

Chapter 3 Habitat Standards and Monitoring

Background

Habitat standards and monitoring protocol in this Conservation Strategy identify provisions that Federal and State land managers throughout the ecosystem are committed to for habitat preservation of a recovered Yellowstone grizzly bear population. Since 1986 and prior to the initial 2007 delisting of the Yellowstone population, grizzly bear habitats in the Greater Yellowstone Ecosystem (GYE) had been managed under standards and guidelines established by the Interagency Grizzly Bear Committee (IGBC 1986) and specified in national forest and national park management plans ~~which included guidelines established by the Interagency Grizzly Bear Committee (IGBC 1986).~~ Acknowledging that humans are the primary agent cause of grizzly bear mortalities, a principal objective of the IGBC was to improve survival rates by implementing management strategies that minimized anthropogenic influences and human-grizzly bear conflicts. IGBC measures implemented inside the Grizzly Bear Recovery Zone (GBRZ) led to the improved management of garbage and food attractants, reduced sheep grazing, and restrictions on motorized access and human development. These standards and guidelines that were imposed upon public lands were instrumental in the recovery of the Yellowstone grizzly bear throughout the mid-1980s and into the 1990s in the GYE.

The subsequent 1993 Grizzly Bear Recovery Plan (USFWS 1993) required the preservation and monitoring of habitat necessary to support a recovered population, leading to the development of more explicit and measurable habitat criteria to be applied inside the GBRZ. These habitat ~~To satisfy this requirement, measurable habitat~~ criteria, which called were established that called for no net loss of habitat with respect to 1998 conditions. These criteria were embraced and incorporated into the draft Conservation Strategy and released for public comment in 2000. Analysis of public comments, and new information was used to establish the final habitat standards for a recovered Yellowstone population as identified in the 2007 Conservation Strategy (USFWS 2007a) and appended in a supplement to the Recovery Plan (USFWS, 2007c) for a recovered Yellowstone population. ~~To reflect the paradigm shift from managing for recovery to one of conservation~~ Upon delisting of the Yellowstone population, the GBRZ is now will be referred to as the Primary Conservation Area (PCA) to reflect the shift from managing for recovery to one of conservation. This 2016 revision of the Conservation Strategy includes some changes to the 2007 document that help clarify habitat standards as they pertain to the 1998 baseline. Clarifying language to the application rules has been inserted where necessary to provide better direction for application of these standards on a local project level. No substantive changes in the content of habitat standards have been made under this revision. However, some modifications in habitat monitoring protocols have been made and are documented in this chapter. Upon delisting of the Yellowstone population, the GBRZ is referred to as the Primary Conservation Area (PCA) to reflect a shift from managing for recovery to one of conservation.

Introduction

Habitat standards apply to Federal lands inside the PCA and identify three factors that must be maintained at, or improved upon with respect to conditions existing in 1998: 1) secure habitat, 2) number and capacity of developed sites, and 3) number and acreage of active commercial livestock grazing allotments. All three of these factors are linked to human activities that affect grizzly bear mortality and displacement. These three standards apply only to public lands within the PCA, an area where past recovery efforts and present habitat conservation measures are primarily focused. The PCA serves as a relatively safe haven located at the core of the ecosystem and accounts for approximately 47% of the Yellowstone grizzly bear's occupied

range as estimated from methods in Bjornlie *et al.* 2014 (Figure 1). The 1998 baseline for habitat standards was selected because studies showed (and recently affirmed) that the Yellowstone grizzly bear population was increasing annually at a robust rate of 4 to 7 percent between 1983 and 2001 (Boyce *et al.* 2001; Harris *et al.* 2006, 2007; IGBST 2012). Habitat conditions in 1998 were considered representative of this time period since levels of secure habitat and developed sites inside the PCA had remained relatively constant in the 10 years preceding 1998 and beyond (USDA 2004). Hence, conditions in 1998 are believed to have supported and contributed to the population growth observed during 1983–2001. Habitat standards as they apply to the 1998 baseline impose measurable side boards on allowed levels of human activity inside the PCA and establish a clear benchmark against which future improvements and impacts of habitat can be measured.

To facilitate management of habitat throughout the PCA, the area inside the PCA is divided into 18 distinct bear management units (BMUs) and 40 subunits (Fig 2, Chapter 1). BMU boundaries were delineated to approximate the average *lifetime* range of an adult female grizzly bear in the GYE. Each BMU was further subdivided into one or more subunits comparable in size to the average *annual* home range of an adult female grizzly bear. Monitoring habitat at a subunit scale provides greater spatial resolution and proved to be better suited for analyzing habitat use patterns and ensuring good distribution of bear habitat throughout the PCA (USDA 1985). Hence, conditions pertaining to secure habitat and developed site standards are measured and compared against 1998 levels for each of the 40 bear management subunits within the PCA. To date, habitat-based criteria throughout the PCA have been successfully maintained at, or surpassed 1998 levels for all 40 subunits. Adherence to these standards ensures that sufficient habitat for the Yellowstone grizzly bear will continue to be available into the foreseeable future. Habitat standards in this document are subject to revision based on the best available science and will be reviewed and updated as necessary.

Agencies responsible for management of grizzly bear habitat in the GYE are committed to continue collecting information needed to evaluate adherence to habitat standards and monitoring protocols throughout the PCA. The overall objective for habitat management inside the PCA is to reduce human-caused grizzly bear mortalities by maintaining or improving habitat with respect to 1998 conditions while maintaining options for resource management activities at approximately the same level that existed in 1998.

Outside the PCA, grizzly bears are allowed to expand into adjacent areas considered biologically suitable and socially acceptable as per direction in the State management plans ([Appendices K, L, and M](#)). The key to successful management of grizzly bears outside the PCA is realized by striking a sustainable balance that accommodates the needs of grizzly bears along with competing demands of human use. As such, an important management objective for areas outside the PCA is to maintain existing resource management and recreational uses and allow agencies to respond to demonstrated problems with appropriate management actions. Approximately 83% of suitable habitat outside the PCA occurs on federally owned land and about 66 percent of that suitable habitat is occupied by grizzly bears. A flexible management strategy is crucial for promoting acceptance and tolerance for grizzly bears as they continue to expand into suitable habitat outside the PCA. [Standards and guidelines for other wildlife species identified in National Forest and Park management plans indirectly provide additional habitat management direction for bears outside the PCA.](#)

State grizzly bear management plans for Idaho, Montana, and Wyoming recommend and encourage land management agencies to maintain or improve habitats important to grizzly bears and to monitor habitat conditions outside the PCA. These three states acknowledge the importance of secure habitat, motorized access management, and road density issues related to the survival of grizzly bears and other wildlife. Consequently, levels of secure habitat and motorized route density are monitored on federal lands outside the PCA to identify and prevent potential habitat threats from negatively impacting the long-term viability of the Yellowstone grizzly bear population. Land management agencies work cooperatively with state wildlife agencies to meet identified population and habitat goals for grizzly bears in the GYE. The process of implementing state and federal grizzly bear management goals is coordinated by the Yellowstone Grizzly Coordinating Committee (YGCC) representing all respective land management agencies in the GYE ([refer to Chapter 6 Implementation and Evaluation](#)).

~~Standards and guidelines for other wildlife species identified in National Forest and Park management plans indirectly provide additional habitat management direction for bears outside the PCA. By approval of this Conservation Strategy immediately upon ESA delisting of the species, Forest Service~~ regional foresters in Regions 1, 2, and 4 [of the U.S. Forest Service](#) agree to add the grizzly bear to their Sensitive Species lists [for the five National Forests in the GYE immediately upon ESA delisting of the species.](#)^[L.L.1] Forest Service sensitive species direction requires that any project “*must not result in loss of species viability or create significant trends toward federal listing*” (~~USDA 2005~~). Sensitive species direction also requires the Forest Service to “*assist states in achieving their goals for conservation of endemic species*” (USDA 2005). A biological evaluation will be completed for all Forest Service projects potentially affecting the [Yellowstone](#) grizzly bear. These evaluations will determine whether projects do or do not meet the habitat standards in this Conservation Strategy. If the biological evaluation demonstrates that a project does not meet the habitat standards as well as other relevant habitat and population criteria, the project will be modified as necessary to ensure complete adherence with all required measures.

Habitat Standards inside the PCA

Human activity is the primary factor negatively impacting availability and security of grizzly bear habitat in the GYE. The relationship between bears and habitat is extremely complex and difficult to quantify. However, unfettered human activity is known to result in displacement and mortality of grizzly bears and was a significant contributing factor leading to listing the grizzly bear in the conterminous U.S. as a Threatened species in 1975. Restrictions in human activities due to management practices implemented by the IGBC in the mid-1980s correlate strongly

with the steady increase in the Yellowstone grizzly bear population that was observed between 1983 and 2001. Habitat standards formalized in this document impose measurable sideboards on levels of human activity allowed on Federal lands inside the PCA, thereby reducing opportunities for grizzly bear-human conflicts, habitat disturbance, and displacement of grizzly bears from valuable habitat.

Habitat standards identified in this document address three key factors related to human activity (motorized access, site development, and commercial livestock grazing) and specifically call for no net loss in secure habitat inside the PCA from what existed in 1998 ([Appendix F](#)). Adequate secure habitat is essential to the survival and reproductive success of grizzly bears, particularly adult females. It is the goal of habitat management agencies to maintain or improve habitat conditions throughout the PCA at or above 1998 levels as measured per bear management subunit. These levels of secure habitat have been maintained and will continue to be maintained and improved where possible, long into the future. Potential impacts to grizzly bears and their habitat will be evaluated and mitigated using the criteria and standards in this Conservation Strategy in coordination with state wildlife agencies.

Omissions to the 1998 habitat measurements comprising the baseline ([Appendix F](#)) may be corrected for when based on new and well documented information substantiating the existence and status of anthropomorphic features (i.e., motorized routes, developed sites, or livestock allotments) that were not properly accounted for in the 1998 baseline. When verified, legitimate corrections to the baseline will be tracked and reported and will constitute new habitat levels against which future change will be measured.

Application rules specific to each habitat standard provide additional direction on how these standards are to be implemented at a Federal project level. The following habitat standards and application rules apply to all Federal lands inside the PCA.

Secure Habitat Standard

The Secure Habitat Standard requires that inside the PCA, the percentage of secure habitat within each bear management subunit must be maintained at or above levels that existed in 1998 ([Appendix F](#)). [The sole exception to the 1998 secure habitat baseline applies to the three subunits identified in the 2007 Conservation strategy as in need of improvement above 1998 levels \(Gallatin #3, Henrys Lake #2, and Madison #2\). These three subunits must be maintained at or above levels attained from the full implementation of the 2006 Gallatin National Forest Travel Management Plan \(Appendix F\).](#) Authorized Federal projects that result in temporary or permanent changes to secure habitat must follow the Application Rules identified below.

Secure habitat is defined as any contiguous area ≥ 10 acres in size and more than 500 meters from an open or gated motorized access route (road or trail) or recurring low level helicopter line during the non-denning period (March 1 – November 30). Gated routes that are closed year-round to public motorized use but remain accessible to administrative personnel are still considered motorized access routes, and hence, detract from secure grizzly bear habitat. Decommissioned routes that are permanently and effectively closed to the public and administrative staff do not count against this standard. Lakes larger than 1 square mile in spatial extent are excluded from secure habitat calculations.

Application Rules for Permanent Changes to Secure Habitat

Permanent changes to secure habitat are allowed inside the PCA when associated with an authorized Federal project involving construction of new motorized routes (i.e., roads or trails), reconstruction of existing motorized routes, or opening of a previously decommissioned route if, and only if, the following conditions are met:

- Any loss in secure habitat below baseline levels is replaced by restoring secure habitat of equivalent habitat quality and quantity (e.g., through decommissioning) in the same Bear Management Subunit. Habitat quality must be assessed based on the best collective scientific understanding of grizzly bear habitat ecology, and the rationale for all mitigation measures must be fully documented.
- Replacement habitat must be in place before project implementation or concurrent with project development as an integral part of the project plan. Replacement habitat must remain in place for a minimum of 10 years before it can be subsequently replaced and mitigated for per application rules (*this duration is based upon the generation time for a female grizzly bear, or the time it takes to replace herself*).
- For those subunits identified as in need of improvement above 1998 levels (*Gallatin #3, Madison #2, and Henry's Lake #2*), secure habitat will be maintained at or above levels associated with full implementation of the 2006 Gallatin National Forest Travel Management Plan (refer to **Appendix F**).
- For activities based on statutory rights such as access to private lands under the *Alaska National Interest Lands Conservation (ANILCA)* or the *1872 General Mining Law*, where permanent reductions in secure habitat cannot be replaced within the affected subunit, then secure habitat will be compensated at a commensurate level at or above the baseline in the nearest possible subunit. In these rare situations, subsequent changes to secure habitat in the two affected subunits constitute permanent changes to the baseline.
- Honor existing oil and gas or other mineral leases. Proposed *Applications for Permit to Drill (APDs)* and operating plans within those leases would strive to meet the application rules for changes in secure habitat. New leases, APDs, and operating plans must meet the secure habitat and developed site standards.
- Motorized routes on private land that post-date 1998 are not counted against this standard. However, for motorized roads or trails acquired through land exchanges or acquisition that are desirable to maintain for public use, mitigation is strongly encouraged.

Application Rules for Temporary Changes to Secure Habitat

Temporary reductions in secure habitat below baseline levels inside the PCA are allowed when associated with authorized Federal projects. Project activities should be concentrated in space and time to minimize disturbance. The following conditions must be met for temporary projects:

- Only one project affecting secure habitat may be active within a given bear management subunit at any one time.

- Total acreage of secure habitat affected within a given BMU does not exceed 1 percent of the acreage of the largest subunit within that BMU. The acreage of a project that counts against the 1 percent limit (i.e., the amount of secure habitat affected) is measured as the acreage within the 500-meter buffer around any temporary motorized project route or low-level helicopter flight line that intrudes into existing secure habitat.
- Use of project roads will be limited to administrative purposes associated with project activities. Project implementation shall not reduce secure habitat below baseline levels for more than 4 consecutive years. The collective set of project roads that affect secure habitat below baseline levels shall be closed to all motorized travel after 3 years. Project roads shall be decommissioned such that secure habitat is restored within 1 year after road closure.

Activities Allowed in Secure Habitat

The following activities are allowed in secure habitat inside the PCA without violating the standard:

- Activities that do not require route construction or reconstruction, re-opening of a permanently closed road, or recurring low level helicopter flight lines.
- Helicopter use for short term (no more than 2 days in the duration of a project), or at higher elevation (> 500 meters above ground level with no landing). Aircraft used in emergency firefighting are allowed.
- Non-wheeled, over-the-snow use (i.e., snow machines) is allowed unless new research identifies a concern. Conflicts associated with winter-use activities that develop either during denning or after den emergence in the spring can be addressed with local area restrictions.
- Access to power lines and/or utility corridors for occasional and necessary maintenance service that does not require new route construction and is ~~not~~ used only for administrative purposes ~~un~~related to power line/utility maintenance.
- Project activities (e.g., temporary road construction and maintenance, or use of recurring low level helicopter flights) that occur during the grizzly bear denning season between December 1 and February 28.

Developed Site Standard

The Developed Site Standard requires that on Federal lands inside the PCA, the number and capacity for human use of developed sites must be maintained at or below 1998 levels (Appendix F). Projects that propose a change in the number or capacity of developed sites must follow the Application Rules specified below.

Developed sites refer to those sites or facilities on public land with features intended to accommodate administrative needs and public recreational use. Such sites typically are identified or advertised via visitor maps, ~~or~~ information displays, or administrative personnel as discernable destination sites promoted by the agency. Developed sites are often associated with human activities that may disrupt grizzly bear use of habitat, or have attractants that potentially lead to increased human-bear conflicts. Examples of developed sites include, but

are not limited to: campgrounds, picnic areas, trailheads, boat launches, rental cabins, summer homes, lodges, service stations, restaurants, visitor centers, and administrative sites. For the purposes of this Conservation Strategy, oil and gas exploratory wells, production wells, work camps, and plans of operation for mining activities are also to be tracked as developed sites.

Administrative sites are those sites or facilities constructed for use primarily by government employees to facilitate the administration and management of public lands. Administrative sites are counted toward developed sites. Examples include administrative headquarters, ranger stations, patrol cabins, park entrances, federal employee housing, and other facilities supporting government operations. **Dispersed sites**, in contrast to developed or administrative sites, are those not associated with a developed site such as a front-country campground. These sites are typically characterized as having no permanent agency-constructed features, have minimal to no site modifications, and may include primitive road access. Dispersed sites are not counted toward developed sites.

Application Rules for Developed Sites

On Federal lands inside the PCA, changes to developed sites or construction of new developed sites are allowed if the following conditions are met:

- Construction of new sites will be mitigated for within that subunit to offset any increase in the number of developed sites and/or capacity for human use, habitat loss, and increased access to surrounding habitats.
- Mitigation of detrimental impacts must occur within the affected subunit and adequately compensate for the type and extent of impacts. Mitigation measures must be in place before implementation of the project or included as an integral part of completion of the project.
- Consolidation and/or elimination of dispersed campsites is considered adequate mitigation for increases in human capacity at developed campgrounds if the new campsite capacity is less than or equivalent to that of the dispersed camping eliminated and if future overnight use of the dispersed site(s) is definitively curtailed.
~~Such modification would not contribute to an increase in baseline developed sites.~~
- Conversion of uncontrolled dispersed campsites to a minor day-use site is allowed if there is a net benefit to both human and bear safety, and if the dispersed site(s) can be modified in such a way that future over-night use of the site is definitively curtailed. Such modification of site-use would not contribute to an increase in baseline developed sites.
- Expansion of existing administrative sites is exempt from mitigation if such developments are deemed necessary for enhancement of public land management, and other viable alternatives are not available. Temporary construction of work camps for highway construction or other major camp maintenance projects are exempt from human capacity mitigation if other viable alternatives are not available. Food storage structures and management must be in place and all other factors resulting in potential detrimental impacts to grizzly bears will be mitigated as identified for other developed sites.
- Modifications to existing developed sites that reduce resource damage, detrimental environmental impacts, and/or the potential for grizzly bear conflicts are allowed (e.g.,

installing a vaulted toilet to avoid damage to water resources or installing bear-resistant food storage structures to reduce conflict).

- For activities based in statutory rights (e.g., 1872 General Mining Law, Americans with Disability Act, ANILCA, etc.), if the number of developed sites exceeds the 1998 baseline, the Forest Service will, to the fullest extent of its regulatory authority, reduce developed sites to commensurate levels and mitigate to offset any increases in human capacity, habitat loss, and increased access to surrounding habitat within the affected subunit if possible. In those rare cases where mitigation cannot be accomplished within that subunit, commensurate compensation will be accomplished in the nearest subunit and changes in the two affected subunits become permanent changes to the baseline.
- Honor existing oil and gas and other mineral leases. For proposed *Applications for Permit to Drill* (APDs) and operating plans within those leases, the Forest Service should, to the fullest extent of their regulatory authority, strive to meet the developed site standard and satisfy application rules for changes in secure habitat. New leases, APDs, and operating plans must meet the developed site standard and satisfy application rules for changes in secure habitat.
- Developments on private land are not counted against this standard. However, for developed sites acquired through land exchanges or acquisitions that are desirable to maintain, mitigation is strongly encouraged but not required. The rationale behind this is to encourage acquisition and transformation of private land to public ownership since this negates the potential for future development, and results in better management for grizzly bears.

Livestock Allotment Standard

The Livestock Allotment Standard requires that on Federal lands inside the PCA, there will be no increase in the number or acreage of active commercial livestock grazing allotments nor an increase in permitted sheep Animal Months (AMs) relative to that which existed in 1998 (see [Appendix F](#)). Existing sheep allotments will be monitored, evaluated, and phased out as the opportunity arises with willing permittees.

Application Rules for Livestock Allotments

Grazing allotments tracked for purposes of grizzly bear conservation include both vacant and active commercial livestock units for sheep, cattle, and/or horse on Federal lands inside the PCA. **Active** allotments are livestock units with active grazing permits. **Vacant** allotments are those without an active permit, but which may be restocked or grazed periodically by other permittees at the discretion of the land management agency to resolve resource issues or other concerns. Changes in livestock allotments inside the PCA that satisfy the allotment standard may occur if the following conditions are met:

- A vacant allotment may be reissued an active permit resulting in an increase in the number of permitted cattle, but the number and net acreage of active allotments inside the PCA must not exceed the 1998 baseline. Appropriate analysis by the action agency must be conducted to evaluate impacts on grizzly bears.
- Combining or dividing existing allotments is allowed as long as the net acreage and number of active allotments does not exceed 1998 levels.

- Where chronic grizzly bear conflicts occur on livestock allotments inside the PCA, and an opportunity exists with a willing permittee, alternatives for resolving conflicts may include authorization of a non-use permit, moving livestock to a vacant allotment where there is less likelihood of conflict, or cattle grazing can be phased out on that allotment.

Habitat Monitoring

The primary objective of habitat monitoring is to track and assess the status of grizzly bear habitat throughout the ecosystem with an emphasis placed on habitat inside the PCA. Monitoring requirements presented in this section focus on evaluation of adherence to habitat standards such that secure habitat, developed sites, and commercial livestock grazing allotments are maintained at, or improved upon, 1998 levels. However, additional habitat parameters pertaining to four high-calorie foods of the grizzly bear diet are also monitored to assist in evaluating the status of grizzly bear habitat and its ability to support a recovered grizzly bear population.

Monitoring Secure Habitat and Motorized Access Route Density

Background

Humans are the primary agent influencing grizzly bear mortality and population trajectories in the Yellowstone ecosystem and elsewhere (McLellan and Shackleton 1988, Mattson and Knight 1991, Mace *et al.* 1996, Schwartz *et al.* 2010, Proctor *et al.* 2012). Motorized access has historically been used as a surrogate measure of human presence on the landscape, and consequently serves as the basis for differentiating secure and non-secure habitat throughout the ecosystem. Land managers throughout the GYE recognize that availability of secure habitat is crucial to the survival and long-term reproductive success of grizzly bears. Managing the landscape to reduce grizzly bear mortality risk requires that motorized roads and trails be considered when evaluating and maintaining secure habitat throughout the ecosystem.

Motorized access parameters, including 1) percent secure habitat, 2) open motorized access route density (OMARD), and 3) total motorized access route density (TMARD), are measured and monitored against levels that existed in 1998. To date, no net decrease in secure habitat relative to 1998 levels has occurred on federal lands in any of the 40 bear management subunits within the PCA. Instead, reductions in motorized access implemented post-1998 have led to an increase of 1.4% in secure habitat inside the PCA; a gain approximate in size to the area of Yellowstone Lake.

Subunits with potential for improvement: Three subunits, Gallatin #3, Henrys Lake #2, and Madison #2 were targeted in the 2007 Conservation Strategy as needing improvement in secure habitat with respect to 1998 levels. The specific areas ~~in need of~~ with potential for improvement identified in these three subunits fall within the Gallatin National Forest boundary and consequently, the quantity and timing of improvements was to be determined by the Gallatin National Forest Travel Management Plan (TMP). ~~A primary factor contributing to elevated OMARD and TMARD levels and impoverished secure habitat levels in these three subunits was motorized access on private land inholdings. Since 1998, the Gallatin National Forest conducted several land exchanges under the Gallatin Range Consolidation and Protection Act in the Gallatin #3 subunit and other areas inside and outside the PCA. These land exchanges resulted in the acquisition of formerly private parcels in and adjacent to the Hyalite-Porcupine-Buffalo Horn Wilderness Study Area (Gallatin #3), which are now administered as part of the Gallatin National Forest. Consequently, the Forest Service inherited some private roads and~~

~~many old timber harvest roads that caused temporary decreases in secure habitat (mostly outside the PCA, but some inside). With implementation of the 2006 Gallatin TMP, many roads inherited from these exchanges have been permanently decommissioned. Non-system routes that are not maintained by the Forest Service have subsequently been closed, with a high priority given to road decommissions in the three subunits identified as in need of improvement.~~ With full implementation of the Gallatin Travel Plan very near completion, measurable increases in secure habitat with respect to 1998 baseline levels (**Appendix F**) and reductions in motorized route density have been realized in the three targeted subunits. The Gallatin National Forest ~~has proposed~~determined, via a Travel Plan Amendment, that all gains in secure habitat resulting from full implementation of the TMP will effectively constitute new baseline levels for these 3 subunits. **If and when approved, elevated secure levels for these 3 subunits will serve as new measures against which future change will be made.**

Monitoring Protocol

Motorized secure habitat and motorized route density are monitored and tracked throughout the ecosystem to verify compliance with secure habitat standards inside the PCA and to assist in balancing grizzly bear security and survival with human land use concerns outside the PCA. Motorized access parameters that are monitored and reported include levels of 1) secure habitat, 2) open motorized access route density (OMARD) greater than one mile per square mile, and 3) total motorized access route density (TMARD) greater than two miles per square mile. Inside the PCA, these three parameters are measured and reported annually for each bear management subunit (BMU). Outside the PCA, secure habitat is measured and reported biennially (even numbered years) for each bear analysis unit (BAU, see Figure 2). Changes in configuration and status of motorized routes are submitted each year to the Grizzly Bear Habitat Database Coordinator by representatives from each National Forest and National Park in the ecosystem. Status and configuration of motorized access routes are inventoried and tracked by the Database Coordinator. This insures that reported measurements are based on the most current available information. Percent secure habitat, OMARD, and TMARD are calculated using the Motorized Access Model as described in **Appendix F**.

Secure Habitat, as defined earlier, refers to those areas ≥ 10 acres in size and more than 500 meters from an open or gated motorized route. Lakes greater than 1 square mile are excluded from secure habitat calculations. **OMARD** is a measure of the density of motorized routes that are open to the public for one or more days during the non-denning portion of the year when grizzly bears are active (March 1–November 30). **TMARD** measures the density of all motorized routes open to the public and/or administrative personnel for one or more days during the non-denning season. Roads that are closed year-round to the public but open to administrative personnel detract from secure habitat and count toward TMARD, but do not contribute to OMARD. Motorized routes that have been permanently decommissioned such that there is no motorized use by either the public or administrative staff, do not contribute to OMARD or TMARD, and do not detract from secure habitat. For a more detailed discussion of OMARD and TMARD, as well changes in monitoring protocol, please refer to **Appendix F**. Measurements are reported annually (inside the PCA) and biennially (outside the PCA) in the Interagency Grizzly Bear Study Team (IGBST) Annual Report, *Yellowstone Grizzly Bear Investigations* and are posted online for public access at the [IGBST website](http://nrmssc.usgs.gov/products/IGBST) (<http://nrmssc.usgs.gov/products/IGBST>).

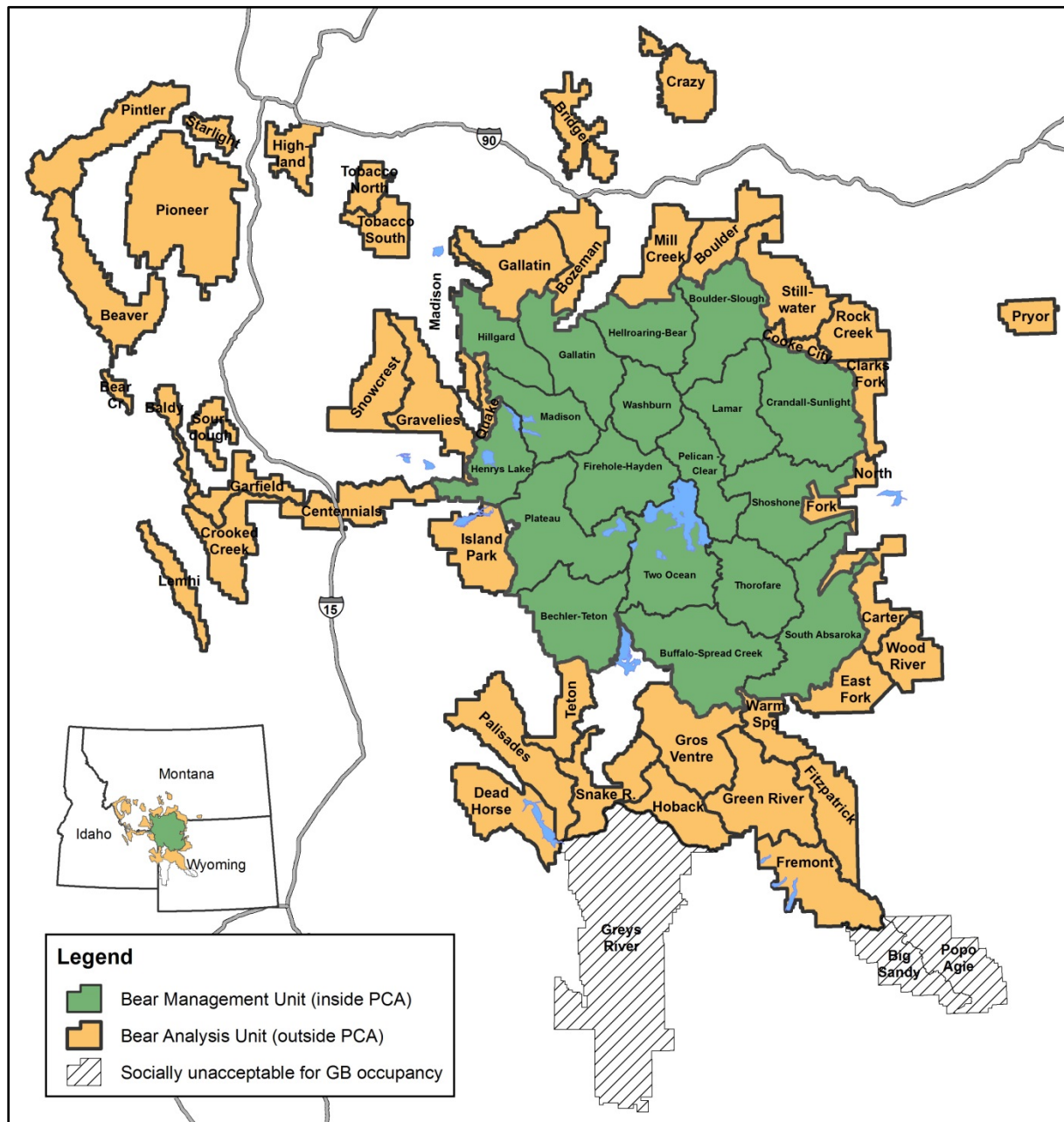


Figure 2. Bear management units and subunits delineated inside the PCA, and bear analysis units outside the PCA.

Monitoring Developed Sites

Background

Levels of human development on the landscape have been shown to be an important predictor of grizzly bear mortality in the GYE (Schwartz *et al.* 2010). Developed sites increase the spatial and temporal extent of human presence on the landscape and contribute to the displacement and mortality of grizzly bears. A significant concern related to developed sites is the increased potential for grizzly bear – human conflicts attributable to food conditioning and habituation. Past attempts at modeling grizzly bear mortality in the GYE have focused on levels of overnight human use as a primary factor related to grizzly bear mortality. Increased numbers of people using an area and potentially interacting with grizzly bears is an important issue in evaluating impacts of developed sites on grizzly bear survival.

Monitoring Protocol

Changes in developed sites on public lands inside the PCA are measured, tracked, and evaluated against 1998 levels (**Appendix F**). Information pertaining to changes in the number of developed sites inside the PCA is submitted annually to the Grizzly Bear Habitat Database Coordinator by representatives from each National Forest and National Park in the ecosystem. Current and baseline numbers of developed sites are inventoried in a GIS database and reported annually in the IGBST Annual Report *Yellowstone Grizzly Bear Investigations* [available online](#).

Monitoring Livestock Grazing

Background

Conflicts between livestock and grizzly bears have historically led to the relocation or removal of grizzly bears in the GYE. Grizzly bears tend to prey on cattle and sheep regardless of the abundance of natural foods because livestock in occupied grizzly bear territory represent one of many foraging opportunities (Gunther *et al.* 2004). Most grizzly bear-livestock conflicts tend to occur outside the PCA since all commercial allotments on National Park lands and many allotments on National Forest lands inside the PCA have been permanently closed. Consequently, monitoring of grizzly bear-livestock conflicts on public lands is not limited to inside the PCA, but is conducted annually throughout the entire ecosystem. Currently, approximately 59% of the Yellowstone grizzly bear's occupied range falls outside the PCA. As commercial livestock grazing persists in areas where grizzly bears live, the number of conflicts will most likely continue to pose a challenge to grizzly bear managers. This is particularly true on domestic sheep allotments. Financial incentives offered through non-governmental organizations (NGOs) have proven to be a successful mechanism for retiring sheep grazing allotments on public land when willing participants were available (Gunther *et al.* 2004). These types of opportunistic partnerships between federal agencies, NGOs, and willing permittees may be considered an alternative for resolving chronic conflicts on grazing allotments within prime grizzly bear habitat.

Livestock Grazing

On federal lands inside the PCA, the number and acreage of commercial livestock grazing allotments and the number of sheep animal months (AMs) is monitored and reported annually relative to 1998 levels. Inside and outside the PCA, grizzly bear conflicts associated with grazing of commercial livestock on federal lands is monitored and reported annually.

Commercial livestock grazing and conflict information is submitted for publication in the IGBST annual report, *Yellowstone Grizzly Bear Investigations* [available online](#).

Monitoring High-Caloric Foods

Background

Grizzly bears are opportunistic omnivores who have evolved highly versatile foraging strategies allowing them to shift diets among numerous food sources, depending on what is available spatially and temporally (Schwartz *et al.* 2003, 2013). Long-term management and conservation of grizzly bears in the GYE call for monitoring four high-calorie foods. These four food types listed by dry weight of kilocalories per gram include (1) army cutworm moths [7.91 kcal/g], (2) winter-killed ungulates [6.80 kcal/g], (3) cutthroat trout [6.10 kcal/g], and (4) whitebark pine seeds [3.99 kcal/g]. These four foods have varying distributions in the ecosystem and are subject to annual fluctuations and therefore do not necessarily serve as major dietary components of every grizzly bear in the GYE. Natural annual fluctuations in abundance and distribution of these four calorie-rich foods make it very challenging to establish reliable thresholds. However, these four high-calorie foods are known to exert a positive influence on grizzly bear fecundity and survival and constitute some of the highest sources of digestible energy available to grizzly bears in the GYE (Mealey 1975, Servheen *et al.* 1986, Pritchard and Robbins 1990, Mattson *et al.* 1992, Haroldson *et al.* 2006, Schwartz *et al.* 2006).

Gunther *et al.* (2014a) exhaustively documented the diet of the GYE grizzly bear to include over 266 distinct plant and animal species ranging from grasses, fungi, berries and seeds, to fish and carrion. The trophic flexibility of grizzly bears, as documented by the variety of foods they consume, allow them to opportunistically forage across diverse habitats spanning the entire GYE. Their highly varied diet serves as an adaptive mechanism that enhances their ability to persist when faced with rapid and long-term changes in availability and abundance of any one food source. Compositional analysis of scats collected over a 37-year period (1943 to 2009) showed that grizzly bears within the GYE most frequently feed on foods that are consistently available and widely distributed such as grasses, sedges, and ants (Gunther *et al.* 2014a). However, when opportunity arises, grizzly bears will shift their diet to maximize body mass gain by selecting calorie-rich foods such as ungulates, fish, whitebark pine seeds, clover, moths, and small mammals.

Human-induced environmental change such as introduced organisms, habitat loss, climate change, and other anthropogenic factors have the potential to affect availability and distribution of these foods in the future. However, despite a substantial decline of whitebark pine and natural stochasticity of other food resources within the GYE, grizzly bears have shown notable resilience by adjusting habitat use (Costello *et al.* 2014) and shifting diets to maintain body mass and condition (Schwartz *et al.* 2014). Because of their high caloric value and use by grizzly bears, whitebark pine, ungulates, cutthroat trout, and arm cutworm moths are currently monitored either directly or indirectly on an annual basis.

Monitoring Protocol

To monitor these four high-caloric foods and their importance to grizzly bears, the IGBST will survey and report on each of these food groups annually as budgetary constraints allow, and per detailed food monitoring protocols identified in **Appendix E**. IGBST scientists will analyze the relationship between abundance and availability of these four food types with the number of grizzly bear-human conflicts, management actions, known and probable mortalities, and changes in distribution and trend of the Yellowstone grizzly bear population. Results of these analyses will be presented when available in the annual reports prepared by the IGBST and

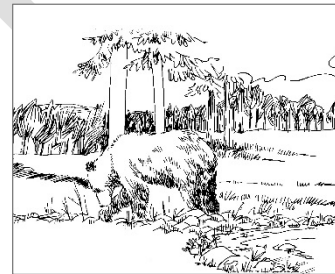
relevant peer-reviewed publications. If detectable declines in certain foods occur and the IGBST concludes these are related to biologically significant changes in demographic parameters, the IGBST shall report these findings for consideration by the GYCC (see Chapter 6, Implementation and Evaluation, for details on this process).

Monitoring protocols of high-caloric foods identified in this Conservation Strategy will continue as long as budgets allow. Monitoring and surveying methods may be modified when necessary to incorporate new technological advances in monitoring techniques or new knowledge of bear foraging and habitat use within the GYE. Existing monitoring programs may be expanded, as budget allows, to include occupied habitat beyond the PCA and areas predicted for future use by bears. Monitoring results of whitebark pine, winter-killed ungulates, cutthroat trout, and army cutworm moths, when available, are to be reported in the annual IGBST publication *Yellowstone Grizzly Bear Investigations* [available online](#).

Winter-killed Ungulates

Background

The GYE harbors one of the most carnivorous grizzly bear populations inhabiting the North American interior (Jacoby *et al.* 1999, Mowat and Heard 2006). Isotopic nitrogen ($\delta^{15}\text{N}$) levels measured in 221 grizzly bear hair samples collected between 2000 and 2010 indicate that on average, terrestrial meat accounted for 44.4% of assimilated protein in the diet of Yellowstone grizzly bears (Schwartz *et al.* 2014). In contrast, in Glacier National Park and adjacent national forest lands, meat accounts for a smaller proportion of the grizzly bear diet; using stable isotope analysis for a small sample of grizzly bears, Jacoby *et al.* (1999) found that meat accounted for only 33%, 0%, and 6% of adult male, adult female and subadult diets, respectively. Protein and fat from ungulate carcasses ranks as the second-highest food source of gross caloric value available to grizzly bears in the GYE (Gunther *et al.* 2014a, b). Winter-killed ungulates, primarily elk and bison, provide an important source of protein to bears especially during early spring before most plant foods become available. As an alternative to carcasses as a spring food, grizzly bears also consume earthworms, ants, and pocket gophers. Grizzly bears continue to opportunistically forage for animal matter and scavenge carrion throughout the active season and will seek out gut piles and other remains left by ungulate hunters in the fall (Haroldson *et al.* 2004).



Monitoring Protocol

Relative abundance of ungulate carrion is often monitored by correlating the number of carcasses available to grizzly bears and other scavengers during the spring with measures of snow-water equivalency (depth, density, and moisture content) in snowpack (Podruzny *et al.* 2012). Availability of carrion for grizzly bears is potentially affected by increased competition from recently reintroduced wolves and changes in elk and bison management practices. For these and other reasons historic carcass transect routes will continue to be surveyed as long as budgetary allocations permit. There are currently 30 spring ungulate carcass survey routes in Yellowstone National Park and 12 transect routes on Yellowstone's Northern Range in the Gallatin National Forest. Current survey methods and ungulate carcass survey routes may be redesigned or modified when appropriate. When available, monitoring results of winter-killed ungulate carcass availability will be summarized and reported annually in the IGBST publication *Yellowstone Grizzly Bear Investigations* [available online](#).

Cutthroat Trout

Background

Due to their highly digestible protein and lipid content, spawning cutthroat trout (*Oncorhynchus clarkii bouvieri*) are one of the highest sources of dietary energy available to grizzly bears with home ranges in close proximity of Yellowstone Lake and its tributaries (Mealey 1975, Gunther *et al.* 2014a). Grizzly bears were once known to prey on cutthroat trout in at least 36 different stream tributaries to Yellowstone Lake (Hoskins 1975, Reinhart and Mattson 1990). Haroldson *et al.* (2005) estimated that approximately 68 grizzly bears per year frequented and likely fished ten Yellowstone Lake spawning stream tributaries monitored during 1997–2000. Introduction of non-native lake trout (*Salvelinus namaycush*) and effects of drought and whirling disease (*Myxobolus cerebralis*) has led to a decline in native cutthroat trout populations and associated decline in number of bears visiting spawning streams (Teisberg *et al.* 2014).



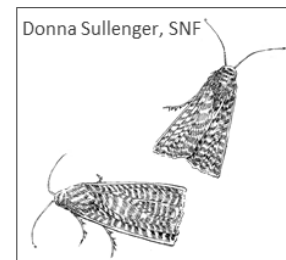
Monitoring Protocol

The Yellowstone Lake cutthroat trout population is monitored most years in the spring, depending on weather and spring snow melt, using large mesh gillnets, weirs with fish traps, and occasionally electronic fish counters. An electronic sonar fish counter was installed and calibrated in 2013 along Clear Creek on the east side of Yellowstone Lake to facilitate annual counting of spawning cutthroat trout ascending Clear Creek on the east side of Yellowstone Lake. Visual stream surveys are also conducted most years to identify trends in the number of cutthroat trout spawning Yellowstone Lake tributaries. Visual surveys to measure the presence of cutthroat trout and rainbow hybrids are also typically conducted at the Trout Lake inlet creek. Yellowstone Park biologists provide an annual summary of cutthroat trout monitoring results to the IGBST for publication in the *Yellowstone Grizzly Bear Investigations* [available online](#). Current survey methods may be modified or redesigned as appropriate.

Moth Aggregation Sites

Background

Alpine moth aggregations are a calorie-dense and nutrient-rich food source found at remote, high-elevation alpine sites dominated by talus and scree slopes in the eastern half of the ecosystem. Knowledge regarding the intricate relationship between army cutworm moths and grizzly bears has improved substantially since the late 1980s when grizzly bear use of moth aggregation sites was first discovered and such sites were included in observation flights (Bjornlie and Haroldson 2014). When available, moths are a valuable source of nutrition for grizzly bears because they have the highest reported gross caloric content per gram of any food available to grizzly bears in the GYE (7.91 kcal/g; Gunther *et al.* 2014a). Some grizzly bears may feed almost exclusively on moths for a period of over one month (French *et al.* 1994). A grizzly bear feeding extensively on moths over a 30-day period can consume 47%, or close to half of its annual energy budget of 960,000 calories (White *et al.* 1999). Grizzly bears whose home ranges include moth aggregation sites often visit these talus slopes during mid-to-late summer and early fall to accumulate fat reserves in preparation for the winter denning season. Although grizzly bear use of moth sites does not vary widely over time (1993 is one notable exception; low bear use due to late, extensive snow cover), annual monitoring provides important data regarding this high-calorie resource.



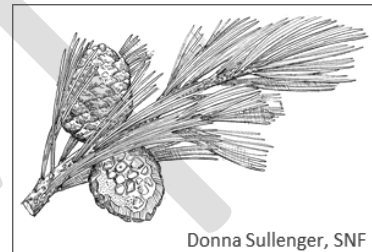
Monitoring Protocol

As of 2013, 37 confirmed and 16 possible moth sites have been identified in the GYE; however, size, location, and moth abundance of sites fluctuate from year to year due to natural variation in environmental factors such as snow cover (Bjornlie and Haroldson 2014). Aerial observations of bears feeding at moth sites are made from fixed-wing aircraft as part of on-going radio tracking and observation flights conducted by the IGBST. Although this monitoring protocol does not provide direct information regarding the abundance of moths, grizzly bear use of aggregation sites can provide an indirect measure of the relative availability of this resource in a given year. Aerial surveys of all confirmed moth sites will be conducted annually and results will be summarized and presented in the annual IGBST report *Yellowstone Grizzly Bear Investigations* [available online](#).

Whitebark Pine Cone Production

Background

Because of their high fat content and potential abundance, whitebark pine seeds are an important fall food for grizzly bears in the GYE (Mattson and Jonkel 1990). Yellowstone grizzly bears consume whitebark pine seeds extensively when whitebark cones are available. Bears may feed almost exclusively on whitebark pine seeds when production exceeds 22 cones per tree (Mattson *et al.* 1992). Because whitebark pine is a masting species, availability varies substantially from year to year. During fall seasons of low whitebark pine seed availability, grizzly bears often seek alternate foods at lower elevations, leading to more frequent bear conflicts and human-caused grizzly bear mortalities (Mattson *et al.* 1992, Blanchard and Knight 1995, Haroldson *et al.* 2006). Conversely, when whitebark pine seeds are abundant, there are generally fewer grizzly bear-human conflicts during fall (Mattson *et al.* 1992, Gunther *et al.* 1997). Studies have shown that during poor whitebark pine years grizzly bears alter their selection for whitebark pine stands (Costello *et al.* 2014) and consume more animal matter, boosting their fat levels to match those measured in years of high cone production (Schwartz *et al.* 2014). Although whitebark pine has experienced widespread declines in the GYE (see subsequent section), extensive studies by IGBST showed no profound negative effects on grizzly bears at the individual or population level (IGBST 2013). Costello *et al.* (2014) reported that approximately one-third of Yellowstone grizzly bears in their study included little or no whitebark pine stands within their fall range.



Monitoring Protocol

Currently there are 21 whitebark pine cone production transects (Figure 3) within the GYE. Annual transect surveys are typically conducted between July 15 and August 15 to count cones after maturation, but before cones and seeds have been collected by red squirrels (*Tamiasciurus hudsonicus*) and Clark's nutcrackers (*Nucifraga columbiana*). The presence or absence of blister rust, beetle infestations as well as activity levels of grizzly bear, black bear, red squirrel, and Clark's nutcracker are also recorded during transect surveys. Monitoring of whitebark pine cone production using current or modified methods will continue under this Conservation Strategy and results will be summarized and reported in the IGBST publication *Yellowstone Grizzly Bear Investigations* [available online](#).

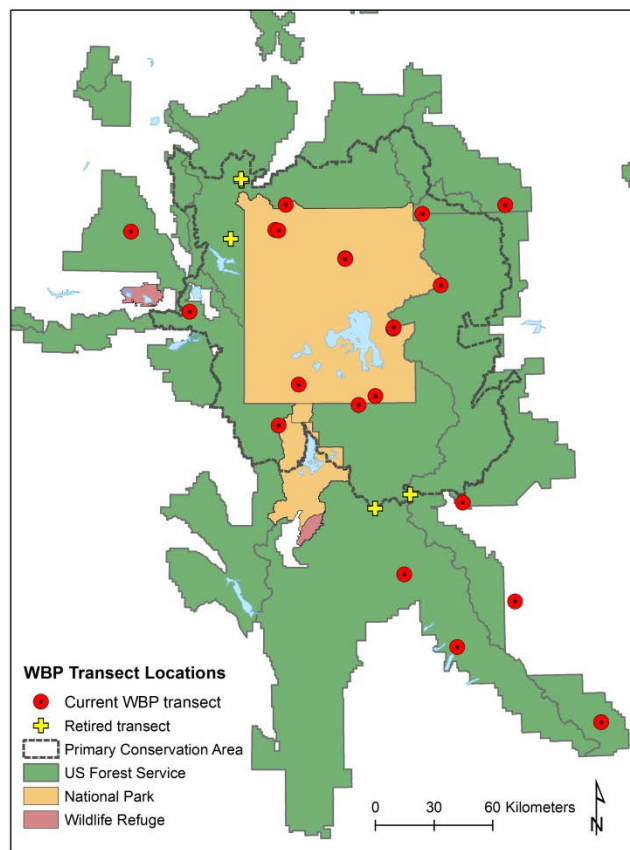


Figure 3. Location of whitebark pine cone production transect sites in the GYE, 2014.

Monitoring Mountain Pine Beetle Infestation and White Pine Blister Rust

Background

Since the early 2000s, whitebark pine has declined significantly throughout much of the species' historic range in the Northern Rockies due to the spread of mountain pine beetle (*Dendroctonus ponderosae*) and white pine blister rust (*Cronartium ribicola*). The greatest levels of whitebark mortality resulted from mountain pine beetle, a native insect that typically attacks large, mature trees with inner bark thick enough to support larvae (Larson 2011). Beetle infestations tend to occur episodically every 20-40 years resulting in high, widespread mortality across coniferous forests. The most recent outbreak began in the early 2000s and impacted millions of hectares in the Rocky Mountains (Raffa *et al.* 2008). The infestation was exacerbated by warmer winters at higher elevations allowing for increased brood development and survival of adult beetles, and greater opportunity for reproduction (Bentz *et al.* 1991, Perkins and Roberts 2003, Larson 2011, Dooley 2012).

White pine blister rust, an exotic invasive pathogen introduced to North America in 1910, affects whitebark pines of all age classes, although seedlings and saplings are especially susceptible to infection. This exotic fungal pathogen infects the cambium of whitebark pine and other five-needle pines, causing reproductive failure and tree mortality (McKinney *et al.* 2009, Bockino and Tinker 2012). However, some individual whitebark pines carry genetic traits that make them more resistant to the disease. Restoration programs launched by the Forest Service use a technique described by Mahalovich *et al.* (2006) to breed and plant rust-resistant whitebark pines as part of an on-going effort to restore and maintain the species in the Yellowstone ecosystem.

In 2000, under the auspices of the Greater Yellowstone Coordinating Committee (GYCC), the Whitebark Pine Subcommittee (WPSC) was created and tasked with forging a comprehensive long-term strategy for monitoring whitebark pine throughout the ecosystem. Recognizing the persistent and pervasive threat that blister rust and pine beetle posed to the health of whitebark pine, the subcommittee reached out to other agency and non-governmental partners to avoid duplication of efforts. The result of these alliances is the Greater Yellowstone Whitebark Pine Monitoring Working Group (GYWPMWG), which consists of partners from the National Park Service (NPS), U.S. Forest Service (USFS), U.S. Geological Survey (USGS), and Montana State University (MSU). Led by the NPS Greater Yellowstone Inventory and Monitoring Network (GRYN), a strategic and peer-reviewed monitoring protocol was established for detecting, tracking, assessing, and reporting the health, status, and trends of whitebark pine throughout the GYE (GYWPMWG 2011). This ground-based monitoring program was initiated in 2004 and will continue to assess the current status and long-term trends of whitebark pine into the foreseeable future.

Monitoring Protocol

Spearheaded by the GRYN, an interagency collaborative monitoring effort involving NPS, USFS, and USGS partners will measure the status and trends of whitebark pine throughout the GYE. Monitoring efforts will focus on collecting critical baseline information for assessing 1) infection rates and severity of white pine blister rust; 2) survival of whitebark pine taking into account synergistic interactions of blister rust, mountain pine beetle, wildland fire, and other agents of change; and 3) recruitment of whitebark pine trees into cone-bearing age classes. Monitoring protocols will follow methods and procedures established in the *Interagency Whitebark Pine Monitoring Protocol for the Greater Yellowstone Ecosystem* (GYWPMWG 2011). Results of current whitebark pine status and trends will be made available at the [GRYN](#)

[Inventory and Monitoring website](#) and referenced in the annual IGBST monitoring report *Yellowstone Grizzly Bear Investigations*.

Monitoring Habitat Connectivity

Background

Habitat connectivity is the degree to which the landscape promotes natural movement of wildlife as they seek important resources for survival and successful procreation. Potential effects of highway improvements, such as increased motorized access, higher traffic volume, and higher speed limits, are known to increase grizzly bear mortality, reduce habitat connectivity, and potentially inhibit gene flow among nearby populations (Mace 2004, Summerfield *et al.* 2004, Proctor *et al.* 2012). Certain road designs and road improvements potentially discourage bear crossings, may lead to increased mortality from vehicle collisions, and may cause habitat fragmentation. The potential impact of highways on demographic and genetic connectivity of grizzly bears in the GYE is a key consideration in the transportation planning process.

Monitoring Protocol

To prevent habitat fragmentation and loss of connectivity, [existing](#) road surveys [information](#) will be ~~conducted~~ [compiled and evaluated](#) by the appropriate land management agency as an integral part of the planning stage of any proposed road improvement and/or construction project in suitable grizzly bear habitat within the GYE (both inside and outside the PCA). During the NEPA analysis stage of such projects, analyses [of road survey information](#) will be conducted to evaluate potential impacts of the project on grizzly bear habitat connectivity. ~~In the NEPA analysis~~ [More specifically](#), federal agencies will identify important crossing areas by collecting [and/or assessing existing](#) information about known [grizzly](#) bear sightings, ungulate road mortality [tiesy data](#), locations of game trails, ~~and analysis of~~ bear home ranges, and habitat use within and near the road corridor. By identifying crossing areas used by grizzly bears, federal officials can recommend mitigation measures to reduce potential impacts from road construction both during and after a project. For example, during construction, work camps should be placed in areas with lower risk of displacing grizzly bears and [use of](#) bear-proof food and garbage storage containers should be ~~installed~~ [implemented](#). Highway planners are encouraged to place warning signs at points of high mortality risk and implement wildlife crossing infrastructure such as culverts or underpasses to enhance safe passage. Road construction in areas of relatively high value for potential grizzly bear habitat linkage should be designed to mitigate potential negative impacts on habitat connectivity, including the consideration of [installing](#) crossing structures.

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