 2003*. Gorham, ME: BioDiversity Research Institute. Retrieved from http://www.briloon.org/lucas-savoy-b-s#p4.

Schaming, T. D. (2015). Population-wide failure to breed in the Clark's nutcracker (*Nucifraga columbiana*). *PLoS ONE, 10*(5). doi:10.1371/journal.pone.0123917. Retrieved from <Go to ISI>://WOS:000354544200020, http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0123917.

Schwartz, C. C., Haroldson, M. A., & White, G. C. (2010). Hazards affecting grizzly bear survival in the Greater Yellowstone Ecosystem. *Journal of Wildlife Management, 74*(4), 654-667. doi:10.2193/2009-206. Retrieved from http://dx.doi.org/10.2193/2009-206, http://www.bioone.org/doi/abs/10.2193/2009-206, http://www.bioone.org/doi/full/10.2193/2009-206.

Schwartz, C. C., Miller, S. D., & Haroldson, M. A. (2003). Grizzly bear (*Ursus arctos*). In G. A. Feldhamer, B. C. Thompson, & J. A. Chapman (Eds.), *Wild mammals of North America: Biology, management, and conservation.* (2nd ed., pp. 556-586). Baltimore, MD: Johns Hopkins University Press. Retrieved from http://www.nrmsc.usgs.gov/staff/cschwartz/pubs, http://www.loc.gov/catdir/description/jhu051/2003007662.html, http://www.loc.gov/catdir/toc/ecip042/2003007662.html.

Schwartz, M. K. (2007). Ancient DNA confirms native Rocky Mountain fisher (*Martes pennanti*) avoided early 20th century extinction. *Journal of Mammalogy, 88*(4), 921-925. doi:10.1644/06-Mamm-a-217r1.1. Retrieved from <Go to ISI>://WOS:000249077500008.

Schwartz, M. K., Copeland, J. P., Anderson, N. J., Squires, J. R., Inman, R. M., McKelvey, K. S., . . . Cushman, S. A. (2009). Wolverine gene flow across a narrow climatic niche. *Ecology, 90*(11), 3222-3232. doi:10.1890/08-1287.1. Retrieved from <Go to ISI>://WOS:000271457300025, http://www.esajournals.org/doi/abs/10.1890/08-1287.1, http://dx.doi.org/10.1890/08-1287.1

Schwartz, M. K., DeCesare, N. J., Jimenez, B. S., Copeland, J. P., & Melquist, W. E. (2013). Stand- and landscape-scale selection of large trees by fishers in the Rocky Mountains of Montana and Idaho.

Forest Ecology and Management, 305, 103-111. Retrieved from http://dx.doi.org/10.1016/j.foreco.2013.05.014.

Scott, J. M., Goble, D. D., Wiens, J. A., Wilcove, D. S., Bean, M., & Male, T. (2005). Recovery of imperiled species under the Endangered Species Act: The need for a new approach. *Frontiers in Ecology and the Environment, 3*(7), 383-389. doi:10.1890/1540-9295(2005)003[0383:Roisut]2.0.Co;2. Retrieved from http://onlinelibrary.wiley.com/doi/10.1890/1540-9295(2005)003[0383:ROISUT]2.0.CO;2/abstract, http://onlinelibrary.wiley.com/doi/10.1890/1540-9295(2005)003%5B0383:ROISUT%5D2.0.CO;2/epdf.

Seidensticker, M. T., Holt, D. W., & Larson, M. D. (2013). Breeding status of flammulated owls in Montana. *Northwestern Naturalist, 94*, 171-179. doi:http://dx.doi.org/10.1898/12-17.1. Retrieved from http://www.bioone.org/doi/full/10.1898/12-17.1.

Semlitsch, R. D., & Bodie, J. R. (2003). Biological criteria for buffer zones around wetlands and riparian habitats for amphibians and reptiles. *Conservation Biology, 17*(5), 1219-1228. doi:10.1046/j.1523-1739.2003.02177.x. Retrieved from <Go to ISI>://WOS:000185473000008.

Semlitsch, R. D., Todd, B. D., Blomquist, S. M., Calhoun, A. J. K., Gibbons, J. W., Gibbs, J. P., . . . Rothermel, B. B. (2009). Effects of timber harvest on amphibian populations: Understanding mechanisms from forest experiments. *Bioscience, 59*(10), 853-862. doi:10.1525/bio.2009.59.10.7. Retrieved from <Go to ISI>://WOS:000271420000008.

Servheen, C. (1981). *Grizzly bear ecology and management in the Mission Mountains, Montana.* (PhD dissertation), University of Montana, Missoula, MT.

Servheen, C. (1983). Grizzly bear food-habits, movements, and habitat selection in the Mission Mountains, Montana. *Journal of Wildlife Management, 47*(4), 1026-1035. doi:10.2307/3808161. Retrieved from http://www.jstor.org/stable/3808161?origin=crossref, http://www.jstor.org/stable/3808161, http://www.jstor.org/stable/pdf/3808161.pdf?acceptTC=true.

Servheen, C. (2017). Common themes in recent human fatalities due to grizzly bear attacks. In The Wildlife Society (Ed.), *Montana Chapter of the Wildlife Society held jointly with the Northwest Section of the Wildlife Society 55th annual conference--Habitat: The science, art, and politics of conserving it.* (pp. 52). Helena, MT: Montana Chapter of the Wildlife Society. Retrieved from http://wildlife.org/wp-content/uploads/2015/05/MCWS-Progam-02-25-2017-Single-pages-Optimized.pdf. Planning record exhibit # 00561.

Servheen, C., & Cross, M. (2010). *Climate change impacts on grizzly bears and wolverines in the Northern U.S. and transboundary Rockies: Strategies for conservation*. Missoula, MT: U.S. Fish and Wildlife Service and Wildlife Conservation Society. Retrieved from http://www.igbconline.org/index.php/y-reports/228-climate-change-grizzlies-and-wolverines-transboundary-workshop-report.

Shaffer, S. C. (1971). *Some ecological relationships of grizzly bears and black bears of the Apgar Mountains in Glacier National Park, Montana.* (MS thesis), University of Montana, Missoula, MT. Retrieved from http://scholarworks.umt.edu/cgi/viewcontent.cgi?article=4636&context=etd.

Sherwin, H. A., Montgomery, W. I., & Lundy, M. G. (2013). The impact and implications of climate change for bats. *Mammal Review, 43*(3), 171-182. doi:10.1111/j.1365-2907.2012.00214.x. Retrieved from http://dx.doi.org/10.1111/j.1365-2907.2012.00214.x.

Simmons, C. A. (1974). *Seasonal movements and migration of the Spotted Bear elk herd*. Missoula, MT: Montana Fish and Game.

Simonin, K. A. (2000). *Vaccinium membranaceum*. Fire Effects Information System. Retrieved from http://www.feis-crs.org/beta/faces/index.xhtml, http://www.fs.fed.us/database/feis/plants/shrub/vacmem/all.html.

Singer, F. J. (1978). Behavior of mountain goats in relation to United States Highway 2, Glacier National Park, Montana. *Journal of Wildlife Management, 42*(3), 591-597. doi:10.2307/3800822. Retrieved from <Go to ISI>://WOS:A1978FN08300017, http://www.jstor.org/stable/3800822?origin=crossref, http://www.jstor.org/stable/3800822.

Singer, F. J., & Doherty, J. L. (1985). Managing mountain goats at a highway crossing. *Wildlife Society Bulletin, 13*(4), 469-477. Retrieved from <Go to ISI>://WOS:A1985AVT9100015, http://www.jstor.org/stable/3782673.

Skelly, D. K., Werner, E. E., & Cortwright, S. A. (1999). Long-term distributional dynamics of a Michigan amphibian assemblage. *Ecology, 80*(7), 2326-2337. doi:10.1890/0012-9658(1999)080[2326:Ltddoa]2.0.Co;2. Retrieved from <Go to ISI>://WOS:000083009400016.

Smith, B. L., & DeCesare, N. J. (2017). *Status of Montana's mountain goats: A synthesis of management data 91960-2015) and field biologists' perspectives; Final report: 1 May 2017*. Missoula, MT: W. P. Montana Fish. Retrieved from https://www.researchgate.net/publication/317098994_Status_of_Montana%27s_mountain_goats_A_synthesis_of_management_data_1960-2015_and_field_biologists%27_perspectives.

Smucker, K., Cilimburg, A., & Fylling, M. (2008). *2008 flammulated owl surveys: Final report*. Missoula, MT: Avian Science Center. Retrieved from http://avianscience.dbs.umt.edu/research_landbird_flam.htm.

Smucker, T., Garrot, B., & Gude, J. (2011). *Synthesizing moose management, monitoring, past research and future research needs in Montana*.Montana State University and Montana Fish, Wildlife and Parks. Retrieved from http://fwp.mt.gov/fishAndWildlife/diseasesAndResearch/research/moose/populationsMonitoring/default.html.

Sneck, K. M. D. (1977). *The fire history of Coram Experimental Forest.* (MS thesis), University of Montana, Missoula, MT. Retrieved from https://www.fs.fed.us/rm/pubs_exp_forests/coram/rmrs_1970_sneck_k001.pdf.

Soutiere, E. C. (1979). Effects of timber harvesting on marten in Maine. *Journal of Wildlife Management, 43*(4), 850-860. doi:10.2307/3808268. Retrieved from <Go to ISI>://WOS:A1979HQ22700002.

Spies, T. A., Johnson, K. N., Burnett, K. M., Ohmann, J. L., McComb, B. C., Reeves, G. H., . . . Garber-Yonts, B. (2007). Cumulative ecological and socioeconomic effects of forest policies in coastal Oregon. *Ecological Applications, 17*(1), 5-17. doi:10.1890/1051-0761(2007)017[0005:Ceaseo]2.0.Co;2. Retrieved from <Go to ISI>://WOS:000245588400002.

Squires, J. (2015). Email from J. Squires to R. Kuennen re: Canada lynx and snowmobiles, Dec. 22, 2015. Planning record exhibit # 00241.

Squires, J. R., Copeland, J. P., Ulizio, T. J., Schwartz, M. K., & Ruggiero, L. F. (2007). Sources and patterns of wolverine mortality in western Montana. *Journal of Wildlife Management, 71*(7), 2213-2220. doi:10.2193/2007-053. Retrieved from http://dx.doi.org/10.2193/2007-053, http://www.bioone.org/doi/pdf/10.2193/2007-053, http://www.bioone.org/doi/full/10.2193/2007-053.

Squires, J. R., DeCesare, N. J., Kolbe, J. A., & Ruggiero, L. F. (2008). Hierarchical den selection of Canada lynx in western Montana. *Journal of Wildlife Management, 72*(7), 1497-1506. doi:10.2193/2007-396. Retrieved from http://www.bioone.org/doi/abs/10.2193/2007-396
http://www.bioone.org/doi/pdf/10.2193/2007-396
http://www.bioone.org/doi/full/10.2193/2007-396.

Squires, J. R., Decesare, N. J., Kolbe, J. A., & Ruggiero, L. F. (2010). Seasonal resource selection of Canada lynx in managed forests of the northern Rocky Mountains. *Journal of Wildlife Management, 74*(8), 1648-1660. doi:10.2193/2009-184. Retrieved from http://www.bioone.org/doi/full/10.2193/2009-184.

Squires, J. R., DeCesare, N. J., Olson, L. E., Kolbe, J. A., Hebblewhite, M., & Parks, S. A. (2013). Combining resource selection and movement behavior to predict corridors for Canada lynx at their southern range periphery. *Biological Conservation, 157*, 187-195. doi:10.1016/j.biocon.2012.07.018. Retrieved from <Go to ISI>://WOS:000316651200022, http://www.sciencedirect.com/science/article/pii/S0006320712003382.

Squires, J. R., & Kennedy, P. L. (2006). Northern goshawk ecology: An assessment of current knowledge and information needs for conservation and management. *Studies in Avian Biology, 31*, 8-62. Retrieved from https://www.treesearch.fs.fed.us/pubs/50153, https://www.fs.fed.us/rm/pubs_journals/2006/rmrs_2006_squires_j001.pdf.

Squires, J. R., & Laurion, T. (2000). Lynx home range and movements in Montana and Wyoming: Preliminary results. In L. F. Ruggiero, K. B. Aubry, S. W. Buskirk, G. M. Koehler, C. J. Krebs, K. S. McKelvey, & J. R. Squires (Eds.), *Ecology and conservation of lynx in the United States.* (Vol. General Technical Report RMRS-GTR-30WWW, pp. 337-350). Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. Retrieved from https://www.fs.fed.us/rm/pubs/rmrs_gtr030/rmrs_gtr030_337_350.pdf.

Squires, J. R., & Reynolds, R. T. (1997). Northern goshawk (*Accipiter gentilis*). *The birds of North America online.* Cornell Lab of Ornithology. Retrieved from http://bna.birds.cornell.edu/bna/species/298.

Squires, J. R., & Ruggiero, L. F. (2007). Winter prey selection of Canada lynx in northwestern Montana. *The Journal of Wildlife Management, 71*(2), 310-315. doi:10.2193/2005-445. Retrieved from http://www.jstor.org/stable/4495187.

Squires, J. R., Ruggiero, L. F., Kolbe, J. A., & DeCesare, N. J. (2006). *Lynx ecology in the intermountain West*. Missoula, MT: USDA Forest Service, Rocky Mountain Research Station. Retrieved from http://www.rmrs.nau.edu/people/jsquires/index.shtml?awa=yes, http://www.rmrs.nau.edu/publications/Lynx_Research_Program_Summary7_19_06_Final/Lynx_Research_Program_Summary7_19_06_Final.pdf.

Staab, C. (2017). *Flathead National Forest harlequin duck monitoring, 1990-2017*. Missoula, MT: USDA Forest Service, Northern Region. Planning record exhibit # 00146.

Stansberry, B. J. (1991). *Distribution, movements, and habitat use during spring, summer, and fall by mule deer in the north Salish Mountains, Montana.* (MS thesis), Montana State University, Bozeman, MT. Planning record exhibit # 00362.

Stenhouse, G., & Boulanger, J. (2016). [E-mails to M. Ruby January 2016 on road density covariate]. Planning record exhibit # 00192.

Stewart, B. P., Nelson, T. A., Laberee, K., Nielsen, S. E., Wulder, M. A., & Stenhouse, G. (2013). Quantifying grizzly bear selection of natural and anthropogenic edges. *Journal of Wildlife Management, 77*(5), 957-964. doi:10.1002/jwmg.535. Retrieved from <Go to ISI>://WOS:000320937000010, http://onlinelibrary.wiley.com/doi/10.1002/jwmg.535/epdf.

Stewart, I. T., Cayan, D. R., & Dettinger, M. D. (2004). Changes in snowmelt runoff timing in western North America under a 'business as usual' climate change scenario. *Climatic Change, 62*(1-3), 217-232. doi:10.1023/B:Clim.0000013702.22656.E8. Retrieved from <Go to ISI>://WOS:000188531900009, http://link.springer.com/article/10.1023%2FB%3ACLIM.0000013702.22656.e8.

Stone, K. (2010). *Martes americana*: American marten. *Fire effects information system [online]*. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Retrieved from https://www.fs.fed.us/database/feis/animals/mammal/maam/all.html.

Sumner, J., & Craighead, J. J. (1973). *Grizzly bear habitat survey in the Scapegoat Wilderness, Montana*. Missoula, MT: Montana Cooperative Wildlife Research Unit.

Swanson, J. (2017). *Flathead National Forest: Northwest Crown of the Continent forest carnivore inventory 2017 update*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00670.

SWCC. (2014). *Forest carnivore monitoring in the Southwestern Crown of the Continent: Progress report 2012-2014*. Progress report 2012-2014.Southwestern Crown Carnivore Monitoring Team. Retrieved from http://www.swcrown.org/monitoring/wildlife-monitoring/. Planning record exhibit # 00185.

SWCC. (2015). *Forest carnivore monitoring in the Southwestern Crown of the Continent: 2015 progress report*.USDA Forest Service, Southwestern Crown Collaborative. Retrieved from http://www.swcrown.org/wp-content/uploads/2015/01/2015-SWCC-Carnivore-Monitoring-Progress-Report-05162016.pdf. Planning record exhibit # 00404.

Swenson, J. E., Sandegren, F., Brunberg, S., & Wabakken, P. (1997). Winter den abandonment by brown bears *Ursus arctos*: Causes and consequences. *Wildlife Biology, 3*(1), 35-38. Retrieved from <Go to ISI>://WOS:000208522500004.

Teisberg, J. E., Madel, M. J., Mace, R. D., Servheen, C. W., & Robbins, C. T. (2015). *Diet composition and body condition of Northern Continental Divide grizzly bears: Final report, March 2015*.U.S. Fish and Wildlife Service. Planning record exhibit # 00363.

Telfer, E. S. (1995). Moose range under presettlement fire cycles and forest management regimes in the boreal forest of western Canada. *Alces, 31*, 153-165. Retrieved from http://flash.lakeheadu.ca/~arodgers/Alces/backissues.html, http://flash.lakeheadu.ca/~arodgers/Alces/vol31_1995.html.

Temple, S. A. (1986). Ecological principles of wildlife management. In J. B. Hale, L. B. Best, & R. L. Clawson (Eds.), *Management of nongame wildlife in the Midwest: A developing art: Proceedings of a symposium held at the 47th Midwest Fish and Wildlife Conference, Grand Rapids, Michigan, 17 December, 1985*. North Central Section, The Wildlife Society.

The White House. (2014). Presidential memorandum--Creating a federal strategy to promote the health of honey bees and other pollinators [Press release]. Planning record exhibit # 00594.

Thomas, J. W. (1979). *Wildlife habitats in managed forests: The Blue Mountains of Oregon and Washington.* Agriculture Handbook No. 553. Washington, DC: USDA Forest Service. Retrieved from https://www.treesearch.fs.fed.us/pubs/6630, https://www.srs.fs.usda.gov/pubs/misc/agh553.pdf.

Thomas, J. W., & Toweill, D. E. (1982). *Elk of North America: Ecology and management.* Harrisburg, PA: Stackpole Books.

TNC (2016). Terrestrial local landscape permeability between grizzly bear ecosystems. Portland, OR: The Nature Conservancy. Planning record exhibit # 00230.

Tomback, D. F. (1998). Clark's nutcracker (*Nucifraga columbiana*). *The birds of North America online.* Cornell Labo of Ornithology. Retrieved from http://bna.birds.cornell.edu/bna/species/331.

Tomback, D. F., & Linhart, Y. B. (1990). The evolution of bird-dispersed pines. *Evolutionary Ecology, 4*(3), 185-219. doi:10.1007/Bf02214330. Retrieved from <Go to ISI>://WOS:A1990DU19600001, http://link.springer.com/article/10.1007%2FBF02214330.

Tomson, S. D. (1999). *Ecology and summer/fall habitat selection of American marten in northern Idaho.* (MS thesis), University of Montana, Missoula, MT.

Trechsel, H. (2014). *Summary information: Vegetation treatments, and wildfire on the FNF forest plan revision*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00545.

Trechsel, H. (2016). *Existing vegetation conditions--FIA data: Flathead National Forest plan revision, final EIS and revised forest plan*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00469.

Trechsel, H. (2017a). *Modeled natural range of variation, existing condition, and desired condition vegetation attributes and natural disturbances: Flathead forest plan revision*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00258.

Trechsel, H. (2017b). *Snag and down wood analysis documentation [Flathead National Forest]*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00487.

Turnock, B., & Anderson, A. (2012). *Northern bog lemming (Synaptomis borealis) survey of northwest Montana*. Kalispell, MT: Montana Fish, Wildlife and Parks. Planning record exhibit # 00373.

Unsworth, J. W., & Kuck, L. (1991). Bull elk vulnerability in the Clearwater drainage of north-central Idaho. In A. G. Christensen, L. J. Lyon, & T. N. Lonner (Eds.), *Proceedings of elk vulnerability: A symposium.* Bozeman, MT: Montana Department of Fish, Wildlife and Parks.

USDA-USDI. (2000). *Canada lynx threatened species biological assessment: Privately operated down hill ski areas on federal lands in the State of Montana*.USDA Forest Service and USDI Bureau of Land Management. Planning record exhibit # 00346.

USDA-USFWS. (2008). *Memorandum of understanding between the U.S. Department of Agriculture, Forest Service and the U.S. Fish and Wildlife Service to promote the conservation of migratory birds (FS Agreement# 08-MU-1113-2400-264)*. Planning record exhibit # 00380.

USDA-USFWS. (2016). *Addendum [to 2008 MOU]: Memorandum of understanding between the U.S. Forest Service and the U.S. Fish and Wildlife Service to promote the conservation of migratory birds*. Washington, DC: USDA Forest Service and U.S. Fish and Wildlife Service. Planning record exhibit # 00371.

USDA. (1980). *Land system inventory of the Scapegoat and Danaher portion of the Bob Marshall Wilderness*. Kalispell, MT: USDA Forest Service, Flathead National Forest.

USDA. (1986). *Flathead National Forest management plan (2001 version)*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Retrieved from https://www.fs.usda.gov/main/flathead/landmanagement/planning.

USDA. (1994). *Biological assessment for Flathead National Forest plan amendment 19*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00197.

USDA. (1995a). *Amendment 19 to the Flathead National Forest Plan environmental impact statement: Allowable sale quantity and objectives and standards for grizzly bear habitat management*. Kalispell, MT: USDA Forest Service, Flathead National Forest.

USDA. (1995b). *Decision notice: Amendment to the Flathead National Forest land and resource management plan, Flathead National Forest, Montana: Amendment no. 19, allowable sale quantity and objectives and standards for grizzly bear habitat management*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00193.

USDA. (1995c). *Inland native fish strategy: Decision notice and finding of no significant impact and environmental assessment*. [place of publication unknown]: USDA Forest Service, Intermountain, Northern, and Pacific Northwest Regions. Retrieved from https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_033158.pdf. Planning record exhibit # 00365.

USDA. (1996). *Status of the Interior Columbia Basin: Summary of scientific findings*. Portland, OR: USDA Forest Service, Pacific Northwest Research Station; USDI, Bureau of Land Management. Retrieved from https://www.fs.fed.us/pnw/publications/pnw_gtr385/, https://www.treesearch.fs.fed.us/pubs/25385.

USDA. (1999). *Record of decision: Amendment to the Flathead National Forest Land and Resource Management Plan--Amendment no. 21 management direction related to old growth forests*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00440.

USDA. (2000). *Lynx habitat mapping of habitat types: Unsuitable areas*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00233.

USDA. (2004). *Updated biological assessment of the proposed revised schedule for implementation of amendment 19 of the Flathead National Forest plan*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00348.

USDA. (2006). *Winter motorized recreation plan, record of decision*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Retrieved from http://merid.org/~/media/Files/Projects/FNF/Recreation/Amendment24Winter%20Motorized%20Rec%20Plan.pdf. Planning record exhibit # 00235.

USDA. (2007a). *Appendix F: Projected fuels treatments in lynx habitat within the northern Rockies lynx amendment area*. Missoula, MT: USDA Forest Service, Northern Region. Planning record exhibit # 00341.

USDA. (2007b). *Lynx habitat in the N. Rockies lynx amendment area by wilderness and roadless area designation*. Missoula, MT: USDA Forest Service, Northern Region. Planning record exhibit # 00342.

USDA. (2007c). *Northern Rockies lynx management direction record of decision, national forests in Montana, and parts of Idaho, Wyoming, and Utah*. Missoula, MT: USDA Forest Service, Northern Region. Retrieved from http://www.snowmobileinfo.org/snowmobile-access-docs/Northern-Rockies-Lynx-Management-Direction-ROD_2007.pdf, http://www.fs.fed.us/r1/planning/lynx.html.

USDA. (2007d). *Northern Rockies lynx management direction: Final environmental impact statement (vols. 1 and 2)*. Missoula, MT: USDA Forest Service, Northern Region. Retrieved from https://www.fs.usda.gov/wps/portal/fsinternet/!ut/p/c5/04_SB8K8xLLM9MSSzPy8xBz9CP0os3gjAwhwtDDw9_AI8zPwhQoY6IeDdGCqCPOBqwDLG-AAjgb6fh75uan6BdnZaY6OiooA1tkqlQ!!/dl3/d3/L2dJQSEvUUt3QS9ZQnZ3LzZfMjAwMDAwMDBBODBPSEhWTjJNMDAwMDAwMDA!/?navtype=BROWSEBYSUBJECT&cid=stelprdb5160650&navid=160120000000000&pnavid=160000000000000&ss=1101&position=Not%20Yet%20Determined.Html&ttype=detail&pname=Region%201-%20Resource%20Management.

USDA. (2010a). *Animal enhancement activity--ANM19--Wildlife corridors: 2011 ranking period 1*.USDA Natural Resources Conservation Service. Retrieved from https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_043327.pdf.

USDA. (2010b). *Food storage special order LC 10 D1 01: Occupancy and use restrictions, Northern Continental Divide Ecosystem, Flathead, Lolo, Helena and Lewis and Clark, National Forests, Region One, USDA, Forest Service*. Missoula, MT: USDA Forest Service, Region 1. Planning record exhibit # 00389.

USDA. (2010c). *Kootenai Idaho Panhandle Zone (KIPZ) climate change report*. Missoula, MT: USDA Forest Service, Region 1.

USDA. (2011a). *Food/wildlife attractant storage special order: Flathead National Forest, order number F10-076-L-11*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00390.

USDA. (2011b). *Sensitive species list: Forest Service, Region 1, February 2011*.USDA Forest Service, Northern Region. Planning record exhibit # 00630.

USDA. (2011c). *Updated baseline for the grizzly bear management direction outside the Northern Continental Divide Ecosystem recovery zone*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00337.

USDA. (2012). *Assessment of implementation of winter motorized recreation (amendment 24), Flathead National Forest plan: 2011-2012 monitoring report*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00525.

USDA. (2013a). *Final environmental impact statement for the revised land management plan, Kootenai National Forest*. Libby, MT: USDA Forest Service, Kootenai National Forest. Retrieved from https://www.fs.usda.gov/main/kootenai/landmanagement/planning, https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5436479.pdf.

USDA. (2013b). *Outstandingly remarkable values assessment of the Flathead River system, Flathead National Forest, Glacier National Park*. Kalispell, MT: USDA Forest Service, Flathead National Forest and USDI National Park Service. Retrieved from https://allisonlinville.files.wordpress.com/2014/07/forest-service-orv-assessment-2013.pdf.

USDA. (2014a). *2013 annual Flathead National Forest forest plan amendment 19 implementation monitoring report and responses to amendment 19 revised implementation schedule terms and conditions*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00436.

USDA. (2014b). *Assessment of the Flathead National Forest, part 1, part 2, and appendices A-E*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Retrieved from https://www.fs.usda.gov/detailfull/flathead/home/?cid=stelprdb5422786&width=full.

USDA. (2014c). *Attendees and topics discussed at interagency meeting: U.S. Forest Service and U.S. Fish and Wildlife Service, Dec. 11, 2014, Flathead National Forest Supervisor's Office, Kalispell, MT*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00158.

USDA. (2014d). *Final identification and inventory of lands on the Flathead National Forest that may be suitable for inclusion in the National Wilderness Preservation System*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00454.

USDA (2014e). Montana Natural Heritage Program marten observations (trapping): Flathead National Forest, 1942-2011. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00060.

USDA. (2015a). *Attendees and topics discussed at interagency coordination meeting, June 18, 2015, Flathead National Forest Supervisor's Office, Kalispell, MT*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00138.

USDA. (2015b). *Attendees and topics discussed at meeting with the NCDE Grizzly Bear Conservation Strategy tream, December 1, 2015, at Hungry Horse Ranger District office*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00162.

USDA. (2015c). *Flathead National Forest amendment 24 monitoring report: Assessment of implementation of winter motorized recreation, 2013-2014*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00496.

USDA. (2015d). *Informational memorandum re: national strategy to promote the health of honey bees and other pollinators*. Washington, DC: USDA Forest Service, Washington Office. Planning record exhibit # 00595.

USDA (2015e). Map of geographic units in Salish demographic connectivity area, Flathead National Forest. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00491.

USDA. (2016a). *2015 Flathead National Forest annual report for the Amendment 19 biological opinion concerning terrestrial species, including August 19, 2016 updates*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00338.

USDA. (2016b). *Attendees and topics discussed during U.S. Forest Service and U.S. Fish and Wildlife Service conference call, April 27, 2016*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00163.

USDA. (2016c). *Corrected 2015 annual Flathead National Forest forest plan amendment 19 implementation monitoring report and responses to amendment 19 revised implementation schedule terms and conditions*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00338.

USDA. (2016d). *Plan components for drivers and stressors*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00587.

USDA. (2016e). *Winter motorized recreation forest plan amendment monitoring report, 2014-2015, Flathead National Forest*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00526.

USDA. (2017). *Flathead National Forest evaluation and compliance with National Forest Management Act requirements to provide for viability and diversity of animal communities*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00246.

USDA (n.d.). Flathead National Forest wolverine observations. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00067.

USDC-Missoula. (2014). *Swan View Coalition, Friends of the Wild Swan, Native Ecosystems Council, and Alliance for the Wild Rockies, plaintiffs, vs. Chip Weber, Flathead National Forest supervisor, et al., defendants*. Missoula, MT: U.S. District Court for the District of Montana, Missoula Division. Planning record exhibit # 00092.

USDI-BR. (1994). *Montana bald eagle management plan*. Billings, MT: USDI Bureau of Reclamation. Retrieved from http://www.fws.gov/montanafieldoffice/Endangered_Species/Recovery_and_Mgmt_Plans/Montana_Bald_Eagle_mgmt_plan.pdf, http://www.fws.gov/montanafieldoffice/Endangered_Species/Recovery_and_Mgmt_Plans.html.

USFWS. (1986). *Recovery plan for the Pacific bald eagle*. Portland, OR: U.S. Fish and Wildlife Service. Retrieved from https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3847245.pdf.

USFWS. (1987). *Northern Rocky Mountain wolf recovery plan*. Denver, CO: U.S. Fish and Wildlife Service. Retrieved from http://www.fws.gov/montanafieldoffice/Endangered_Species/Recovery_and_Mgmt_Plans/Northern_Rocky_Mountain_Gray_Wolf_Recovery_Plan.pdf.

USFWS. (1989). *Biological opinion on Summit House Restaurant expansion on Big Mountain, Flathead National Forest*. Helena, MT: U.S. Fish and Wildlife Service, Fish and Wildlife Enhancement. Planning record exhibit # 00481.

USFWS. (1993). *Grizzly bear recovery plan*. Missoula, MT: U.S. Fish and Wildlife Service. Retrieved from https://www.fws.gov/mountain-prairie/es/species/mammals/grizzly/Grizzly_bear_recovery_plan.pdf, http://www.fws.gov/mountain-prairie/species/mammals/grizzly/.

USFWS. (1995a). *Biological opinion on Big Mountain Ski Area expansion, Flathead National Forest*. Helena, MT: U.S. Fish & Wildlife Service, Ecological Services. Planning record exhibit # 00480.

USFWS. (1995b). *Biological opinion on the Flathead National Forest plan amendment 19*. Helena, MT: U.S. Fish and Wildlife Service, Ecological Services. Planning record exhibit # 00199.

USFWS. (1995c). *Consultation on the supplement to biological assessment of Feb. 10, 1995, for the Flathead National Forest amendment 19 to the forest plan and amendment to the incidental take* *statement in the Jan. 6, 1995, biological opinion*. Helena, MT: U.S. Fish and Wildlife Service, Ecological Services. Planning record exhibit # 00198.

USFWS. (1998). *Endangered and threatened wildlife and plants; Notice of 12-month finding on a petition to list the northern goshawk in the contiguous United States west of the 100th meridian*.Federal Register/Vol. 63, No. 124/Monday, June 29, 1998/Proposed Rules. Retrieved from https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_021351.pdf.

USFWS. (1999). *50 CFR Part 17, Endangered and Threatened Wildlife and Plants; Final Rule To Remove the American Peregrine Falcon From the Federal List of Endangered and Threatened Wildlife, and To Remove the Similarity of Appearance Provision for Free-Flying Peregrines in the Conterminous United States Federal Register/ Vol. 64, No. 164/ Wednesday, August 25, 1999/ Rules and Regulations 46542-46558*. U.S. Fish and Wildlife Service. Retrieved from https://www.federalregister.gov/articles/1999/08/25/99-21959/endangered-and-threatened-wildlife-and-plants-final-rule-to-remove-the-american-peregrine-falcon.

USFWS. (2001). *Biological opinion on the effects on lynx of ski resorts on Forest and BLM land in Montana*. Helena, MT: U.S. Fish and Wildlife Service, Montana Field Office. Planning record exhibit # 00345.

USFWS. (2003a). *Endangered and threatened wildlife and plants; notice of remanded determination of status for the contiguous United States distinct population segment of the Canada lynx; Clarification of findings; Final rule*. Federal Register. Retrieved from https://www.fws.gov/mountain-prairie/species/mammals/lynx/lynxremandfrnotice.pdf.

USFWS. (2003b). *Post-delisting monitoring results for the American peregrine falcon (Falco peregrinus anatum)*. Portland, OR: Federal Register. Retrieved from http://www.fws.gov/mountain-prairie/species/birds/apfalcon/Monitoring%20Results%20for%20Breeding%20American%20Peregrine%20Falcons.pdf.

USFWS. (2005a). *Biological opinion on the effects on grizzly bears of the Flathead National Forest plan amendment 19 revised implementation schedule*. Helena, MT: U.S. Fish and Wildlife Service, Ecological Services. Planning record exhibit # 00201.

USFWS. (2005b). *Recovery outline, contiguous United States distinct population segment of the Canada lynx*. Helena, MT: U.S. Fish and Wildlife Service, Region 6, Montana Field Office. Planning record exhibit # 00382.

USFWS. (2006a). *Biological opinion on the effects of the Flathead National Forest plan on grizzly bears*. Helena, MT: U.S. Fish and Wildlife Service, Montana Field Office. Planning record exhibit # 00336.

USFWS. (2006b). *Biological opinion on the effects of the winter motorized recreation forest plan amendment for the Flathead National Forest ("A24") on grizzly bears*. Helena, MT: U.S. Fish and Wildlife Service. Planning record exhibit # 00237.

USFWS. (2006c). *Biological opinion on the effects to grizzly bears, bull trout, and bull trout critical habitat from the implementation of proposed actions associated with plan of operation for the Revett RC Resources Incorporated Rock Creek Copper/Silver Mine as proposed by the U.S. Forest Service, Kootenai National Forest*.U.S. Fish and Wildlife Service, Montana Ecological Services Field Office. Retrieved from https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd499362.pdf. Planning record exhibit # 00442.

USFWS. (2006d). *Biological opinion on the proposed Troy mine*. Helena, MT: U.S. Fish and Wildlife Service, Ecological Services. Planning record exhibit # 00677.

USFWS. (2007a). *Biological opinion on Big Mountain downhill bicycle trail expansion project, Flathead National Forest*. Helena, MT: U.S. Fish & Wildlife Service, Ecological Services. Planning record exhibit # 00485.

USFWS. (2007b). *Biological opinion on the Northern Rockies lynx management decision*. Helena, MT: U.S. Fish and Wildlife Service. Planning record exhibit # 00339.

USFWS. (2009). *50 CFR Part 17, Federal Register /Vol. 74, No. 62 /Thursday, April 2, 2009 /Rules and Regulations / Endangered and Threatened Wildlife and Plants; Final Rule To Identify the Northern Rocky Mountain Population of Gray Wolf as a Distinct Population Segment and to Revise the List of Endangered and Threatened Wildlife, Pages 15123 - 15188 [FR DOC # E9-*

5991]. Washington, DC: U.S. Fish and Wildlife Service. Retrieved from http://www.gpo.gov/fdsys/pkg/FR-2009-04-02/pdf/E9-5991.pdf, http://www.gpo.gov/fdsys/browse/collection.action?collectionCode=FR, http://www.archives.gov/federal-register/cfr/about.html.

USFWS. (2010). *50 CFR Part 17, Federal Register / Vol. 75, No. 73 / Friday, April 16, 2010 / Proposed Rules. Endangered and threatened wildlife and plants; 90-day finding on a petition to list a distinct population segment of the fisher in its United States northern Rocky Mountain range as endangered or threatened with critical habitat, Pages 19925 - 19935 [FR DOC # 2010-8795]*. Washington, DC: U.S. Fish and Wildlife Service. Retrieved from http://www.gpo.gov/fdsys/browse/collection.action?collectionCode=FR, http://www.gpo.gov/fdsys/pkg/FR-2010-04-16/pdf/2010-8795.pdf, http://www.archives.gov/federal-register/cfr/about.html.

USFWS. (2011a). *50 CFR Part 17, Federal Register / Vol. 76, No. 126 / Thursday, June 30, 2011 / Proposed Rules. Endangered and threatened wildlife and plants; 12-month finding on a petition to list a distinct population segment of the fisher in its United States northern Rocky Mountain range as endangered or threatened with critical habitat, Pages 38503 - 38532 [FR DOC # 2011-16349]*. Washington, DC: U.S. Fish and Wildlife Service. Retrieved from http://www.gpo.gov/fdsys/browse/collection.action?collectionCode=FR, http://www.gpo.gov/fdsys/pkg/FR-2011-06-30/pdf/2011-16349.pdf, http://www.archives.gov/federal-register/cfr/about.html.

USFWS. (2011b). *Biological opinion on the proposed Big Mountain Chair 4 and Chair 5 Project, Flathead National Forest*. Helena, MT: U.S. Fish & Wildlife Service, Ecological Services. Planning record exhibit # 00484.

USFWS. (2011c). *Grizzly bear (Ursus arctos horribilis) 5-year review: Summary and evaluation*. Missoula, MT: U.S. Fish and Wildlife Service, Grizzly Bear Recovery Office. Retrieved from https://ecos.fws.gov/docs/five_year_review/doc3847.pdf. Planning record exhibit # 00211.

USFWS. (2012a). *2012 amended incidental take statement in response to Nov. 17, 2011, request for review of Flathead National Forest updated baseline for grizzly bear*. Helena, MT: U.S. Fish and Wildlife Service, Ecological Services. Planning record exhibit # 00335.

USFWS. (2012b). *Biological opinion on Big Mountain downhill bike trail expansion project, Flathead National Forest*. Helena, MT: U.S. Fish & Wildlife Service, Ecological Services. Planning record exhibit # 00486.

USFWS. (2012c). *Biological opinion on Flathead National Forest environmental baseline update for the September 23, 2005, effects of the Flathead National Forest plan on grizzly bears biological assessment (2011) and amended incidental take statement*. Helena, MT: U.S. Fish and Wildlife Service, Montana Field Office, Ecological Services. Planning record exhibit # 00597.

USFWS. (2012d). *Biological opinions on the effects of the Island Unit [Flathead National Forest] trail system addition project and management of the Island Unit under the forest plan on grizzly bears*. Helena, MT: U.S. Fish and Wildlife Service, Montana Field Office, Ecological Services. Planning record exhibit # 00598.

USFWS. (2013a). *50 CFR Part 17, Endangered and Threatened Wildlife and Plants; Threatened Status for the Distinct Population Segment of the North American Wolverine Occurring in the Contiguous United States. Federal Register / Vol. 78, No. 23 / Monday, February 4, 2013 / Proposed Rules/ Pages 7864-7890*. U.S. Fish and Wildlife Service. Retrieved from http://www.regulations.gov/, http://www.fws.gov/mountain-prairie/species/mammals/wolverine/, http://www.archives.gov/federal-register/cfr/about.html.

USFWS. (2013b). *Biological opinion on Whitefish Mountain Resort chair 8 project, Flathead National Forest*. Helena, MT: U.S. Fish & Wildlife Service, Ecological Services. Planning record exhibit # 00475.

USFWS. (2013c). *Draft Northern Continental Divide Ecosystem grizzly bear conservation strategy*. [place of publication unknown]: U.S. Fish and Wildlife Service. Retrieved from http://www.fws.gov/mountain-prairie/species/mammals/grizzly/continentalindex.html, http://www.fws.gov/mountain-prairie/species/mammals/grizzly/NCDE_Draft_CS_Apr2013_Final_Version_corrected_headers.pdf.

USFWS. (2013d). *Endangered and threatened wildlife and plants; Draft conservation strategy for the Northern Continental Divide Ecosystem grizzly bear. Federal Register / Vol. 78, No. 86 / Friday, May 3, 2013 / Notices/ Page 26064*. U.S. Fish and Wildlife Service. Retrieved from http://www.fws.gov/endangered/species/recovery-plans.html.

USFWS (2013e). Modeled wolverine habitat in western United States. Boise, ID: U.S. Fish and Wildlife Service. Planning record exhibit # 00033.

USFWS. (2014a). *50 CFR Part 17 Endangered and threatened wildlife and plants; Revised designation of critical habitat for the contiguous United States distinct population segment of the Canada Lynx and revised distinct population segment boundary; Final rule. Federal Register Vol. 79 (No. 177), September 12, 2014*. Washington, DC: U.S. Fish and Wildlife Service. Retrieved from https://www.fws.gov/mountain-prairie/species/mammals/lynx/CHFinalRule2014/20140912_Lynx_CH_Final_Rule_Fed_Reg.pdf.

USFWS. (2014b). *50 CFR Part 17, Threatened Status for the Distinct Population Segment of the North American Wolverine occurring in the Contiguous United States. U.S. Department of the Interior, Fish and Wildlife Service. Proposed rules; withdrawal. Federal Register / Vol. 79, No. 156 / Wednesday, August 13, 2014 / Proposed Rules, 47522-47545*. Retrieved from http://www.regulations.gov/, http://www.archives.gov/federal-register/cfr/about.html.

USFWS. (2014c). *Biological opinion on the effects of the Flathead National Forest plan amendment 19 revised implementation schedule on grizzly bears*. Helena, MT: U.S. Fish and Wildlife Service, Montana Field Office. Planning record exhibit # 00200.

USFWS. (2014d). *Final environmental assessment: Revised designation of critical habitat for the contiguous United States distinct population segment of the Canada lynx*. Denver, CO: U.S. Fish and Wildlife Service, Region 6. Retrieved from http://www.fws.gov/mountain-prairie/species/mammals/lynx/.

USFWS. (2014e). *U.S. Fish and Wildlife Service concurrence with programmatic biological assessment on North American wolverine: U.S. Forest Service Northern Region*. Helena, MT: U.S. Fish and Wildlife Service, Ecological Services, Montana Field Office. Planning record exhibit # 00652.

USFWS. (2015). *Biological opinion on the Big Mountain summit project, Flathead National Forest*. Helena, MT: U.S. Fish and Wildlife Service, Ecological Services. Planning record exhibit # 00476.

USFWS. (2016a). Court ruling reopens comment period on North American wolverine proposed listing rule [Press release]. Planning record exhibit # 00589.

USFWS (2016b). [Letter re: new information related to amendment 19, Swan Valley subunits, Flathead National Forest]. Planning record exhibit # 00394.

USFWS. (2017a). *50 CFR Part 17, Federal Register / Vol. 82, No. 192 / Thursday, October 5, 2017 / Proposed Rules. Endangered and threatened wildlife and plants: 12-month findings on petitions to list 25 species as endangered or threatened species, Pages 46618-46645*. Washington, DC: U.S. Fish and Wildlife Service.

USFWS. (2017b). *Biological opinion for the revised forest plan--Flathead National Forest*. Helena, MT: U.S. Fish & Wildlife Service, Ecological Services. Retrieved from www.fs.usda.gov/goto/flathead/fpr. Planning record exhibit # 00703.

USFWS. (2017c). *Biological opinion on the effects of the Northern Rockies Lynx Management Direction on designated critical habitat for Canada lynx*. Helena, MT: U.S. Fish and Wildlife Service, Ecological Services, Montana Field Office. Planning record exhibit # 00146.

USFWS. (2017d). *Species status assessment report for the northern Rocky Mountains Fisher (Pekania pennanti), version 2.0*. Denver, CO: U.S. Fish and Wildlife Service, Mountain-Prairie Region. Planning record exhibit # 00667.

USFWS. (2017e). *Threatened, endangered and candidate species for the Flathead National Forest, 11/17/2017*. Helena, MT: U.S. Fish and Wildlife Service, Ecological Services. Retrieved from https://www.fws.gov/montanafieldoffice/Endangered_Species/Listed_Species/Forests/Flathead_sp_list.pdf. Planning record exhibit # 00680.

Vanbianchi, C. M., Murphy, M. A., & Hodges, K. E. (2017). Canada lynx use of burned areas: Conservation implications of changing fire regimes. *Ecology and Evolution, 7*(7), 2382-2394. doi:10.1002/ece3.2824. Retrieved from <Go to ISI>://WOS:000399738700035.

Vander Wall, S. B., & Hutchins, H. E. (1983). Dependence of Clark's nutcracker, *Nucifraga columbiana*, on conifer seeds during postfledging period. *Canadian Field Naturalist, 97*(2), 208-214. Retrieved from http://www.biodiversitylibrary.org/item/89042.

Varley, N. (1998). Winter recreation and human disturbance on mountain goats: A review. *Northern Wild Sheep and Goat Proceedings 1998.* (pp. 7-13). Yellowstone National Park, WY: Symbiosis Consulting. Retrieved from http://www.nwsgc.org/proceedings.html, http://www.nwsgc.org/contents/1998contents.html, http://media.nwsgc.org/proceedings/NWSGC-1998/1998-Varley.pdf.

Vinkey, R. S. (2003). *An evaluation of fisher (Martes pennanti) introductions in Montana.* (MS thesis), University of Montana, Missoula, MT.

Vinkey, R. S., Schwartz, M. K., McKelvey, K. S., Foresman, K. R., Pilgrim, K. L., Giddings, B. J., & LoFroth, E. C. (2006). When reintroductions are augmentations: The genetic legacy of fishers (*Martes pennanti*) in Montana. *Journal of Mammalogy, 87*(2), 265-271. doi:10.1644/05-Mamm-a-151r1.1. Retrieved from <Go to ISI>://WOS:000237125800009.

Vore, J. (2013). *Region One mountain goat report*.Montana Fish, Wildlife & Parks. Planning record exhibit # 00161.

Vore, J. M., Hartman, T. L., & Wood, A. K. (2007). Elk habitat selection and winter range vegetation management in northwest Montana. *Intermountain Journal of Sciences, 13*, 86-97. Retrieved from http://www.intermountainjournal.org/.

Vore, J. M., & Schmidt, E. M. (2001). Movements of female elk during calving season in northwest Montana. *Wildlife Society Bulletin, 29*(2), 720-725. Retrieved from <Go to ISI>://WOS:000169858100037, http://www.jstor.org/stable/3784200, http://www.jstor.org/stable/pdfplus/3784200.pdf?acceptTC=true&jpdConfirm=true.

Waller, J. S., & Mace, R. D. (1997). Grizzly bear habitat selection in the Swan Mountains, Montana. *Journal of Wildlife Management, 61*(4), 1032-1039. doi:10.2307/3802100. Retrieved from <Go to ISI>://WOS:000071737200005, http://www.jstor.org/stable/3802100, http://www.jstor.org/stable/pdf/3802100.pdf.

Waller, J. S., & Miller, C. S. (2015). Decadal growth of traffic volume on US Highway 2 in northwestern Montana. *Intermountain Journal of Sciences, 21*(1-4), 29-37. Planning record exhibit # 00489.

Waller, J. S., & Servheen, C. (2005). Effects of transportation infrastructure on grizzly bears in northwestern Montana. *Journal of Wildlife Management, 69*(3), 985-1000. doi:10.2193/0022-541x(2005)069[0985:Eotiog]2.0.Co;2. Retrieved from http://www.jstor.org/stable/3803338#fndtn-references_tab_contents, http://www.jstor.org/stable/pdf/3803338.pdf?acceptTC=true, http://dx.doi.org/10.2193/0022-541X(2005)069[0985:EOTIOG]2.0.CO;2

Walters, C. J., & Holling, C. S. (1990). Large-scale management experiments and learning by doing. *Ecology, 71*(6), 2060-2068. doi:10.2307/1938620. Retrieved from <Go to ISI>://WOS:A1990EL09600005, http://www.jstor.org/stable/1938620, http://www.jstor.org/stable/pdf/1938620.pdf.

Walther, G.-R., Post, E., Convey, P., Menzel, A., Parmesan, C., Beebee, T. J. C., . . . Bairlein, F. (2002). Ecological responses to recent climate change. *Nature, 416*(6879), 389-395. doi:10.1038/416389a. Retrieved from <Go to ISI>://WOS:000174607800036, http://www.nature.com/nature/journal/v416/n6879/full/416389a.html.

Warren, N. (2016a, April 13). [Notes on phone call with J. Squires April 13 re: mountain lion predation on lynx in relation to snow compaction]. Planning record exhibit # 00242.

Warren, N. (2016b, March 24). [Summary of March 24, 2016, phone conversation with J. Squires, Rocky Mountain Research Station re: lynx effects analysis section of Flathead forest plan revision]. Planning record exhibit # 00165.

Warren, N., Van Eimeren, P., & Trechsel, H. (2017). *Biological assessment for threatened, endangered, and proposed species: Forest plan amendments--incorporating habitat management direction for the NCDE grizzly bear population into the Helena, Lewis and Clark, Kootenai, and Lolo National*

Forest plans. Kalispell, MT: USDA Forest Service, Flathead National Forest. Retrieved from www.fs.usda.gov/goto/flathead/fpr. Planning record exhibit # 00547.

Warren, N. M. (1998). *Old-growth associated wildlife: Status and management strategies*. Kalispell, MT: USDA Forest Service, Flathead National Forest. Planning record exhibit # 00188.

Weaver, J. L. (2014). *Conservation legacy on a flagship forest: Wildlife and wildlands on the Flathead National Forest, Montana*. Bozeman, MT: Wildlife Conservation Society. Retrieved from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwjI5LmQ19nKAhUK6mMKHeRNC38QFggcMAA&url=http%3A%2F%2Fwww.wcsnorthamerica.org%2FAdmin-Plus%2FDocustore%2FCommand%2FCore_Download%2FEntryId%2F28194.aspx&usg=AFQjCNFbCN6XJslT6iW_LSda_zKBLU1O8g&bvm=bv.113034660,d.cGc.

Webb, S. M., Anderson, R. B., Manzer, D. L., Abercrombie, B., Bildson, B., Scrafford, M. A., & Boyce, M. S. (2016). Distribution of female wolverines relative to snow cover, Alberta, Canada. *Journal of Wildlife Management, 80*(8), 1461-1470. Retrieved from http://onlinelibrary.wiley.com/doi/10.1002/jwmg.21137/full.

Weckwerth, R. P., & Wright, P. L. (1968). Results of transplanting fishers in Montana. *Journal of Wildlife Management*, *32*(4), 977-980. Planning record exhibit # 00439.

Weir, R. D., Lofroth, E. C., & Phinney, M. (2011). Density of fishers in boreal mixed-wood forests of northeastern British Columbia. *Northwestern Naturalist, 92*, 65-69. Retrieved from https://www.jstor.org/stable/41300880.

Wenger, S. (1999). *A review of the scientific literature on riparian buffer width, extent and vegetation*. Athens, GA: University of Georgia, Institute of Ecology. Retrieved from https://www.semanticscholar.org/paper/A-Review-of-the-Scientific-Literature-on-Riparian-Wenger/866ae8d8a9fc075bf9f057af72b6ea2131ea54a0.

Westerling, A. L., Hidalgo, H. G., Cayan, D. R., & Swetnam, T. W. (2006). Warming and earlier spring increase western U.S. forest wildfire activity. *Science, 313*(5789), 940-943. doi:10.1126/science.1128834. Retrieved from <Go to ISI>://WOS:000239817000035, http://www.sciencemag.org/content/313/5789/940, http://www.sciencemag.org/content/313/5789/940.full.pdf.

White, C. M., McLaren, M. F., Van Lanen, N. J., Pavlacky Jr., D. C., Blakesley, J. A., Sparks, R. A., . . . Hanni, D. J. (2015). *Integrated monitoring in bird conservation regions (IMBCR): 2014 field season report*. Brighton, CO: Rocky Mountain Bird Observatory. Retrieved from http://www.birdconservancy.org/what-we-do/science/monitoring/imbcr-program/, http://www.birdconservancy.org/wp-content/uploads/2015/10/2014_IMBCR_report.pdf.

White, D., Kendall, K. C., & Picton, H. D. (1999). Potential energetic effects of mountain climbers on foraging grizzly bears. *Wildlife Society Bulletin, 27*(1), 146-151. Retrieved from http://www.jstor.org/stable/3783951, http://www.jstor.org/stable/pdf/3783951.pdf.

White, J., Don, Kendall, K. C., & Picton, H. D. (1998). Grizzly bear feeding activity at alpine army cutworm moth aggregation sites in northwest Montana. *Canadian Journal of Zoology, 76*(2), 221-227. doi:10.1139/z97-185. Retrieved from http://www.nrcresearchpress.com/doi/abs/10.1139/z97-185#.WGVv0Xy7paQ.

Whittington, J., St Clair, C. C., & Mercer, G. (2005). Spatial responses of wolves to roads and trails in mountain valleys. *Ecological Applications, 15*(2), 543-553. doi:10.1890/03-5317. Retrieved from http://www.esajournals.org/doi/abs/10.1890/03-5317, http://dx.doi.org/10.1890/03-5317, http://onlinelibrary.wiley.com/doi/10.1890/03-5317/epdf.

Whittle, E., Hanauska-Brown, L., Brown, T., & Bodenhamer, h. (2015). *Hobo data logger retrieval and bat roost observations for Little Bitterroot Canyon Ice Cave on Plum Creek land near Marion, Flathead County, Montana*.Montana Fish, Wildlife & Parks and the Montana Natural Heritage Program. Planning record exhibit # 00226.

Wiggins, D. A. (2004). *Black swift (Cypseloides niger): A technical conservation assessment*. Oklahoma City, OK: Strix Ecological Research. Retrieved from https://www.researchgate.net/publication/281860959_Black_Swift_Cypseloides_niger_A_Technical_Conservation_Assessment.

Wiggins, D. A. (2005). *Harlequin duck (Histrionicus histrionicus): A technical conservation assessment*. Oklahoma City, OK: Strix Ecological Research. Retrieved from https://www.fs.fed.us/r2/projects/scp/assessments/harlequinduck.pdf, https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5182003.pdf.

Wilk, R. J., Raphael, M. G., Nations, C. S., & Ricklefs, J. D. (2010). Initial response of small ground-dwelling mammals to forest alternative buffers along headwater streams in the Washington Coast Range, USA. *Forest Ecology and Management, 260*(9), 1567-1578. doi:10.1016/j.foreco.2010.08.005. Retrieved from <Go to ISI>://WOS:000283458600016.

Wilson, S. F., & Shackleton, D. M. (2001). *Backcountry recreation and mountain goats: A proposed research and adaptive management plan*. Victoria, BC: British Columbia Ministry of Environment, Lands and Parks, Wildlife Branch. Retrieved from http://www.env.gov.bc.ca/wld/documents/techpub/b103.pdf.

Wisdom, M. J., & Bate, L. J. (2008). Snag density varies with intensity of timber harvest and human access. *Forest Ecology and Management, 255*(7), 2085-2093. doi:10.1016/j.foreco.2007.12.027. Retrieved from https://www.treesearch.fs.fed.us/pubs/33276, https://www.fs.fed.us/pnw/pubs/journals/pnw_2008_wisdom001.pdf.

Wisdom, M. J., Holthausen, R. S., Wales, B. C., Hargis, C. D., Saab, V. A., Lee, D. C., . . . Eames, M. R. (2000). *Source habitats for terrestrial vertebrates of focus in the interior Columbia Basin: Broadscale trends and management implications; Volume 1--Overview*. General Technical Report PNW-485. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. Retrieved from https://www.treesearch.fs.fed.us/pubs/3081, https://www.fs.fed.us/pnw/pubs/gtr485/, https://www.fs.fed.us/pnw/pubs/gtr485/gtr485v1.pdf.

Woods, T., Morey, S., & Mitchell, M. (2014). *Wolverine Science Panel Workshop*. Spokane, WA: Retrieved from http://www.fws.gov/mountain-prairie/science/PeerReviewDocs/Final_Wolverine_Panel_Report.pdf.

Wright, V. (1996). *Multi-scale analysis of flammulated owl habitat use: Owl distribution, habitat management, and conservation.* (MS thesis), University of Montana, Missoula, MT. Planning record exhibit # 00370.

Youmans, H. B. (1979). *Habitat use by mule deer of the Armstrong Winter Range, Bridger Mountains, Montana.* (MS thesis), Montana State University, Bozeman, MT. Retrieved from http://scholarworks.montana.edu/xmlui/bitstream/handle/1/6423/31762100227329.pdf?sequence=1.

Zager, P., Jonkel, C., & Habeck, J. (1983). Logging and wildfire influence on grizzly bear habitat in northwestern Montana. *Bears: Their Biology and Management, 5*, 124-132. doi:10.2307/3872529. Retrieved from http://www.jstor.org/stable/3872529, http://www.jstor.org/stable/pdf/3872529.pdf.

Zielinski, W. J., Thompson, C. M., Purcell, K. L., & Garner, J. D. (2013). An assessment of fisher (*Pekania pennanti*) tolerance to forest management intensity on the landscape. *Forest Ecology and Management, 310*, 821-826. doi:10.1016/j.foreco.2013.09.028. Retrieved from <Go to ISI>://WOS:000330601000085.

Zielinski, W. J., Truex, R. L., Schmidt, G. A., Schlexer, F. V., Schmidt, K. N., & Barrett, R. H. (2004a). Home range characteristics of fishers in California. *Journal of Mammalogy, 85*(4), 649-657. doi:10.1644/Bos-126. Retrieved from <Go to ISI>://WOS:000223457700008.

Zielinski, W. J., Truex, R. L., Schmidt, G. A., Schlexer, F. V., Schmidt, K. N., & Barrett, R. H. (2004b). Resting habitat selection by fishers in California. *Journal of Wildlife Management, 68*(3), 475-492. doi:10.2193/0022-541x(2004)068[0475:Rhsbfi]2.0.Co;2. Retrieved from <Go to ISI>://WOS:000222901700006.