U.S. Fish and Wildlife Service
U.S. Department of the Interior

MOOSEHORN NATIONAL WILDIFE REFUGE
BARING, MAINE

FIRE MANAGEMENT PLAN

Environmental Assessment /Assessment of Effect

January 2008

Environmental Assessment
Assessment of Effect
for
FIRE MANAGEMENT PLAN

Moosehorn National Wildlife Refuge

2008

Public Comment
Note to Reviewers and Respondents:

If you wish to comment on this environmental assessment, you may mail comments to the name and address below. This environmental assessment will be on public review for 30 days. Please note that names and addresses of people who comment become part of the public record. If you wish us to withhold your name and/or address, you must state this prominently at the beginning of your comment. We will make all submissions from organizations, businesses, and individuals identifying themselves as representatives or officials of organizations or businesses, available for public inspection in their entirety.

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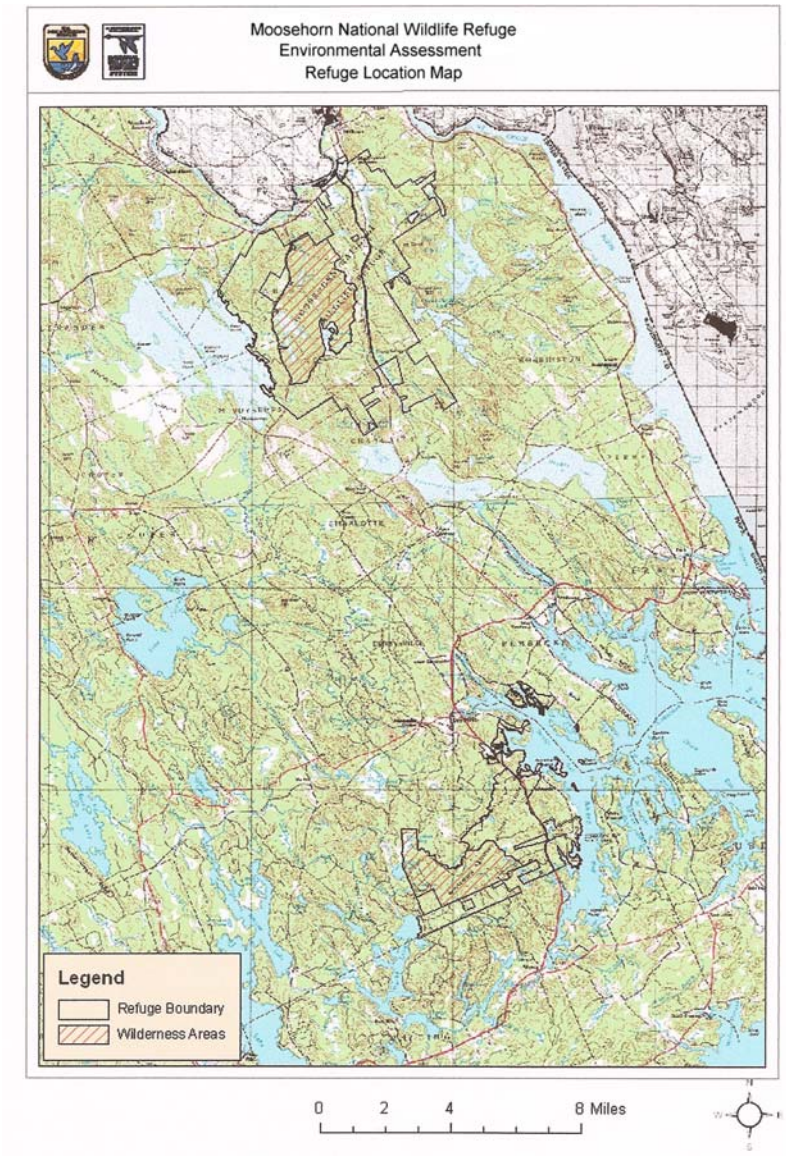
INTRODUCTION

The 28,898-acre Moosehorn National Wildlife Refuge (NWR) lies within the furthest reaches of Downeast Maine (Washington County), a region of spectacular rocky coastline, dense spruce fir forests, extensive beaver flowages, clear lakes and ponds, and meandering streams intermixed with blueberry barrens, cleared fields, and young forests. Moosehorn NWR was established to protect habitat for migratory birds and is the only unit within the National Wildlife Refuge System that devotes a major portion of its management effort for research and demonstration of habitat management techniques that benefit American woodcock (*Scolopax minor)*. This type of management also benefits a wide variety of migratory birds and resident wildlife including black ducks, neotropical migrant birds, ruffed grouse and mammals such as the moose.

Figure 1



The Refuge is administratively divided into two divisions (Figure 1), the 20,027-acre Baring Division located about three miles southwest of Calais, Maine, and the 8,871-acre Edmunds Division located three miles south of Dennysville, Maine, directly adjacent to Dennys and Whiting Bays along U.S. Highway 1. Within the Refuge, 7,462 acres are designated as Wilderness Areas: 4,680 acres on the Baring Division and 2,782 on the Edmunds Division. The Edmunds Division encompasses Cobscook Bay State Park. The Refuge is named for Moosehorn Stream, a waterway within its boundaries.

Moosehorn NWR contains 4401 acres of wetlands ranging from open water lakes to emergent marshes. The Refuge has more than 50 managed impoundments or flowages. Many of these were likely once beaver flowages or small streams. Numerous dikes and water control structures were built in the 1950's and 1960's to benefit nesting and migrating waterfowl. The Refuge has 18 miles of rocky shoreline along Dennys and Whiting Bays and 7 miles of shoreline on Meddybemps Lake. Over 4400 acres of the Baring Division is within the Dennys River Watershed; the Dennys is a high priority river for Atlantic salmon recovery. Cobscook Bay supports the highest nesting density of eagles in the northeastern U.S. and is considered essential to the recovery of the eagle in the east. The Refuge supports several eagle pairs.

Purpose and Need

The purpose of this Environmental Assessment (EA) is to ensure that the Moosehorn National Wildlife Refuge fulfills the requirements of the National Environmental Policy Act of 1969 in the course of implementing the actions described in the U.S. Fish and Wildlife Service Manual, Part 621, Fire Management (February 7, 2000). Part 621 requires that each refuge capable of sustaining wildland fire develop a Fire Management Plan (FMP) describing the long-range actions required to manage a safe, effective, and environmentally sound fire management program. At the present time, Moosehorn National Wildlife Refuge does not have a current and up-to-date fire management plan (FMP). The FMP currently in place was written and approved in 1998. The Environmental Assessment (EA) developed for that FMP was prepared in 1984. In addition, Moosehorn NWR does not currently have a Comprehensive Conservation Plan (CCP), though they are in the process of actively developing that document. As a result, the Moosehorn National Wildlife Refuge is developing this EA as a means to meet policy requirements reflecting current conditions and uses within the Refuge. Within the body of this Environmental Assessment, all reasonable alternatives and options for the development of an FMP are explored and the potential impacts of each are described. Analysis of the alternatives outlined in this document will provide a basis for decision-making at the Refuge and regional level and will provide an opportunity for public involvement in the planning process.

Wildland fires occur today as the result of both human-caused and natural processes. Therefore, any fire management plan that is developed for practical implementation must be capable of defining levels of preparedness and of establishing attendant procedural actions under a wide range of wildland fire types and conditions. Adequate provisions must be in place to provide for human safety and the protection of Refuge resources.

Changes in refuge vegetation resulting from insects, storm damage, and past management practices have impacted present day vegetation on refuge lands. In some areas of the refuge,

trees and shrubs that have died as a result of the aforementioned impacts have been responsible for an increase in accumulations of dead and down fuels. Forest composition has also been altered over time, with a build-up of hazardous fuels increasing in some areas due to natural accumulation of fine and woody material. The ignition of hazardous fuels in an uncontrolled situation, whether by a human occurrence or by lightning, could have important impacts on sensitive natural resources of the refuge. In addition, these types of wildland fire pose a real threat to human life and refuge capitalized resources.

A variety of fire management activities may be utilized in order to provide for the protection of refuge resources. The proposed suitability and implementation of these methods, singularly or in combination, is analyzed in this document. These techniques include: the use of prescribed fire and non –fire (mechanical, manual, and chemical) applications to reduce hazardous fuels; reduce and/ or remove invasive species, perpetuate and/ enhance the proliferation of native vegetation, manage select ecosystem habitats to meet a variety of wildlife species needs and protect the full range of refuge natural resources.

The objective for the writing of a fire management plan is to address refuge issues related to fire management as discussed in the previous paragraph. As previously described, refuges must also comply with the requirements of USFWS Policy and the National Environmental Policy Act in meeting these objectives.

This Environmental Assessment has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended; the regulations of the Council on Environmental Quality (CEQ) (40 CFR 1508.9); the USFWS Service Manual, Part 621 and accompanying Handbook, and the National Historic Preservation Act (NHPA) of 1966, as amended (36 CFR 800).

Objectives

Moosehorn National Wildlife Refuge was established by Congress in 1937 as a Migratory Bird Refuge. Its primary purpose was to protect habitat for migratory birds and for improving habitat and prompting research for the American woodcock ((*Scolopax minor)* as well as waterfowl. It is the only unit with the National Wildlife refuge System that devotes a major portion of its management efforts towards the benefit of the woodcock.

The Refuge has also been tasked to prepare and implement a fire management program that supports this legislative mandate. The objectives of the fire management program that relate directly to the core mission of the refuge are:

- Facilitate implementation of those actions and activities which will perpetuate the integrity, diversity (species and age classes), and productivity of a variety of habitats, including natural and managed non-forested wetlands, uplands, forested wetlands, wilderness, and coastal habitat.
- Provide optimal habitat for the largest number of wildlife species possible, including birds, mammals, reptiles, and amphibians, with special emphasis upon species of concern (i.e. American woodcock).

- Restore fire as an integral part of refuge ecosystem processes.
- Implement fire management activities which comply with the spirit and intent of the enabling and regulatory legislation of the refuge, as well as with provisions of existing approved planning documents (i.e. Habitat Management, Forest Management Plans, etc).
- Conduct a safe and vigorous wildland fire management program with the highest professional and technical standards.
- Efficiently accomplish resource management objectives through the application and management of prescribed, wildland and non-fire treatments.

Corollary objectives specific to fire management as mandated through the National Fire Plan (2005) and Service Manual, Part 621 are:

- Suppress all unscheduled ignitions
- Ensure smoke production does not violate state and federal standards; and minimize smoke impacts to refuge neighbors
- Assess and reduce hazardous fuels that pose potential threats to resources to be protected (values at risk)
- Cooperate with partners and other interested parties on fire management issues
- Reduce the hazard from wildland fire around developed areas
- Explore the use of prescribed fire, possibly in combination with non-fire (mechanical and chemical) methods, as a tool in restoring and maintaining natural resources in order to meet management objectives of the refuge as stated in planning documents (i.e. Habitat Management Plan, Forest Management Plan, Annual Work Plans, etc).

Scoping Issues and Impact Topics

Issues and concerns affecting this plan were identified by USFWS specialists, as well as from the input of cooperating and interested parties. Internal scoping was conducted at the refuge Headquarters on December 3-6, 2007, as well as in subsequent discussions. The interdisciplinary experts evaluated a variety of different strategies with which to effectively implement a fire management plan for the Refuge. Discussions relating to the development of fire management plans for the refuge were centered upon core management objectives that have been identified in a variety of refuge management plans and associated documents that were discussed in the previous section on objectives.

Moosehorn National Wildlife Refuge has a Fire Management Plan that was prepared in 1998. In addition, the Environmental Assessment for the FMP was written in 1984. Since the refuge is in the developmental stages of preparing a Comprehensive Conservation Plan (CCP), it was critical to develop a fire management program that reflects current refuge conditions and USFWS policy. As a result, during the internal scoping meetings, a wide variety of issues relating to Refuge management and fire were discussed, many in great detail, by the participants. *The results of the internal scoping process and impact topic development are summarized below.*

Impact Topics Selected for Consideration

- Provide for safety as the paramount objective during all fire management activities, including safety for firefighters, refuge visitors, and the adjacent public. This emphasis on safety is mandated by USFWS policy and is the highest single priority in any activity involving wildland fire management.
- Comply with state and federal air quality regulations in all fire related actions. Air quality was adopted as an impact topic.
- Protect natural vegetative systems and, to the extent practicable, improve the overall ecological functioning and health of refuge vegetative systems, particularly those that relate to the promotion of healthy wildlife habitat or that are in danger of encroachment from invasive and/ or exotic species. As a result, vegetation was adopted as an impact topic.
- The refuge serves as home to a wide variety of wildlife species. Their protection and well-being are arguably the most important management objectives of the refuge, thus, the inclusion of wildlife as an impact topic.
- The potential impact of fire management plan alternatives on soils is of concern to refuge management and was selected as an impact topic.
- Wetlands are found in abundance at the Moosehorn National Wildlife Refuge. These areas serve as important habitat for birds, wildlife, and vegetative species. For these reasons, wetlands and floodplains were selected as an impact topic to be included in this assessment.
- Because Moosehorn National Wildlife Refuge presently contains plant and animal species designated on federal and state lists as being *threatened, endangered*, or otherwise designated as *species of concern*, discussions regarding these species were selected as an impact topic.
- Moosehorn National Wildlife Refuge contains lands designated as Federal Wilderness. Because of this designation, wilderness was included as an impact topic.

Impact Topics Dismissed from Further Consideration

The rationale for dismissing specific topics from further consideration is given below.

Prime and Unique Farmlands

In August, 1980, the Council on Environmental Quality (CEQ) directed that federal agencies must assess the effects of their actions on farmland soils classified by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) as prime or unique. Prime or unique farmland is defined as soil that particularly produces general crops such as common foods, forage, fiber, and oil seed; unique farmland produces specialty crops such as fruits, vegetables, and nuts. According to the NRCS, there are no soil types contained within the Moosehorn National Wildlife Refuge that are designated as prime and unique farmlands. Therefore, the topic of prime and unique farmlands was dismissed as an impact topic in this document.

Socioeconomic Environment

The proposed action is unlikely to change local and regional land use or impact local businesses or other agencies in any way other than in the short term. If a large and intense wildfire was to occur on refuge lands, and damage to the forest overstory was serious enough, a commercial salvage operation might be warranted benefiting the local timber industry. Implementation of the proposed action, particularly as it relates to prescribed burning, may require temporary closures of project areas which may, in turn, inconvenience some visitors to the refuge. Such closures, however, are likely to be small in size and of very short duration. The impacts to refuge visitors are regarded as negligible. Therefore, the socioeconomic environment will not be addressed as an impact topic in this document.

Environmental Justice

Executive Order 12898, "General Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. The proposed action would not have disproportionate health or environmental effects on minorities or low-income populations or communities as defined in the Environmental Protection Agency's Environmental Justice Guidance (1998). Therefore, environmental justice was dismissed as an impact topic in this document.

Overview of Predominant Fire Management Strategies

The primary goals of fire management are the preservation and protection of human life, property, and resources. In developing a reasonable range of alternatives for implementing a fire management plan, it is important to understand the types of fire management strategies that are available to land managers. A discussion of each of the predominant fire management strategies is provided below. Because there are a limited number of strategies available, each alternative may be composed of a combination of strategies as defined in this section.

Wildland fire suppression (aggressive) – This strategy utilizes a variety of tactics in order to achieve control of a wildland fire in the most expeditious manner possible. Primary emphasis is placed upon limiting the fire to the smallest possible perimeter size. This may entail the use of mechanized equipment (dozers, tractor plows, engines and aerial resources that utilize retardants), or the use of handcrews building fireline as close to the edge of the flaming front of the fire as possible.

Wildland fire suppression (appropriate management response) – This strategy employs tactics where fire suppression resources utilize opportunities to allow fires to burn into areas where fuels are either non-existent or where fuel loadings are reduced. These areas are typically represented by pre-existing natural and man-made features on the landscape (i.e. streams, trails, roads, railroads right-of-ways, rockslides, riparian areas, or any area with light fuels). This strategy may result in more acreage burned. However, it reduces or precludes the necessity of placing

suppression resources in areas where Refuge values at risk may be damaged by their presence, thus preventing a situation where more damage may be caused by suppression efforts than by the effects of the fire itself.

Non-fire treatments – See hazardous fuel reduction

Prescribed fire – Fire intentionally ignited by fire management professionals under specific pre-determined conditions (a *prescription- see definition below*) in order to meet specific objectives related to hazardous fuels reduction or habitat improvement. A written, approved prescribed fire burn plan is prepared for *each individual* prescribed fire project application. This burn plan provides the information needed to implement an individual prescribed burn project, and includes measurable criteria, or prescriptions, that define the conditions under which a prescribed fire may be ignited, guides selection of appropriate management responses, and indicates other required actions. Criteria may include safety, economic, public health, environmental, geographic, administrative, social, or legal considerations, each of which is specific to the project being implemented.

A key component of the use of prescribed fire is the requirement of the preparation of a Fire Effects Monitoring Plan. This plan would describe quantifiable fire effects and methods for monitoring vegetation to determine if the desired outcomes were being achieved. If, in the course of implementation of a Fire Management Plan (FMP), Fire Effects Monitoring yields data that reflects negative impacts to the resources of the Refuge, a new plan would be written to reduce or cease the use of prescribed fire within the Refuge (the adaptive management technique).

Prescription – A pre-defined range of environmental variables that must be present in order for a prescribed fire to be implemented. (For example; ambient air temperature, relative humidity, fuel moisture, mixing heights, transport speeds, wind direction, fuel loading).

Hazardous fuel reduction – Hazardous fuel accumulations accrue through a variety of environmental processes. The most common is the natural accumulation of fuels over a long period of time, usually exacerbated by the total suppression of wildland fire. These accumulations can also be created through the cumulative action of such events as wind, insect damage, and ice and snow. Heavy fuel loadings create a significant wildland fire hazard since any fires occurring in these areas burn with intensities and spread rates that often are beyond the capabilities of suppression resources to effectively manage. In addition, fires of this type are much more prone to damage vegetation, soils, and forest resources through the intense heat they generate and the longer residence times they produce during the life of the fire. Fuel loading can be quantitatively measured and then reduced to safe levels through the use of a variety of techniques. Depending upon location and amount of excess fuel, manual hazard fuel reduction methods or prescribed fire may be utilized effectively, either individually or in combination. In addition, herbicide application may also be a part of the treatment regime. This process is referred to as *integrated fuels management*. For example, an extremely effective tool in the maintenance of some vegetation communities is the manual hazard fuel reduction and removal of excess fuel through hand-cutting, accompanied by application of low intensity prescribed fire.

Hazardous fuel accumulations may also be manually cut, piled, and then burned when environmental conditions are favorable for their removal.

Integrated Fuels Management – See above (hazardous fuel reduction).

Chemical treatments – The use of herbicides to reduce populations of unwanted vegetation, such as invasive species, is an effective management tool. Herbicide use is often carried out under the guidance of an Integrated Pest Management (IPM) plan; however, there can be a beneficial overlap between IPM and fire management. Chemical treatments are often used as a follow-up to an application of prescribed fire or mechanical cutting in order to eliminate stump and root sprouting that may occur after treatment. For example, the use of prescribed fire and mowing as a technique to place stress on black locust saplings, followed by a treatment of individual stumps with an indicated herbicide, is a very effective technique shown to reduce the proliferation of this invasive species.

Herbicides may also be effectively used in broadcast application in order to eliminate selected invasive species. Re-seeding with a desired species is then undertaken, followed by an application of prescribed fire in order to aid and maintain the proliferation of native species. This technique is most commonly used in the restoration of native warm season grass communities that occur in areas where the restoration of historic grass communities is a priority. All use of herbicides will be consistent with the guidelines established in DM Part 517, Chapter I and the USFWS Manual.

Wildland Fire Use – Natural ignitions (lightning) are allowed to burn under pre-determined prescribed environmental conditions in order to meet Refuge management objectives. ***Note: This strategy will not be used at Moosehorn National Wildlife Refuge.***

In each of the alternatives that follow, predominant fire management strategies are discussed as they relate to operational implementation of each alternative. Each of the alternatives discussed will address refuge needs for fire management preparedness as governed by the USFWS Manual, Part 621, Fire Management.

ALTERNATIVES CONSIDERED

Alternative I - No-Action (Aggressive Fire Suppression Only)

The Moosehorn National Wildlife Refuge currently has no *current* fire management plan (FMP). The Fire Management Plan that the refuge is utilizing operationally was written in 1998 and needs to be updated in order to meet current policy and refuge fire management needs. Since all USFWS refuges are mandated by Department of Interior Policy to prepare an FMP, a fire management plan needs to be prepared in order to incorporate preparedness actions, program requirements, and formats as outlined in the current USFWS Manual, Part 621 for Fire Management. The sole fire management strategy allowed under this alternative would be to continue to suppress all wildland fire ignitions using the most expeditious means necessary (aggressive fire suppression). Under the no action alternative, the fire management plan would not address any actions for the reduction of the accumulation of hazardous fuels, nor would it permit prescribed fire for wildlife and resource management benefit. Under the guidance of an

already approved plan for management of invasive vegetation, chemical treatments would continue to be utilized in order to meet management objectives.

Alternative II – Appropriate Management Response and Integrated Fuels Management (Preferred Alternative)

This alternative would allow for the preparation of a fire management plan that includes wildland fire management preparedness actions as well as detailed procedural actions during wildland fire events. In this alternative, the suppression of all wildland fire ignitions would utilize an appropriate management response (AMR). It would also provide a detailed action plan for preparedness and suppression of wildland fires including the mitigation of impacts, safety, and resource protection. The use of prescribed fire, either individually or as a part of an integrated management approach, would be utilized to accomplish the full range of natural resource management and hazardous fuel reduction goals. All prescribed fires would be planned and approved consistent with the method and format required by the Service Manual. *Wildland fire use would not be a permissible option under appropriate management response.*

This alternative includes the use of prescribed fire for the purpose of hazardous fuel reduction. The use of prescribed fire would allow the reduction of hazardous fuels that have accumulated from a variety of causes, including the absence of naturally occurring fires and impacts from severe storms. Their implementation would decrease the likelihood of a catastrophic wildland fire that potentially presents a danger to human life as well as to refuge resources. In many ecosystems in the eastern United States, normal precipitation patterns and low to normal fuel loadings preclude the potential for serious wildland fires. However, in those years when drought is present, the likelihood of a human – caused wildland fire is increased significantly. This increased potential for fire ignition and spread is intensified by the presence of fuel loadings outside of the normal range. Generally this means that fuel loading for deciduous and mixed pine/ deciduous forests is greater than ~16 tons/ acre but <25 tons/ acre, and considerably less for most shrub, brush and grass fuel models. Prescribed fire treatments may be applied on a rotational basis as a means of treatment to remove these excess fuels and at the same time enhance ecosystem variability for wildlife. Prescribed fires whose principal purpose is the reduction of hazardous fuels are generally implemented in such a manner that only ground fuels are consumed, ensuring that little or no ignition occurs in the crown structure of the forest .

In those areas where fuel loading is heavier (>26 tons/acre for forest fuels, less for shrub, brush, and grasses), particularly near structures, non-fire manual or mechanical reduction methods will normally be utilized to reduce fuel loading. Where access is available, fuels will be removed and disposed of by removing them from the site. In those areas where access is limited, piles of cut debris may be constructed for burning at an opportune time. Generally this occurs during the winter months when the ground is snow-covered and/ or wet from winter precipitation, temperatures are low, and winds are minimal.

Upland forests on the refuge may be found in various stages of succession. The diversity of these forests provides important habitat for many avian and mammal species, including the American woodcock (*Scolopax minor*). A healthy, genetically diverse upland forest also provides habitat for a wide variety of mammal, avian, and reptile life that are indigenous to the area. Prescribed

fire may be used as a management tool to reduce fuel loading, thereby reducing overall risk from the effects of an unwanted wildland fire fueled by many years of fuel accumulation resulting from the effects of storms, insects and natural accumulation. It may also be used to assist in creating a more diverse forest ecosystem by engendering the growth of various age and size classes of many vegetative species. This in turn, provides suitable habitat for a variety of early and late successional species. Its use also helps promote the establishment and restoration of some herbaceous vegetation types, particularly native warm season grasses and other select species.

One of the broad goals of the National Wildlife Refuge System has been the protection, enhancement and preservation of the natural resource systems that benefit wildlife. By using prescribed fire to enhance current eco-systems, other natural resource benefits would accrue. For example, wildlife habitat would be enhanced through the use of prescribed fire, increasing the number and palatability of various herbs and grasses upon which many species depend for food and forage. As a result, wildlife populations would benefit.

Invasive species can also be treated effectively with combinations of prescribed fire and non-fire (hand-pulling and herbicide) techniques. Reductions in invasive species provide opportunities for native species to re-populate areas previously dominated by introduced species. Generally this leads to beneficial ecosystem changes since other plants and animals in the area are adapted to live within the context of their native ecosystems.

In accordance with Service Directives, a monitoring plan would be developed and implemented for each project. The purpose of these plans would be to allow managers the ability to determine if project objectives were met or not, and, if not, how treatment(s) could be altered to meet stated objectives (adaptive management).

Alternative III – Appropriate Management Response and Non-Fire Fuels Management

The fire management program under this alternative would, as in Alternative II, suppress all wildland fire ignitions using the appropriate management response. It would also allow for the use of non-fire fuel reduction techniques such as the use of mechanical hazardous reduction and the use of chemical herbicides, either individually or in combination, to achieve Refuge natural resource and fuels management objectives. Prescribed fire would not be used in this alternative.

Alternative IV – Wildland Fire Use

Under this alternative, a full range of available fire management strategies including appropriate management response, wildland fire use (the use of naturally occurring wildland fire ignitions to meet resource management objectives) and prescribed burning would be used. This alternative also allows for the use of mechanical treatments and chemical herbicides.

Alternative V – No Management

Under this alternative, all unscheduled wildland fire ignitions (lightning) would be allowed to burn unimpeded by management actions until objectives were met. Prescribed fire and non-fire hazardous fuel reduction would not be utilized in this alternative.

Alternatives Considered and Rejected

Alternative IV – Wildland Fire Use

This alternative has been considered and rejected because it is not feasible to safely manage a wildland fire to achieve resource benefits with the limited size and staff of the Moosehorn National Wildlife Refuge.

Alternative V – No Management

This alternative has been considered and rejected because it could threaten the integrity of Moosehorn National Wildlife Refuge natural resources and does not ensure the safety of refuge visitors or employees.

Environmentally Preferred Alternative

The environmentally preferred alternative is determined by applying the criteria suggested in the National Environmental Policy Act of 1969 (NEPA), which is guided by the Council on Environmental Quality (CEQ). The CEQ provides direction that "the environmentally preferable alternative is the alternative that will promote the national environmental policy as expressed in NEPA's Section 101" (*Forty Most Asked Questions Concerning Council on Environmental Quality's National Environmental Policy Act Regulations*, 1981.)

Section 101 of the National Environmental Policy Act states that "…it is the continuing responsibility of the Federal Government to … (1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations; (2) assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings; (3) attain the widest range of beneficial uses of the environment without degradations, risk to health or safety, or other undesirable and unintended consequences; (4) preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment which supports diversity and variety of individual choice; (5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and (6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources." The environmentally preferable alternative for this project is based on these national environmental policy goals.

Alternative I - This alternative would aggressively suppress all wildland fires. It would allow for an increased potential of ground disturbing activities during wildland fire suppression operations due to the effects of the use of heavy equipment (bulldozers and tractor plows) used in aggressive suppression activities. Hand line construction by suppression crews also may lead to

increased ground disturbance in this alternative. Therefore, this alternative would not result in the same level of protection for natural and cultural resources and the public over the long term as would occur with the preferred alternative. Consequently, this alternative does not satisfy Provision 4 of NEPA's Section 101.

Alternative II - Appropriate Management Response and Integrated Fuels Management would provide for continued suppression of all unscheduled wildland fire ignitions using the most appropriate management response. This would allow managers to choose a suppression alternative that would minimize ground, vegetation, and wildlife disturbance activities. This alternative would also provide for use of prescribed fire, non-fire methodologies such as mechanical fuel reduction and chemical herbicides, used individually or in combination, to achieve natural resource, cultural landscape and fuel management objectives. The wildland fire suppression operations as utilized in this alternative would ultimately provide for better protection of natural and cultural resources, the health and safety of visitors and refuge employees because of its ability to reduce hazardous fuel loadings in a proactive manner *before* a catastrophic wildfire event occurs. In addition, the natural and cultural resource values of the refuge may be enhanced through the use of prescribed fire used as a tool to propagate native herbaceous species populations, manage vegetation in various successional stages of development, reduce or remove invasive species, and preserve and enhance some habitat types by reducing or eliminating invasive species where practicable. This alternative would best satisfy each of the provisions of the national environmental policy goals.

Alternative III – Appropriate Management Response and Non-Fire Fuels Management would provide the same elements as Alternative II, however this alternative would not allow the use of prescribed fire to achieve natural resource, wildlife and fuels management objectives. This alternative excludes one of the potential methods of cultural and natural resource protection that has proven to be successful and at the same time exert a low impact on refuge resources. Consequently, this alternative does not satisfy provisions 3, 4 and 6 of NEPA Section 101.

The Environmentally Preferable Alternative is:

Alternative II – Appropriate Management Response and Integrated Fuels Management because it surpasses Alternative I and Alternative III in realizing the full range of national environmental policy goals as stated in δ101 of the National Environmental Policy Act. The use of prescribed fire to enhance native herbaceous species, reduce and remove invasive plants, enhance forest habitat, maintain vegetation in various stages of succession for the benefit of wildlife, and reduce heavy fuel accumulations, provides a clear advantage over the other alternatives that do not utilize techniques that closely replicate natural processes. A rejection of the preferred alternative may result in further degradation of natural resources and add to the accumulation of hazardous fuels. Admittedly, manual methods of hazardous fuel reduction can be effective, but, in and of themselves, they do not offer as many of the advantages that can be attributed to prescribed fire. Careful application of prescribed fire is considerably more cost effective than manual hazardous fuel reduction, and can be applied in a manner that enhances the safety of the crews doing the work. The negative impacts of smoke from prescribed burns cannot be totally eliminated, but they can be mitigated through the use of a variety of implementation techniques that relate to: time of ignition, ignition pattern used, fuel moisture at the time of the

burn, and adherence to favorable conditions in the upper atmosphere that relate to the height of convection column rise and dispersion of pollutants.

ENVIRONMENTAL CONSEQUENCES

Refuge managers have reviewed critical natural resources that may be impacted through the implementation of this fire management plan. Impact topics have been selected on the basis of the significant resources of the refuge and the potential for beneficial or adverse effects on them by each alternative. An Internal Scoping meeting held by the refuge determined the identified impact topics as having particular relevance for the Moosehorn National Wildlife Refuge.

Methodology for Assessing Impacts

Applicable and available information on known natural and cultural resources were compiled. Alternatives were evaluated for their effects on the resources and values determined during the scoping process. The impact analyses were based on professional judgment using information provided by refuge staff, relevant references and technical literature citations, and subject matter experts. For each impact topic, the analysis includes a brief description of the affected environment and an evaluation of effects. Potential impacts are described in terms of type (are the effects beneficial or adverse), context (are the effects site-specific, local, or even regional), duration (are the effects short term or long term), and intensity (are the effects negligible, minor, moderate, or major or would the effects constitute impairment of Moosehorn National Wildlife Refuge resources and values). Because definitions of intensity (negligible, minor, moderate, or major) vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this environmental assessment beginning with Table 1 on page 18.

Direct, indirect, and cumulative effects are discussed for each impact topic. Predictions about direct and indirect effects are based on previous studies, monitoring information, wildland fire effects that have occurred at either Moosehorn National Wildlife Refuge or similar vegetation communities, and the expertise and judgment of resource management specialists.

When appropriate, mitigation measures have been identified that may be employed to offset or minimize potential adverse impacts.

Definitions of intensity levels vary by impact topic, but, for all impact topics, the following definitions were applied.

Beneficial: A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.

Adverse: A change that moves the resource away from a desired condition or detracts from its appearance or condition.

Direct: An effect that is caused by an action and occurs in the same time and place.

Indirect: An effect that is caused by an action but is later in time or farther removed in distance but is still reasonably foreseeable.

Short term: An effect that within a short period of time would no longer be detectable as the resource is returned to its pre-disturbance condition or appearance. Short term impacts, depending on impact topic, may range from a few hours up to five years (see table1 below).

Long term: A change in a resource or its condition that does not return the resource to pre-disturbance condition or appearance and for all practical purposes is considered permanent.

Intensity of Effects Defined

The following table defines impact thresholds, by impact topic, for each level of intensity included in this assessment.

Table 1.Impact Threshold Definitions

Impact Topic	Negligible	Minor	Moderate	Major	Duration of Impact
Firefighter and Public Safety	An action that could cause a change in level of risk to human safety, but the change would be so small that it would not be of any measurable or perceptible effect.	An action that could cause a change in risk level, but the change would be small and have a localized effect. Mitigation would be a standard procedure and highly effective in minimizing risk.	An action that would cause change to levels of risk; however, mitigation to offset adverse effects would generally be of moderate complexity and would be effective.	An action that would cause a severe change or exceptional benefit to human safety related values. The change would have a substantial and possible permanent effect, and mitigation to offset adverse effects is not assured.	Short term would refer to the duration of a fire management incident. Long term refers to duration extending beyond the specific incident.
Air Quality	Impact would be barely detectable and not measurable; if detected, would not be of any perceptible consequence.	Impact measurable but localized and of little consequence. No mitigation measures would be necessary.	Changes in air quality would have conse-quences to sensitive receptors, but effects would remain relatively local. Mitigation measures necessary and likely effective.	Changes in air quality would have substantial consequences to sensitive receptors. Mitigation measures necessary and success of meas-ures not assured.	Short term would refer to hours or days; i.e., the duration of the fire management incident. Long term would refer to that substantially beyond the duration of the incident or action.

Wilderness	Impacts would be temporary, localized, and distributed at such a time and location that their effects would not be noticed.	Impacts would be temporary, but the nature of their influence could be extended beyond just a short period (few hours) of time. Location and timing would possibly attract attention to the processes creating the impact(s).	Impacts would extend into times and locations where their effects would be noticeable by outside receptors.	Impacts would be extended by the presence of activities in locations and for durations far exceeding normal timeframe.	Short term would refer to hours or days; i.e., the duration of the fire management incident. Long term would refer to that substantially beyond the duration of the incident or action.
Vegetation	The change in native vegetation communities would be so small that it would not be of any measurable or perceptible consequence.	Changes in populations of native vegetation would be small, localized, and of little consequence. Response to fire and/or other treatments would be within the range of normal fire effects. Any adverse effects can be effectively mitigated.	A large segment of one or more species populations would exhibit effects that are of consequence but would be relatively localized. Response to fire and/or other treatments would be within the normal expected range of normal fire effects. Mitigation could be extensive but likely effective.	Severely adverse and possibly permanent effects to native plant communities over a large area. Response to fire and/or other treatments would be outside the normal range of expected fire effects. Mitigation to offset adverse effects may be required and extensive, and success not assured.	Short term refers to a period of less than 10 years. Long term refers to a period longer than 10 years.
Wildlife	The change in wildlife populations and/or habitats would be so small that it would not be of any measurable or perceptible consequence.	Changes in wildlife populations or habitats would be measurable but small, localized, and of little consequence. Response to fire and/or other treatments would be within	Changes in wildlife populations or habitats would be of consequence but would be relatively localized. Response to fire and/or other treatments would be within the normal expected	Severely adverse and possibly permanent effects to native wildlife populations or habitats. Response to fire and/or other treatments would be outside the normal range of expected fire	Short term refers to a period of less than 10 years. Long term refers to a period longer than 10 years.

		the range of normal fire effects. Any adverse effects can be effectively mitigated.	range of normal fire effects. Mitigation to offset adverse effects to native species extensive but likely successful.	effects. Mitigation to offset adverse effects may be required and extensive, and success not assured.	
Soils	Impacts to soils would not be measurable or of any perceptible consequence.	Changes to character of soils are detectable but small, localized, and of little consequence. Any mitigation needed to offset adverse effects would be standard, uncomplicated, and effective.	Changes to character of soils would be readily apparent and of consequence. Changes may be evident over large portion of the refuge area. Mitigation measures to offset adverse effects would probably be necessary and likely successful.	Impacts to characteristics of soils would be severe or of exceptional benefit over a wide area. Mitigation to offset adverse effects would be needed, but its success not assured.	Short term refers to durations of less than 5 years. Long term refers to durations in excess of 5 years.
Wetlands And Riparian Resources	Impacts would be so small that they would not be of measurable or perceptible consequence. No substantial change to wetland or riparian functions. A Section 404 permit from the U.S. Army Corps of Engineers would not be required.	Changes to riparian or wetland functions would be measurable but small, localized, and of little consequence. Any adverse effects to function can be effectively mitigated. A Section 404 permit from the U.S. Army Corps of Engineers may or may not be required.	Changes to riparian or wetland functions would be of consequence. Mitigation to offset adverse effects extensive but likely successful. A Section 404 permit from the U.S. Army Corps of Engineers would be required.	Changes to riparian or wetland functions would be noticeable over a relatively large area and result in severely adverse or beneficial impacts. Loss of ecological function may be permanent. Mitigation to offset adverse effects is required and extensive, and success not assured. A Section 404 permit from the U.S. Army Corps of Engineers would likely be required.	Short term refers to a period of 1-3 years. Long term refers to a period longer than 3 years.

Threatened, Endangered, and Species of Concern	Listed species would not be affected or the change would be so small as to not be of any measurable or perceptible consequence to the population. Negligible effect would equate with a "may effect, not likely to adversely affect" determination in U.S. Fish and Wildlife Service terms.	There would be a measurable effect on one or more listed species or their habitats, but the change would be small and relatively localized. Minor effect would equate with a "may effect" determination in U.S. Fish and Wildlife Service terms and would be accompanied by a statement of "likely" or "not likely to adversely affect" the species.	A noticeable effect to a population of a listed species. The effect would be of consequence to populations or habitats. Moderate effect would equate with a "may effect" determination in U.S. Fish and Wildlife Service terms and would be accompanied by a statement of "likely" or "not likely to adversely affect" the species.	Noticeable effect with severe consequences or exceptional benefit to populations or habitats of listed species. Major effect would equate with a "may effect" determination in U.S. Fish and Wildlife Service terms and would be accompanied by a statement of "likely" or "not likely to adversely affect" the species or habitat.	Short term refers to a period of 1-3 years. Long term refers to a period longer than 3 years.

Cumulative Impacts

Impacts to cultural and natural resources may be direct, indirect, or cumulative. Direct impacts are caused by an action and occur at the same time and place as the action. Indirect impacts are caused by the action and occur later in time or farther removed from the place, but are still reasonably foreseeable.

The Council on Environmental Quality (CEQ), which implements the National Environmental Policy Act, requires assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts were determined by combining the effects of each of the alternatives with other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions (40 CFR 1508.7). As a result, it was necessary to identify other ongoing or reasonable foreseeable future projects within the Moosehorn National Wildlife Refuge and, if applicable, the surrounding region. Cumulative impacts are considered for all of the alternatives.

Moosehorn National Wildlife Refuge is situated far away from large urban areas. It is primarily surrounded by forest land, owned by many private individuals. Almost without exception these lands are managed for timber production, with most of the land showing signs of recent harvesting activity. Although some residential properties are located adjacent to or in close proximity to the Refuge boundary, their number and density is low. With the exception of an asphalt production plant (Lane Construction) surrounded by Refuge land, there is no industrial development adjacent to the Refuge. Domtar operates a Paper Mill in Woodland ME. An emissions plume from this facility sometimes impairs visibility over the Baring Wilderness Area of the Refuge

Though relatively limited in size and scope compared to some areas near urban centers, activities and projects associated with these adjacent lands do have the potential to contribute to cumulative impacts within the refuge, particularly in regard to air pollution (atmospheric deposition of particulates of concern and heavy metals).

Of perhaps greatest concern for refuge management, and the most difficult to quantify, are the uncertainties of predicted changes in climate and their effects on wildlife, vegetation, and wetland and riparian resources. Commonly referred to as "global warming", the potential impacts of rising water levels, changes in atmospheric temperatures, wildlife migration modifications, etc, present a challenge for refuge managers.

Impairment of Refuge Resources or Values

In addition to determining the environmental consequences of the alternatives presented, U.S. Fish and Wildlife Service policy (Service Manual) requires analysis of potential effects to determine whether or not actions would impair refuge resources.

The fundamental purpose of the National Wildlife Refuge System, established by Congress begins with a mandate "to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people". Refuge managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adversely impacting refuge resources and values. However, the laws do give the U.S. Fish and Wildlife Service the management discretion to allow limited impacts to refuge resources and values when necessary and appropriate to fulfill the mission of the refuge. This applies as long as the impact does not constitute impairment of the affected resources and values. In addition, there is a statutory requirement which mandates that the USFWS must leave refuge resources and values unimpaired, *unless* a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible refuge manager, would harm the integrity of refuge resources or values, including, in some cases, the opportunities that otherwise would be present for the enjoyment of those resources or values. An impact to any refuge resource or value may constitute impairment. An impact would be more likely to constitute impairment to the extent that it has a moderate or severe adverse effect upon a resource or value whose conservation is:

- Necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the refuge
- Key to the natural integrity of the refuge; or
- Identified as a goal in the refuge Comprehensive Conservation Plan or other relevant U.S. Fish and Wildlife Service planning documents.

Determinations as to impairment are included for each of the following impact topics under each alternative.

IMPACT SUMMARY

The impacts associated with the implementation of the proposed alternatives for the Fire Management Plan are described and analyzed in this section.

Table 2 - Summary Comparison of Impacts

Objective	Alternative I (Beneficial)	Alternative II (Beneficial)	Alternative III (Beneficial)
Provide for firefighter and public safety	Short term safety would not be affected by the adoption of this alternative.	Firefighter safety in the long term is enhanced through use of mechanical treatments to reduce hazardous fuels, thus reducing the threat of large wildland fires driven by heavy accumulations of those fuels. Benefits are enhanced to the maximum extent possible through use of prescribed fire, mechanical treatments, and chemical use to reduce hazardous fuels. The ability to employ an appropriate management response provides the greatest protection of firefighter and public safety in suppression actions. Wildland fire prevention activities provide for long term safety.	Firefighter safety in the long term is enhanced, though not to the same extent as in alternative II. In addition, the ability to employ an appropriate management response provides the greatest protection of firefighter and public safety in all suppression actions.
	(Adverse)	**(Adverse)**	**(Adverse)**
	Aggressive fire suppression poses greater risks to personnel than an appropriate management response by placing personnel in situations where fire control actions allow little flexibility for options in the decision-making process. Hazardous fuels may actually increase in the long term creating a greater hazard through the perpetuation of aggressive fire suppression.	Personnel will be exposed to short term impacts of working with power equipment, heavy lifting, and exposure to prescribed fire operations.	Inability to utilize prescribed fire reduces ability to accomplish fuel reduction throughout the refuge to the maximum extent. As a result, fuel loads may increase, with an increased potential for wildfires. Moderate impacts to risk in the long term for suppression resources.
Air Quality(avoid violation of air quality standards)	**Alternative I (Beneficial)**	**Alternative II (Beneficial)**	**Alternative III (Beneficial)**
	Aggressive suppression may limit the size of wildland fires reducing the amount of smoke produced to low levels in the short term. Because there is no prescribed fire in this alternative, there will be no smoke impacts from these types of activities.	Because fuels are removed through the combined effects of an integrated program of fuels management, impacts would be short term and minor to moderate in those areas that have been treated. Generally, more fuels can be treated with this alternative.	Similar to Alternative II, except that not as much fuel is removed due to the lack of the availability of prescribed fire as a management tool. As in alternative I, there will be no smoke impacts from prescribed fire.

	(Adverse)	**(Adverse)**	**(Adverse)**
	Aggressive suppression of fires allows for the gradual build-up of fuels, thus creating the production of longer lasting and higher volume smoke impacts when wildland fires do occur. This may occur at times when environmental conditions favor stagnation and lack of dispersion.	Short term, minor impacts from smoke produced as a result of prescribed fires will result.	Impacts will still occur, though their effects will be moderate, both in terms of intensity and exposure. Because prescribed fire is not utilized as a management tool to reduce hazard fuels in this alternative, there would be no additional impacts due to smoke from prescribed fires; however, this benefit may be offset by the fact that not as much fuel is removed, thus increasing the potential for smoke intensity and duration when wildland fire does occur.
Wilderness	**Alternative I (Beneficial))**	**Alternative II (Beneficial)**	**Alternative III (Beneficial)**
	Aggressive suppression of wildland fires could result in fires of smaller size and intensity. Because the emphasis on suppression activities in this alternative relies upon total suppression in the most expeditious manner, suppression resources would, by necessity, be made available for deployment during critical periods of activity.	Because fire suppression activities utilize the Appropriate Management Response, wildland fires may be suppressed with methods that maximize suppression techniques that create minimize impacts to wilderness attributes i.e. soils, vegetation, etc. Because heavy fuel accumulations are removed through the combined effects of an integrated program of fuels management, impacts would be short term and minor in those areas that have been treated. Generally, more fuels can be treated with this alternative since they use a combination of prescribed fire and non-fire techniques. Because prescribed fire more closely replicates natural processes, wildlife and vegetation often benefit from the application of management techniques identified in this alternative.	Impacts to wilderness will be very similar to those stated in alternative II with a few differences. Because prescribed fire will not be used in this alternative, impacts associated with the use of prescribed fire, i.e. smoke produced from burns and the use of power saws, pumps, and equipment, will not in evidence.
	(Adverse)	**(Adverse)**	**(Adverse)**
	Impacts from aggressive fire suppression would be potentially greater than in the other alternatives. Because all fires will be suppressed in the most aggressive manner, large numbers of personnel and equipment will be needed to implement suppression activities, thus creating moderate impacts on wilderness values such as soil and wildlife. Over time, hazardous fuel build-ups would occur due to the aggressive suppression policy.	Suppression activities expose wilderness values to short term impacts from the use of power tools and suppression personnel. The noise and presence of suppression personnel can be disruptive in the short term to vegetation, soils and wildlife. Because some fires will not be aggressively suppressed, the duration of some fires and their relative intensities may be greater than those exhibited in alternative I.	Impacts to wilderness will be very similar to those described in alternative II. Because prescribed burning will not be used in this alternative, the build-up of hazardous fuels is likely to occur at a rate that exceeds that found in alternative II since non-fire fuel reduction methods are more time and labor intensive. They also do not as closely replicate natural processes mimicked by prescribed fire, so impacts on vegetation and wildlife could be intensified.

Vegetation	Alternative I (Beneficial)	Alternative II (Beneficial)	Alternative III (Beneficial)
	Short term impacts on vegetation would not be affected by the adoption of this alternative.	This alternative would be beneficial in maintaining viability in the upland forests as well as for associated understory vegetation. Forests could be managed for different successional stage productivity using prescribed fire, thus providing a wide range of successional species. Accumulations of hazardous forest fuels that have accumulated over time can be effectively reduced through the application of low-intensity prescribed fire. Native herbaceous species such as warm season grasses and other similar species would also benefit from changes in patterns of plant succession evoked by the use of prescribed fire. Encroaching invasive species would be reduced. Impacts from prescribed fire and mechanical treatments should be short term and negligible to minor. Use of appropriate management response should reduce potential suppression-related impacts.	Impacts from mechanical treatments should be short term and negligible to minor. Selective cutting and removal of hazardous fuels would benefit some species, though not to the extent as in Alternative II.
	(Adverse)	**(Adverse)**	**(Adverse)**
	Aggressive suppression activities have the potential to cause local and minor adverse impacts. Increased accumulations of hazardous fuel would lead to the potential for fires of greater intensity, thus creating potential loss of some vegetation types. Long term control of wildland fires would become more difficult due to additional fuel loading.	The potential for the short term introduction and proliferation of invasive species is present in this alternative. There is a reduced benefit to those species that are not fire–tolerant.	The potential is greater for adverse impacts due to increased foot and/or machine traffic, if more invasive forms of mechanical reduction are utilized. Use of appropriate management response should reduce potential suppression-related impacts. Upland forests and herbaceous-dominated open areas will not benefit from the use of prescribed fire.
Wildlife	**Alternative I (Beneficial)**	**Alternative II (Beneficial)**	**Alternative III (Beneficial)**
	Lack of prescribed fire and aggressive suppression of wildland fire favors fire intolerant species, particularly those that thrive in non-disturbance ecosystems. Long term minor impacts result.	Increased diversity and abundance of some species will occur through changes in habitat. Conversely, some specie may decline. This applies to both forest as well as open field/ brush systems. An elevation in reproductive rates will result from an increase in nutrient availability and habitat improvement. Long term moderate beneficial impacts result. Habitat of some species important to the	Long term minor habitat improvements can be expected, though these may be limited dependent upon funding for hazardous fuel reduction projects. Fire intolerant species will benefit in the short term. Changes in vegetative successional structure can be accomplished in this alternative, but to a lesser extent that in alternative II.

		Refuge, such as the American Woodcock, would directly benefit from the creation of various stages of successional habitat through the use of prescribed fire and non-fire techniques.	
	(Adverse)	**(Adverse)**	**(Adverse)**
	Because all fires are aggressively suppressed at the smallest size, fuel loading levels will increase exponentially with time. Fueled by the accumulation of excessive hazardous fuel loadings, wildland fires can be expected to exhibit fire behavior and spread rates that are difficult to suppress. As a result, wildland fires, over time, will burn with greater intensity and for longer durations. Loss of vegetation and the wildlife that utilize it, both as food and for cover, can be expected when this occurs. Wildlife diversity and abundance will remain at levels lower than otherwise might be found with the implementation of alternatives II or III.	Some mortality of individuals may occur during prescribed fire operations. These are generally negligible and short term in their impact and isolated in scope. Smoke produced from prescribed burns may have short term disruptive influences on some species.	The major adverse long term impact regarding this alternative is the inability to utilize those management tools, such as prescribed fire, that replicate natural processes and, as a result, produce an increase in wildlife habitat and species diversity. Impacts will not be as dramatic as those in alternative I, but species diversity and abundance will remain at low levels.
Soils	**Alternative I (Beneficial)**	**Alternative II (Beneficial)**	**Alternative III (Beneficial)**
	There will be no soil disturbance in the short term occurring unless and until wildland fires occur. Negligible short term impact.	The use of appropriate management response suppression techniques during wildland fire suppression minimizes impacts to soils through alternative strategies and tactics that minimize such soil disturbance activities such as the use of mechanized equipment and handline construction. In addition, in areas where soils are more prone to damage, this alternative allows for the ability to avoid the area altogether, engaging in fire suppression activities on more favorable ground. Prescribed fire removes hazard fuels and greatly reduces the potential for intense wildland fires that might otherwise have adverse impacts upon soils. The use of prescribed fire enhances native herbaceous species, such as warm season grasses, thus protecting soils from erosion and potential deleterious effects of some invasives. The use of prescribed fire also reduces the reliance upon mechanical and manual methods of hazard fuel reduction, thus	The same as alternative II except that the inability to utilize prescribed fire limits the potential benefits that would otherwise accrue through the implementation of those strategies and tactics. Minor to moderate impacts in the long term.

		reducing foot and mechanized equipment impacts on soils. Moderate impacts in the long term.	
	(Adverse)	**(Adverse)**	**(Adverse)**
	The use of aggressive suppression strategies and tactics may cause more disturbances of soils than in the other alternatives. This effect is potentially exacerbated by the suppression-only policy of this alternative that allows fuels to buildup on the soil surface, creating potential for wildland fires that burn with more intensity and for longer periods of time, thus impacting soils in a negative manner. Dependent upon environmental conditions and fireline intensity, moderate to major impacts on soils may occur.	Soil stability may be disturbed in the short term. The removal of some vegetation through the use of prescribed burning can increase the susceptibility of soil to erosion. These effects can be mitigated through seeding and other erosion prevention strategies. Minor impacts overall with the implementation of this alternative.	Due to increased reliance upon hazard fuel removal techniques that require the use of personnel and mechanized equipment, the potential for soil disturbance is increased. Because these techniques may not be able to be implemented in some areas due to limited access, lack of resources needed to accomplish the work, inadequate funding, etc, fuel accumulations may continue to increase over time creating potential for wildland fires that burn with more intensity and for longer periods of time, thus impacting soils in a negative manner. Moderate impacts overall with the implementation of this alternative.
Wetlands And Riparian Resources	**Alternative I (Beneficial)**	**Alternative II (Beneficial)**	**Alternative III (Beneficial)**
	There might not be disturbance of wetlands and wetland systems in the short term due to the lack of wildland fires. Depending upon fire intensity, location, and time of year, invasive plant populations might not be encouraged to proliferate, since inappropriately placed and timed wildland fires encourage the proliferation of some invasives through site disturbance.	The ability to utilize appropriate management response strategies and tactics in wildland fire suppression largely avoids the unnecessary impacts associated with aggressive fire suppression tactics and strategies. Hazardous fuels may be removed incrementally and at the appropriate time and place for overall ecosystem benefit. In addition, invasive species could be dealt with in the same beneficial manner. Ecosystems may accrue enhanced minor to moderate benefit in the long term.	Same as Alternative II, except that long term ecological benefits are reduced through the inability to utilize prescribed fire as an ecosystem enhancement tool. As a result, only minor short term benefits are likely to accrue.

	(Adverse)	**(Adverse)**	**(Adverse)**
	The use of aggressive wildland fire suppression strategies and tactics can have short to long term minor to moderate negative impacts upon wetlands. This is achieved largely through disturbance caused by fireline construction, both by personnel and mechanized equipment, and through the use of chemical fire retardants and fire suppressants.	The ability to utilize an integrated approach to fire management, allows managers the ability to minimize the negative impacts of suppression activities, prescribed burns, and various non-fire treatments. The use of prescribed fire at the wrong place and/ or the wrong time could result in short term negative impacts on wetlands and floodplains, though these would be minor in nature and would be "repaired" in relatively short time by a healthy ecosystem.	Non-fire fuel and vegetation manipulation techniques, while effective, are difficult to implement across broad ecosystem landscapes, their cost is high, drawdown on personnel resources needed for implementation is high, and effectiveness is often short term and limited unless timely follow-up processes are adhered to. This may not always be possible due to management constraints imposed by budget reductions, lack of personnel, and the lack of appropriate environmental conditions.
Threatened and Endangered Species/ Species of Concern	**Alternative I (Beneficial)**	**Alternative II (Beneficial)**	**Alternative III (Beneficial)**
	In the short term, lack of wildland fires could have little or no appreciable impact upon species of concern.	Through the implementation of this alternative, long term ecosystem processes would be enhanced. Forest habitat, primarily the upland forests found on the Refuge, benefits greatly from the effects of periodic low intensity fire, increasing habitat diversity and forest structure for many species such as the American Woodcock and other forest dwelling species. Benefits accrued would be moderate and would likely occur in the long term.	Long term ecosystem enhancement, on which many species of concern ultimately depend, may be restored on a selective basis, though not to the extent as in alternative II.
	(Adverse)	**(Adverse)**	**(Adverse)**
	In the long term, minor to moderate negative impacts could result for many species as a result of the potential damage inflicted by aggressive wildland fire suppression strategies and tactics, spread and proliferation of invasive species, and lack of ecosystem restorative process in both wetland and forest habitats which would indirectly affect some species.	Short term negligible impacts could accrue due to the implementation of some prescribed fire and non-fire treatments; primarily resulting from smoke and the presence of personnel in and around habitat areas. These activities can be mitigated depending upon timing of treatments.	Lack of the ability to use prescribed fire limits the potential for the breadth and scope of ecosystem restoration. The long term loss of wetland and forest habitat may have minor short to long term impacts upon some species.

Impact Analysis

1. Provide for Firefighter and Public Safety

Affected Environment.

U.S. Fish and Wildlife Service policy requires that all lands under its control and that possess vegetation capable of sustaining wildland fire prepare and implement a comprehensive Fire Management Plan. The Moosehorn National Wildlife Refuge meets these criteria but does not currently have a Fire Management Plan that meets recently published criteria or that is consistent with the new Comprehensive Conservation Plan (CCP) being prepared for the refuge. The development of this plan is intended to meet that requirement. The overriding goal of this plan is to provide for the protection of all refuge resources and offer a safe environment for visitors, refuge personnel, and adjacent land owners. Safety is always the first priority!

Methodology.

All available information on wildland fire operations and safety was compiled into this assessment. Intensity of effects are defined in Table 1 found on page 18.

Cumulative – Impacts, though negligible, accrue through the passage of time, becoming minor to major and possibly become hazardous and irreversible.

Regulations and Policies.

Current laws and policies require that the following conditions be achieved in the refuge:

Desired Conditions: Refuge natural and cultural resources, including visitors, personnel, and adjoining landowners would be protected from unsafe practices emanating from within the refuge boundaries. *Source* – USFWS Manual (2007).

Impacts of Alternative I - No-Action

Impact Analysis

Under the no-action alternative, a fire management plan would be developed that would address safety issues involved with preparedness for wildfires and firefighter training. No hazardous fuel reduction or wildfire prevention activities would be adopted. Under this alternative the safety of firefighters would be enhanced in the short term due to less exposure to wildland fire. However, there would be a moderate long term risk to both the general public and firefighters as a result of the accumulation of fuels that may increase the seriousness of wildfires should they occur. While the risk of wildfires is relatively low, should one occur, present and future accumulations of fuels in some areas are sufficient to seriously jeopardize human life, property, and natural and cultural resources. Firefighters would be forced to aggressively suppress ignitions that might be beyond their effective capability to safely control, thus significantly increasing the threat to firefighter and public safety. Overall, this would constitute a moderate adverse impact of a localized nature.

Cumulative Effects

The accumulation of natural fuels over time presents a greater risk to firefighters with this alternative, since firefighters are working under suppression strategies and tactics that dictate aggressive fire suppression. These activities manifest themselves in the form of direct suppression that requires line construction and significant involvement in the extinguishing of residual fires. These operations take place regardless of the intensity and size of the fire. Under the auspices of this alternative, Moosehorn National Wildlife Refuge would not be an active participant with its partners, private or interagency, in the reduction of hazardous fuels, thus potentially increasing the likelihood of ignition and increased fire behavior on their lands. This would likely result in an increased risk of unwanted wildland fire on adjacent land managed by private individuals and other agencies. Since visitation to the Refuge has shown constant and incremental growth over the last twenty years, the numbers of visitors are expected to continue to increase. As a result, the potential risk to both firefighters and the public would be slightly increased over time. The implementation of this alternative would lead to a continued accumulation of hazardous fuels across the general landscape and, hence greater potential for large fires and increased risk to suppression personnel from all agencies.

Conclusion

The no-action alternative would have temporary moderate impacts on the safety of resources both on Refuge land and to adjacent agency lands. The implementation of this alternative would place the safety of some critical refuge and adjacent agency resources, i.e. firefighters and visiting public, at increased risk; thus making the implementation of this alternative less desirable than any of the other alternatives. The implementation of this alternative would not constitute impairment.

Mitigation

Firefighters engaged in suppression activities will be required to be trained in firefighter safety as dictated through Service Manual, Part 621 (Fire Management). Because wildland fires may be burning at high intensity levels, firefighters may have to “back off” from some intense fires and suspend operations until environmental conditions are again favorable for suppression efforts. This may be particularly difficult to accomplish in areas where critical resources, natural, cultural, or developed, are located.

Impacts of Alternative II – Preferred Alternative

Impact Analysis

The most beneficial result of the implementation of this alternative is the decreased potential for both the ignition and propagation of wildland fires. Both of these phenomena are directly related to the amount of fuel that is available to burn in a given wildland fire situation, as well as the environmental conditions related to weather at the time of the incident. By utilizing a variety of reduction methods, managers will be able to reduce hazardous fuel accumulations over a broad spectrum of environmental conditions. The effectiveness of these reduction activities are enhanced in this alternative by the ability to utilize increasingly low impact reduction methods,

such as prescribed fire and non-fire reduction (i.e. hand tools, herbicides). Effective treatment utilizing this integrated management approach will assist in maintaining fuels in a safe state for an extended period of time (generally 5-10 years per treatment). Although safety is of paramount importance in prescribed fire operations, some risk of injury is possible. Adequate training, planning, and supervision minimize the likelihood of problem occurrences.

Cumulative Effects

The ability of the refuge to utilize integrated management activities in reducing excess fuel loads, combined with the coordinated efforts of adjacent local agencies such as the Maine Forest Service, local fire departments, and even private land owners, would assist in creating an environment where the potential for wildland fires is decreased across the landscape through cooperative fuel reduction efforts. Although little can be done to reduce the potential increase in numbers of visitors to the area, perhaps the single greatest potential threat for wildland fire ignitions, the potential for ignitions in areas where resource values at risk are high, can be reduced through the implementation of a proactive integrated approach to hazard fuels reduction as outlined in this alternative.

Conclusion

Of the alternatives considered, Alternative II provides the best opportunity for safety of refuge resources and the public. Implementation of this alternative provides opportunities for long term protection through joint cooperative fire prevention and suppression. Risks to the refuge and public resources are kept to a minimum. Properly implemented programs of hazard fuel reduction, especially those of the interagency variety, greatly decrease the risk to personnel as well as to cultural and natural resources. The implementation of this alternative would not constitute impairment.

Mitigation

Firefighters engaged in suppression activities will be required to be trained in firefighter safety as dictated through Service Manual, Part 621. Since they will also be engaged in hazardous fuel reduction activities, personnel will have to be trained in the use of chainsaws, chippers, brush cutting, and related safety equipment. Prescribed fires can be utilized during those time periods when environmental conditions are favorable to the safety of firefighters and the public and in accordance with the approved prescribed burn plan. For example, prescribed fires would only be used during time periods when exposure to smoke is minimized through the combination of environmental parameters conducive to smoke dispersion. Herbicides would only be applied by trained and qualified practitioners as outlined in USFWS policy (Part 562, FW1).

Impacts of Alternative III – Appropriate Management Response and Non-Fire Fuels Management

Impact Analysis

This alternative provides some of the benefits associated with non-fire reduction of hazardous fuels, but falls short of providing the long term protection of the preferred alternative. The

exclusion of prescribed fire as a tool in this alternative eliminates the ability to reduce fuels in those areas where access is limited, and prevents the follow-up, low maintenance benefits of fuel reduction that the preferred alternative provides. As a result, impacts on safety are confined to minor risks, but are extended over a longer period of time than in the preferred alternative.

Cumulative Effects

Similar to the preferred alternative, but the cumulative accumulation of fuels in some areas where manual reduction methods are unable to be used, such as in those areas where access is limited or are reduced due to access problems (i.e. Wilderness) and/ or restrictions imposed by environmental constraints, may lead to moderate impacts on safety through increased fuel loadings and potentially higher intensity wildfire events.

Conclusion

This alternative provides some of the advantages of the preferred alternative in the short term, but fails to capitalize on the long term benefits of an integrated fuels management treatment program involving the use of prescribed fire. The risk associated with non-fire hazard fuel reduction methods (chainsaws, brush cutters, axes, herbicides), is proportional to the level of experience and training that the personnel involved in these types of activities possess. The implementation of this alternative does not constitute impairment.

Mitigation

Same as alternative II but without prescribed fire.

2. AIR QUALITY

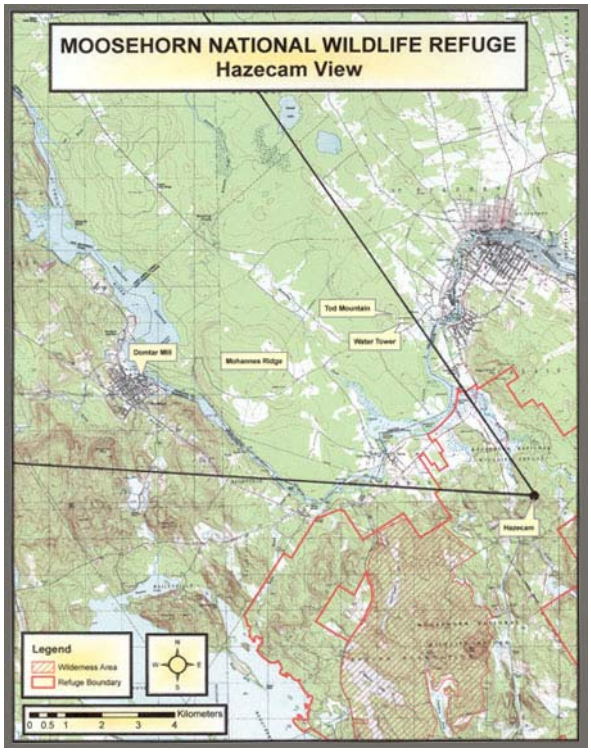
Affected Environment.

Good air quality values are important to Moosehorn NWR. As a result, the protection of these resources is given full consideration in fire management planning and associated operations. The refuge complies with all applicable Federal, State, interstate, and local air pollution control requirements, as specified in Section 118 of the Clean Air Act, as amended (42 USC 7418). The Clean Air Act also has established air quality class designations, where emissions of particulate matter and sulfur dioxide are restricted. Restrictions are most severe in areas possessing federally designated Wilderness. Wilderness areas exceeding 5000 acres in size are classified as mandatory Class I areas, those receiving the highest protection. Moosehorn National Wildlife Refuge is classified as a Class I Air Quality area on the basis of its 7,462 acre Wilderness Designation. A Class I designation indicates the maximum allowable increase in concentrations of pollutants over baseline concentrations of sulfur dioxide and particulate matter, as specified in the 1963 Clean Air Act (42 U.S.C. 7401 *et seq*.). Further, the Clean Air Act provides that federal land managers have an affirmative responsibility to protect air quality related values (including visibility, plants, animals, soils, water quality, cultural resources, and visitor health) from adverse

pollution impacts. Fire management activities planned by the USFWS which result in the discharge of pollutants are subject to, and must comply with, all applicable federal, state, interstate, and local pollution control requirements. The USFWS submits project-specific prescribed burn plans for each planned application of prescribed fire to the appropriate state agency located in the area where the burn is scheduled for implementation: Maine (Maine Forest Service). These project specific plans include in-depth procedures for managing emissions, modeling results of predicted air quality impacts, and the identification of smoke mitigation techniques.

Moosehorn NWR is a partner in the Mid-Atlantic/ Northeast Visibility Union (MANE-VU), a consortium of agencies whose purpose is to encourage a coordinated approach towards meeting the requirements of the Environmental Protection Agency (EPA) regional haze rules and reducing the impairment of air quality in both federal areas (i.e. wildlife refuges, national parks and in Wilderness areas). For monitoring purposes, a 24-hour visual camera (Hazecam, Fig 2) is located at Moosehorn NWR as a means to visually detect changes in area haze and associated visibility.

Figure 2- Hazecam and associated Air Quality at Mooesehorn National Wildlife Refuge.



Moosehorn National Wildlife Refuge is also part of a nation-wide interagency program to monitor and study the impacts of potential changes in air quality. An IMPROVE fine-particulate air quality sampler has been installed on the refuge. Scientific studies have been conducted to determine the impacts of acid deposition from the atmosphere on refuge water quality.

The major pollutant in the smoke produced by prescribed fire is manifested in the form of particulate matter (PM2.5 and PM 10). This material is composed chiefly of a mixture of tars, soot, and other volatile organics (Stanturf 2002). Particulates are not the only emissions produced by fire. Besides carbon dioxide and water vapor, gaseous hydrocarbons, carbon monoxide, and nitrous oxides are also released. However, only a small proportion (less than 3 percent) of the total emissions of particulates, carbon monoxide, and hydrocarbons can be attributed to prescribed burning. By conducting prescribed burning under atmospheric conditions that encourage rapid mixing, the problems associated with high levels of carbon monoxide can be eliminated (Stanturf 2002). Unsaturated hydrocarbons result from incomplete combustion of organic fuels. Because of their high affinity for oxygen, these compounds may form photochemical smog in the presence of sunlight and oxygen-donating compounds. Methane, ethylene, and literally hundreds of other gases are released during prescribed burning. Most of the hydrocarbons released during prescribed fires are quite different from those released in internal combustion engines (Stanturf 2002). Nitrogen oxides are not likely to be released in significant quantities during prescribed burning (Stanturf 2002). Nitrogen is volatized contingent upon the amount released into the atmosphere and depending upon such environmental factors as ambient air temperature and relative humidity. Sulfur dioxide emissions from prescribed fires are of minor importance since the sulfur concentrations of most forest fuels is less than 0.2 percent (Stanturf 2002).

Methodology.

Air pollution sources from proposed prescribed fire projects were compared with existing pollution sources found adjacent to the refuge in order to determine the potential for impacts. Proposed project information relating to the number of acres annually to be treated by non-fire methods and prescribed fire was used to estimate impacts. Wildland fire acreage was estimated based upon the historical fire occurrence and fire return intervals. In addition, data from local agencies and organizations (Maine DEP, MANE-VU) was also utilized in making the analysis.

All available information on air quality was compiled and integrated into this assessment. Intensity of effects are defined in Table 1 on page 19.

Cumulative – Impacts, though negligible, may add up through time becoming minor to major and may be irreversible

Regulations and Policies.

Current laws and policies require that the following conditions be achieved in the refuge:

Desired Conditions - Air quality related values would be protected from pollution sources emanating from within and outside refuge boundaries. Refuge management activities do not violate Federal and State air quality and conformity standards.

Sources – Clean Air Act; USFWS Service Manual, 561 FW2 and 563 FW2, Air Quality protection in Federally Designated Wilderness (Class I).

Impacts of Alternative I - No-Action

Impact Analysis

Under the no-action alternative, wildland fires would be aggressively suppressed with the primary goal of keeping them to the smallest acreage possible. Direct adverse impacts to air quality from wildland fire under this alternative would include the release of particulates and smoke into the airshed. Since these fires would most likely be the result of heavier than normal accumulations of dead and downed fuel, fire intensity and duration could provide considerable resistance to control for suppression resources, thus these events would last longer. This condition is somewhat mitigated by the fact that, even though areas of excessive hazardous fuel are located in the refuge, they are generally not continuous, but rather are composed of isolated cells of heavy fuel that are not always interconnected with one another. This fact may give suppression resources the opportunity to isolate heavy fuel accumulations and suppress fires in a more expeditious manner. This would lead to a reduction in overall smoke and particulate emissions. Generally, durations of smoke particulates would range from minor to moderate (1-5 days). In most cases, especially those in which drought is not a factor, fires would produce a short term impact. The fire suppression tactics used in this alternative would focus on extinguishing fires as quickly as possible. This would normally minimize smoke production because the total number of acres burned would be kept to a minimum.

Cumulative Effects

Due to the short term nature of most wildland fires, the cumulative effects on air quality would be localized and minor. This alternative would not contribute to cumulative effects on air quality in the long term. Air quality at the refuge would continue to be impacted from daily vehicle emissions on roads and other management activities that utilize power-driven machinery. In addition, some private timber companies and the public utilize prescribed burning as a tool in forest management and Silviculture, and to improve the production of blueberries and other local vegetation. The smoke resulting from these prescribed fires could have a cumulative impact on air quality when combined with smoke from wildland fires and / or prescribed burns taking place on the refuge. The continued use of prescribed burning in the general area is expected to continue. In areas located outside of the refuge, backyard trash burning, a common practice in rural and suburban communities, would present a small but consistent impact on air quality over time. The use of outdoor wood boilers has also proven to be a popular, if controversial, home heating application in areas surrounding the refuge. Impacts resulting from the use of these types of heating systems have been closely regulated in some areas of the country due to the amount of smoke and emissions produced over time. Their impact on air quality at the refuge is likely to be minor, but long term. When certain environmental conditions persist, emissions from a large mill located relatively near to the refuge also impact air quality on refuge lands. Development outside of the refuge is not projected to increase in the future, so it is reasonable to assume that the uses of motor vehicles, power equipment and other machinery, though having a deleterious impact, and being largely unnoticeable, could still exert a relatively small, but stable, influence on air quality. Although visitation to Moosehorn NWR is expected to increase in the future, the cumulative impacts on air quality resulting from the increase in vehicle emissions would be localized and minor to moderate in intensity.

Conclusion

Since recent wildland fire occurrence is infrequent and fire size has been small, the direct and indirect adverse impacts of this alternative on air quality would be localized, short term, and minor. Wildland fire smoke impacts would be minimized in the case of smaller fires that result from the implementation of aggressive suppression tactics. It should be noted that there may be cases where fires, particularly those driven by excess hazardous fuel loadings, may exceed the capabilities of suppression resources to effectively and safely suppress, thus allowing fires to burn with increased intensity and resultant increased smoke production. Despite the potential for adverse impacts in the short term, the adoption of this alternative does not constitute impairment.

Mitigation

During aggressive fire suppression activities, the rapid suppression of fires and the extinguishment of residual smoke during the mop-up phase generally assist in reducing smoke impacts. This generally occurs during the smoldering phase of combustion often seen during the waning periods of a wildland fire's life cycle.

Impacts of Alternative II – Preferred Alternative

Impact Analysis

Wildland fire suppression, non-fire hazard fuel reduction and prescribed fire would result in minor to moderately adverse, but short term (1-4 days) impacts to air quality. Depending on the tactics of wildland fire suppression used, air quality impacts could be prolonged because tactics would be employed to minimize potential resource damage. As a result, wildland fires could burn longer and consume more total acres. This would lead to minor to moderate smoke impacts of longer duration (5-6 days). Indirect adverse impacts resulting from these emissions could be responsible for reduced visibility along roads, reductions in visitor use due to the presence of smoke, odors, and potential health effects to sensitive receptors, including nearby private residents located outside of the refuge. These adverse impacts would be short to long term (7+days), localized, and minor. Smoke from prescribed fires is only present during the time period when a prescribed burn is being implemented. This includes those time periods when mop-up activities are being conducted (residual smokes being suppressed). Since most prescribed burns at the refuge are projected to be small in acreage, a typical burn in the active stages would last approximately 4-12 hours. Prescribed fire is projected to be used to treat only approximately a maximum of 500 acres over a 5-10 year period; a very small percentage of the refuge land base. Smoke from prescribed fire can be minimized by altering ignition patterns and burning during times of the day when smoke dispersal is maximized. In spite of these measures, minor to moderate, localized, short term impacts are likely to occur.

Pollutants generated by non-fire fuel reduction projects would add a negligible amount of air pollution above those levels discussed in alternative I since additional acreage would be treated with manual fuel reduction techniques. Pollutants would be generated by the use of gasoline-powered equipment in these operations, but the impacts upon air quality, given the small size of the projects and the infrequency of the activity, would be localized, short term, and negligible to minor. The indirect and longer-term adverse impacts would be negligible.

Cumulative Effects

Air quality at the refuge would continue to be impacted in the short term with minor impacts from such uses as daily vehicle emissions and other similar management and/ or public activities such as trash or backyard burning. Important local industries, such as timber and blueberry harvesting have close ties with prescribed burning and utilize it as a management tool, particularly in the spring of the year, as a tool to improve Silviculture and crop yields. On days when environmental conditions are such that emissions from these practitioners are directed towards the refuge, the combined smoke will likely create short term periods of visibility impairment. The Baring Division Wilderness Area on the refuge also can be directly impacted by emissions from a large Domtar-operated mill located in Woodland, a relatively short distance from the refuge. When combined with emissions from sources located within the refuge, impacts from smoke in the short term could be moderate in scope and duration. In the long term, adverse impacts would be lessened as accumulations of hazardous fuels were reduced through fuel reduction strategies (manual, mechanical, prescribed fire) both in and outside the refuge through cooperative efforts with neighbors and sister agencies.

Conclusion

This alternative would have a temporary minor to moderate adverse impact on air quality in those areas where hazardous fuels are being removed, either by non-fire fuel reduction or through prescribed fire. Wildland fire smoke impacts may be increased in the short term through the use of the appropriate management response to fire suppression tactics. In the long term, this same approach allows more fuels to be consumed and may actually reduce the potential for both smoke production and duration. Smoke impacts from prescribed burns are short term, usually from between 4-12 hours, and may be planned for periods of the day when environmental conditions are maximized for smoke dispersion and direction, a major change from most wildland fires resulting from human causes. These types of fires typically result from human activities such as refuse burning, unintentional ignitions resulting from improper use of fire, and even arson, that typically occur during periods of the day/ night when environmental conditions are such that smoke production is increased (higher relative humidity/ greater fuel moistures) and dispersion is reduced (stable atmospheric conditions). The adoption of this alternative does not constitute impairment.

Mitigation

The extinguishment of residual fires produced by burning fuels (mop-up) during wildland fire incidents would lead to reduction of residual smoke resulting from prescribed burns.

Coordination with adjacent regulatory agencies before prescribed fire operations would lead to a more efficient extinguishment of smoke produced by pre-identified heavy fuel accumulations. In addition, the public could be notified of the potential impacts of smoke and their anticipated duration.

During prescribed fire operations, a variety of techniques may be utilized to reduce the production of smoke emissions and/ or plan for their dispersion:

- Ignitions only implemented when relative humidity is optimized for fuel consumption (less smoke production in a “clean” burn)
- Fuel moistures are relatively low
- Ignition patterns utilized that minimize smoke production (backing fires).
- Mixing heights at least 500 meters or more
- Transport winds greater than 12 mph
- Wind direction away from critical identified targets
- Prescribed burn projects compartmentalized into smaller units, resulting in smaller sections burned with less smoke production.
- Burning during periods of atmospheric instability (daylight hours)

Impacts of Alternative III – Appropriate Management Response and Non-Fire Fuels Management

Impact Analysis

Under this alternative, the impacts would be similar to those described under the preferred alternative (alternative II), *except* that there would be no impacts attributable to prescribed fire. Wildland fire suppression (appropriate management response) and non-fire hazard fuel reduction would cause minor to moderate adverse, but short term impacts to air quality. Depending upon the wildland fire suppression tactics utilized, air quality impacts could be prolonged because techniques would be employed to minimize potential resource damage. These would be manifested primarily through the use of indirect attack strategies and tactics as well as confinement strategies that allow the fire to burn unimpeded until natural fuel breaks are encountered. As a result, wildland fires could burn longer and consume more total acres, leading to minor to moderate smoke impacts over longer periods of time. This alternative would eliminate smoke from prescribed fires and would rely upon non-fire (manual, mechanical, chemical) methods to reduce hazardous fuel accumulations. Those impacts would be of short term consequence and negligible in their impact.

Cumulative Effects

There would be no short term smoke produced from prescribed fires in this alternative. Because of the short duration of most hazard fuel reduction activities, this alternative would not contribute to the cumulative impacts of air quality over the long term in the strict sense of the activity. But, because prescribed fire is not available as a fuel reduction tool in this alternative, potential for increased fuel loading to occur over time may lead to increased wildland fire activity and smoke production in the future. Air quality in the refuge would always be impacted in the short term from daily vehicle emissions, local industry (i.e. paper mills) and other management activities requiring motorized equipment.

Conclusion

The implementation of this alternative could have a short term minor to moderate adverse impact on air quality in those areas of the refuge where non-fire reduction of hazardous fuels is

undertaken. Although these methods are an effective means of removing hazardous fuels, they are at the same time a costly, labor intensive treatment that depends upon significant funding for implementation. Funding for these projects may or may not be available. As a consequence, significant amounts of fuel may continue to build-up unabated, which increases the potential for smoke impacts, both in terms of intensity and duration, when wildland fires do occur in untreated areas. The adoption of this alternative does not constitute impairment.

Mitigation

Extinguishment of residual smoke from burning and smoldering fuels during wildland fire incidents would occur.

3. Wilderness

Affected Environment.

Moosehorn National Wildlife Refuge contains a total of 7, 462 acres of federally designated Wilderness (Public Law 88-577 Wilderness Act, September 3, 1964). The Edmunds Wilderness, comprising 2, 782 acres, was established by Public Law 91-504 on October 23, 1970. The Baring Wilderness, comprising 4,680 acres, was established by Public Law 93-632 on January 3rd, 1975. The total wilderness acreage, 7, 462, constitutes over one fourth (26%) of the refuges total acquisition size (28, 898 acres). The two wilderness areas are known collectively as the Moosehorn Wilderness. Wilderness classification mandates that those specific areas of the refuge be managed with special consideration for human impacts to the natural environment and visitor recreation opportunities, and in particular that wilderness areas “shall be managed to promote and perpetuate the wilderness character of the land and its specific values of solitude, physical and mental challenge, scientific study, inspiration, and primitive recreation” (Wilderness Act of 1967 and 1975 extension, PL 88-577 and 93-622).

Nearly all of the areas in the refuge, including wilderness, are returning to forested conditions that existed prior to the influx of settlement before the refuge was established. Much of the Baring Wilderness Area is in an advanced sub-climax seral stage, composed of a thick duff layer and a dense understory of spruce and fir re-generation. The overstory is closed to semi-closed mature spruce and hardwoods. Some of the oldest and largest white pines in the area (*Pinus strobus*) are found in the Baring Wilderness Area.

The Baring Wilderness Area contains a white pine- mixed conifer forest that as been identified as being in “exemplary condition” (MNAP 2007).There is also preliminary indication that a red pine woodland, a natural community of state significance, may also be located within the area (MNAP 1997)

The Edmunds Wilderness Area is composed mostly of forest that is represented by a spruce-fir climax stage. An exception is an approximately 570 acre section that was burned by a wildland fire in April of 1985. This was an intense fire, and the affected area has been slow to respond. Much of the area is in spruce-fir regeneration (<6 ft tall). In addition, aspen and birch

reproduction (12-20 ft in height) is established in some of the areas. There are also representative stands of northern white cedar (T*huja Occidentalis L.*) and balsam fir (*Abies balsamea).*

Both of the areas have stands of dead and downed trees that have resulted from a variety of natural events; i.e. storm, insect infestations. These areas are of particular interest to fire managers since they represent potential high-hazard fuel areas where wildland fires can more easily ignite and propagate themselves under the right set of environmental conditions. The presence of large tracts of private timber land surrounding the Moosehorn Wilderness mandate that, in the event of a wildland fire, appropriate management responses to wildland fires are instituted as soon as possible with resources sufficient to safely and appropriately manage the predicted size and intensity of the fire.

Currently, neither of the wilderness areas includes facilities or roads; primitive trails are the only form of "development" found. When wilderness was legislated, over 16 miles of gravel roads found in the current wilderness areas were closed to vehicular use and converted to use as primitive trails. One loop of trails in the Edmunds Wilderness Area is a part of the Cobscook Trails Network. Attractions for users of the refuge wilderness areas include opportunities to enjoy hiking, wildlife viewing, hunting, fishing, cross-country skiing, nature study, and the opportunity to enjoy solitude undisturbed by the trappings of civilization.

Methadology

All available information on Wilderness was compiled from the Comprehensive Conservation Plan (Draft 2005) for Moosehorn National Wildlife Refuge, Forest Management Plan, Moosehorn National Wildlife Refuge (1985), Wilderness Management Plan (1979), Habitat Management Plan, Moosehorn National Wildlife Refuge (Draft, 2007), Fire Management Plan (1998), USFWS Service Manual, Part 610 FW 1-5, and the Wilderness Act of 1967 and 1975 extension, PL 88-577 and 93-622 and various other available literature. Predictions about short- and long term site impacts were based on this information.

All available information on vegetation was compiled. Intensity of effects are defined in Table 1 on page 19.

Cumulative

No known cumulative impacts, either in the present or future, are expected.

Sources

See sources for information listed in methodology above.

Impacts of Alternative I – No Action

Impact Analysis

The implementation of Alternative I would have minor to moderate, temporary, short -term, localized, adverse impacts on wilderness *character*. The primary objective of suppression activities (other than safety) would be to keep fires at their smallest possible size by utilizing suppression tactics that optimize expedient suppression results. This type of response could require the use in wilderness areas of large and often noisy mechanized equipment such as helicopters, chainsaws, portable pumps, ATV's, engines, large groups of firefighters, and in extreme cases, possibly even heavy mechanized equipment such as bulldozers. Although mechanized and motorized equipment is generally not permitted in designated Wilderness Areas, their use might be the only viable option left to suppression resources in the event of a large and fast-moving fire that threatened either human life or valuable developments and resources.

The implementation of this alternative presents somewhat of a paradox in regards to fire management. Though the goal of aggressive fire suppression is to keep fires at their smallest size, a goal that it often achieves, long term impacts to wilderness systems can result in a build-up of fuels, primarily on the forest floor. Typically, these fuels would be eliminated through the activity of fire in less aggressive suppression scenarios where strategies and tactics are not geared towards necessarily keeping fires at their smallest possible size. Instead, they concentrate on achieving control through the utilization of appropriate management response techniques that create less of an impact on ecosystems in general and wilderness in particular by utilizing natural breaks in fuels and terrain and letting the fire burn itself out along these naturally developed "control lines". Due to personnel and equipment limitations, Moosehorn NWR will likely have to rely upon the Maine Forest Service to bear the brunt of large wildland fire suppression in wilderness areas.

Cumulative Effects

No reasonable foreseeable future activity or event would combine with activities as described in this alternative that would contribute to cumulative impacts on the wilderness character of refuge.

Conclusion

This alternative results in some impacts on wilderness values and systems. In the short term the perception that this alternative is having beneficial impacts on wilderness is engendered because fires are only responded to when they occur. Depending upon the frequency of wildland fire events (in Moosehorn ecosystems, natural fire occurrence is usually measured in decades), the general impression is that all is well. The reality is that by suppressing small fires, the stage is often being set for larger, more catastrophic fires. These fires are ignited and propagated by allowing forest fuels to build up to levels that, when an ignition does occur, results in an even larger and more difficult to suppress fire. In addition, the presence of large quantities of suppression equipment and personnel are needed to achieve the objectives of this alternative.

Their very presence imparts an adverse impact on wilderness character, at least for the short term.

Mitigation

None

Impacts of Alternative II – Preferred Alternative

Impact Analysis

Alternative II would have fewer overall impacts than Alternative I in the long term, but could produce a larger number of minor adverse impacts in the short term. Long term impacts would be largely beneficial. Impacts from prescribed fire activities would be similar to those attributed to suppression activities in Alternative I; short term, minor in intensity, and localized in scope.

Over time, the potential adverse impacts to forest structure brought on by changes as the result of the implementation of Alternative I would be replaced through the reduction of hazardous fuels achieved as the result of appropriate management response suppression techniques; those that allow suppression forces to afford themselves opportunities to utilize natural barriers to fire spread, instead of relying solely upon personnel and equipment to create breaks in fuel that stop fire spread. Initially, the use of non-fire mechanical reduction of fuels would be utilized on those areas of wilderness where excessive fuel loadings (i.e. trees killed by insects/ disease) occurred, necessitating the use of personnel and light mechanized equipment (chain saws) and creating short term impacts on wilderness character through noise and other human disturbance. Eventually, prescribed fire could be used as a maintenance tool to keep fuel levels at normal levels. Impacts for these activities generally are short term and minor in intensity and scope. Long term impacts are beneficial and moderate in scope. The adoption of this alternative does not constitute impairment.

Cumulative Effects

No reasonable foreseeable future activity or event would combine with activities as described in this alternative that would contribute to cumulative impacts on the wilderness character of refuge.

Conclusion

This alternative provides clear opportunities for the protection and enhancement of wilderness systems at the refuge. It does produce, however, short term impacts that are adverse in character, though these remain minor to moderate and short term in scope. Long term impacts are largely beneficial, are moderate in scope and extend across a wide range of wilderness systems. On balance, this alternative provides the greatest potential for beneficial impacts and offers the widest range of flexibility for minimizing adverse impacts.

Mitigation

Minimize impacts from suppression operations through the use of MIST (minimum impact suppression tactics) (See Appendix D). Hazard fuel reduction in wilderness will be implemented with hand and small power tools and other methods that impose fewer impacts than do those techniques that utilize more invasive mechanical procedures (e.g. tractors, mowing decks, hydro axes and other heavy mechanized equipment). Through the implementation of appropriate management response fire suppression techniques, low intensity wildland fires would be suppressed allowing for opportunities for suppression resources to use natural breaks in fuels to slow and stop the fires progress, instead of having to dig fire line and disturb soil to the extent called for in Alternative I.

A staff resource professional knowledgeable in wilderness management will be assigned to the planning and implementation phase of each prescribed burn and /or manual reduction effort to help minimize negative impacts to wilderness resources.

Impacts of Alternative III – Appropriate Management Response and Non-Fire Fuels Management

Impact Analysis

Alternative III offers some of the beneficial impacts discussed in Alternative II (the use of appropriate management response suppression techniques and hazardous fuel reduction), as well as those discussed that are adverse in their impacts (presence of large numbers of personnel, mechanized equipment). The adoption of this alternative does not constitute impairment.

Cumulative Effects

No reasonable foreseeable future activity or event would combine with activities as described in this alternative that would contribute to cumulative impacts on the wilderness character of refuge.

Conclusion

The major difference between this alternative and alternative II is the *inability* to use prescribed fire as an effective tool to achieve management goals in wilderness. This represents a major departure from alternative II since the use of prescribed fire to achieve management objectives (such as hazardous fuel reduction and vegetation management) is *not* indicated for this alternative. This alternative relies exclusively upon non-fire (manual, mechanical and chemical) methods to meet objectives. These methods, while producing some beneficial impacts, can be at odds with wilderness values (non-disturbance, solitude) and do not as closely replicate natural processes. Properly applied, prescribed fire provides both a means to meet objectives and replicate natural processes.

The removal of heavy fuel loadings from select wilderness areas would have a beneficial long term impact and would minimize wildland fire intensity levels in the long term. The use of appropriate management response during wildland fires would provide protection of most

wilderness resources. The inability to use prescribed fire could lead to increased impacts from non-fire reduction of hazardous fuels caused by increased foot traffic, use of mechanized equipment, and the mechanical processes used in the removal of excess fuels. As has already been mentioned, the use of mechanized equipment would have to go through a review and approval process by refuge management. This could also result in greater project costs. As a result, some needed fuel reduction activities and restoration might not occur, with long term minor to moderate adverse effects occurring in these areas from a lack of treatment. The adoption of this alternative does not constitute impairment.

Mitigation

Impacts from suppression operations would be minimized through the use of MIST (minimum impact suppression tactics Appendix D). Hazard fuel reduction in areas of heavy fuel concentrations would be implemented with hand and small power tools and other methods that impose fewer impacts than do those techniques that utilize more invasive mechanical procedures (e.g. tractors, mowing decks, hydro axes and other heavy mechanized equipment).

A staff resource professional knowledgeable in wilderness management will be assigned to the planning and implementation phase of each prescribed burn and /or manual reduction effort to help minimize negative impacts to wilderness resources.

4. VEGETATION

Affected Environment

Conifer and mixed hardwood-conifer forests cover much of the refuge and are the predominant vegetation type. The deciduous component of the forest includes mixed stands of quaking and big tooth aspen, paper and gray birch, red maple, American beech, and black cherry. Common understory species typically include winterberry, bearberry, bracken fern, sedges, and bunchberry. The conifer component is dominated by mixed and pure stands of spruce and balsam fir. There is also a component of red pine scattered throughout the refuge, mostly in mono-typical plantations. Approximately 2,000 acres of the Baring Unit and most of the Edmunds Unit are in pure spruce-fir forest, much of which has been heavily infested with spruce-budworm, resulting in large acreages of forest in various stages of defoliation and/ or standing dead timber. Old growth white pine are scattered throughout (USFWS 1990b). In 1976, the Refuge initiated a long term management plan (through 2020) to increase forest habitat diversity by altering age and species composition, with a primary focus of providing a shifting mosaic of young forest to benefit American woodcock. Timber harvesting and other forest management techniques are used on the Refuge to benefit wildlife and not necessarily to maximize timber yields (USFWS 1985a), and were chosen to demonstrate how small woodlot owners can manage forest wildlife habitat on their own woodlots through timber harvesting.

A land cover study of Mooosehorn NWR was completed in 2004 (Sewall). A compilation of that survey can be found in Table 3.

Table 3. Land Cover Types on Moosehorn NWR.

Land Cover Type	Total Acres (%)	Baring Division Acres (%)	Edmunds Division Acres (%)
Wetlands			
Shrub Swamp	889 (3%)	706 (4%)	183 (2%)
Graminoid Marsh	831 (3%)	713 (4%)	118 (1%)
Open Water	822 (3%)	731 (4%)	91 (1%)
Beaver Marsh/Pond/Bog	451 (2%)	295 (1%)	156 (2%)
Red Maple Swamp	341 (1%)	236 (1%)	105 (1%)
Northern White Cedar Swamp	319 (1%)	186 (1%)	133 (2%)
Peat Bog	280 (1%)	152 (1%)	128 (1%)
Conifer Swamp	196 (1%)	93 (<1%)	103 (1%)
Ledge/Rocky Shoreline	104 (<1%)	0 (0%)	104 (1%)
Tidal Flat	60 (<1%)	0 (0%)	60 (1%)
Saltmarsh	55 (<1%)	0 (0%)	55 (1%)
Treed Peat Bog	53 (<1%)	52 (<1%)	1 (<1%)
Total Wetlands	**4,401 (15%)**	**3,164 (16%)**	**1,237 (14%)**
Aspen-Birch Woodland/Forest	10,332 (36%)	8,182 (41%)	2,150 (24%)
Spruce-Fir Upland Forest	9,147 (32%)	4,320 (22%)	4,827 (55%)
Red Maple-Pine Forest	1,967 (7%)	1,919 (10%)	48 (1%)
White Pine-Hemlock	1506 (5%)	1481 (7%)	25 (<1%)
Spruce-Fir Flats	498 (2%)	328 (2%)	170 (2%)
Abandoned Field	435 (2%)	262 (1%)	173 (2%)
Northern Hardwood Forest	174 (1%)	110 (1%)	64 (1%)
Utility/Transportation	135 (<1%)	115 (1%)	20 (<1%)
Log Yard	56 (<1%)	38 (<1%)	18 (<1%)
Administrative/Recreational	26 (<1%)	14 (<1%)	12 (<1%)
Upland Brush	23 (<1%)	5 (<1%)	18 (<1%)
Gravel Pit	17 (<1%)	14 (<1%)	3 (<1%)
Ledge	11 (<1%)	1 (<1%)	10 (<1%)
Red Pine Plantation	10 (<1%)	10 (<1%)	0 (0%)
Residential	10 (<1%)	1(<1%)	9 (<1%)
Total Uplands	**24,347 (85%)**	**16,800 (84%)**	**7,547 (86%)**
Refuge Total Acres	**28,748 (100%)**	**19,964 (69%)**	**8,784 (31%)**

A comprehensive botanical survey of the Refuge has not been conducted. Never the less, one State threatened plant, Vasey's Pondweed (*Potamogeton vaseyi)* has been identified; a specimen was collected from Popple Flowage in 2002. During the summers of 2006 and 2007 a clump of Showy Lady's-slipper (*Cypripedium reginae)* was discovered in a grassy opening just west of the Charlotte Road in Baring. This species is considered rare in Maine. Other rare and/or unusual plants have been documented in the past.

Portions of both divisions of the Refuge were evaluated in 1998 for possible inclusion in a statewide ecological reserve program. Reconnaissance was coordinated by the Maine Natural Areas Program. No rare natural communities were discovered during this assessment.

Research Natural Areas

In 1947, the Society of American Foresters (SAF) organized a committee to consider the national need for a suite of "natural areas." Their goal was to set-aside representative examples of each forest type in the U.S. before "all of our forest lands not specifically reserved will be cut over." They viewed these natural areas as remnants of the primitive forest that a forester would use as a reference in "maintaining the balance between species. This in large measure will determine the successful management of the forests." The purpose of these areas is for science, research, and education.

In 1948, two natural areas were established on Moosehorn NWR. A 160-acre natural area on the Edmunds Division was designated in 1948 to preserve a representative sample of the red spruce-balsam fir type. This natural area, outside the Wilderness Area, had 130 acres of spruce-fir and 30 acres of northern white cedar. At the same time, a 160-acre natural area was identified on the Baring Division containing some of the best old growth white pine in the region. This area is now known as the Bertrand E. Smith Natural Area and is within the Wilderness Area. Two additional natural areas were designated in 1967 on the Baring Division, outside the Wilderness Area. The 10-acre Sunken Bog Natural Area is a small depression in a glacial moraine that developed into a typical northern bog with a small pond at the center and a representative black spruce-tamarack type. The 50-acre Moosehorn Meadows Natural Area has a strip of alder near a stream and adjacent slope extending to a ridge top. The natural area is managed to maintain and demonstrate optimum conditions for woodcock. Two natural areas were designated inside the Edmunds Wilderness Area. The 10-acre Hobart Natural Area is one of the few pure stands of northern white cedar. The 40-acre Camp Two Natural Area is a dense stand of balsam fir.

Invasive Vegetative Species

The USFWS identifies an "invasive species" as a species that is 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112). Moosehorn NWR is relatively free of extensive invasive plant species and hence should remain vigilant about monitoring the status of potential invasive species. Refuge staff have used the standard regional protocols to survey Moosehorn NWR for invasive plants. Currently fourteen invasive plants are documented on the Refuge:

Multiflora rose	(*Rosa Multiflora*)
Canada thistle	(*Cirsium arvense*)
Common mullein	(*Verbascum thapsus*)
Black locust	(*Robinia pseudoacacia*)
Climbing nightshade	(*Solanum dulcamara*)
Purple loosestrife	*Lythrum salicaria)*
Cypress spurge	*(Euphorbia cyparissias)*

Reed Canary Grass	*(Phalaris arundinacea)*
Autumn Olive	*(Elaeagnus umbellata)*
Japanese barberry	*(Berberia thumbergii)*
Glossy buckthorn	*(Frangula alnus)*
Garden heliotrope	*(Valerina officinalis)*
Bell's Honeysuckle	*(Lonicera X Bella)*
Morrow's Honeysuckle	(*Lonicera morrowii)*

There is a dense stand of Japanese knotweed (*Polygonum cuspidatum*) *adjacent to the boundary* of the Edmunds Division along the South Edmunds Road.

Methodology

All available information on vegetation was compiled from the Comprehensive Conservation Plan (Draft 2005) for Moosehorn National Wildlife Refuge, Forest Management Plan, Moosehorn National Wildlife Refuge (1985), Habitat Management Plan, Moosehorn National Wildlife Refuge (Draft, 2007), Fire Management Plan (1998) and various other available literature. Predictions about short- and long term site impacts were based on this information.

All available information on vegetation was compiled. Intensity of effects are defined in Table 1 on page 19.

Cumulative – Impacts, though negligible, add up through time becoming minor to major and may be irreversible

Source – Moosehorn NWR Enabling Legislation (Executive Order 7650, 1937), USFWS Service Handbook 611 FW1, National Environmental Policy Act, Executing Order 13112 Invasive Species.

Impacts of Alternative I - No-Action.

Impact Analysis

Under the no-action alternative, prescribed fires could not be used in order to produce desired changes in vegetation; and aggressive suppression activities would be used during wildland fire occurrences that could have short term minor adverse impacts on vegetation. Since emphasis in this alternative is on keeping fires to the smallest possible size, suppression methods may be utilized in areas where sensitive vegetation is present. This could include areas where fragile grasses and herbaceous species are found (near riparian areas and/ or wetlands), or areas where invasive species are found in relative abundance. In either case, there is increased potential for ground disturbance activity that might seriously damage fragile vegetation and potentially favor invasive species over native varieties. In addition, the use of mechanized equipment and fireline construction techniques that utilize extensive line construction may have obvious negative adverse short term impacts upon vegetation. The timing and intensity of wild land fires potentially favor the further development of some invasive species. For example, ignitions that occur as the result of human activity may occur during the spring months (debris burning, blueberry enhancement prescribed burns, etc). This is the time of the year when most vegetation

is undergoing phenologic changes as a result of their efforts to achieve robust spring growth. In this condition, they are often susceptible to the effects of even moderate heat generated by a wildland fire. Large, unwanted wildland fires, particularly those fueled by excess fuel accumulations during the periods of prolonged drought, typically in the late summer and fall, can cause extensive mortality in many species. This could allow invasive species on the periphery of the fire to colonize with their often hardy and abundant seed sources. In addition, fires fueled by excess fuels can remove significant amounts of the duff layer, thus laying bare large areas of mineral soil which make the area ripe for the introduction of invasive species. Localized, short to long term moderate adverse impacts may occur as a result of these processes.

Because the reduction of hazardous fuels would not be undertaken, the potential for large or unusually intense fires would be increased with the potential results described in the preceding paragraph.

Barring disturbance from major events (insect infestations and storms) upland forest communities would continue to undergo changes in species composition, primarily as the result of succession. Upland forests dominated by spruce and fir would continue to mature. As a result with the passage of time they would tend to become less vigorous and more susceptible to the effects of insects and storm damage. Since understory vegetation would not be removed, except through the effects of infrequent disturbance, such as major storms or fire, fine (needle cast), brush and ladder fuels would continue to accumulate, and, when mixed with dead and down trees, provide heavy fuel accumulations in some areas. This would lead to an increased potential for fire ignition and more intense wildland fire behavior should a fire occur. Vegetation diversity would be limited due to the continued expansion of shade tolerant brush and shrub species. The presence of dead and dying trees (snags) would increase the potential for wildland fire ignitions since these types of trees are often struck by lightning and are capable of sustaining fire for extended periods of time even if the lightning is accompanied by quantities of rain that meet or exceed normal amounts.

Cumulative Effects

No reasonable foreseeable future activity or event would combine with activities as described in this alternative that would contribute to cumulative impacts on vegetation of refuge.

Conclusion

This alternative would produce localized minor to moderate adverse vegetation impacts in the short term, and would have long term moderate adverse impacts on some vegetation types, particularly those found in the conifer dominated upland forests. The proliferation of some invasives could lead to unwanted changes in native vegetation and an increased potential for wildland fire. The risk of wildland fire would increase with the implantation of this alternative and an accompanying potential loss of vegetative habitat could result, with an attendant loss of vegetative diversity. The implementation of this alternative would not constitute impairment

Mitigation

Wildland fire personnel engaging in fire suppression are required to have current certification in regard to training and physical fitness. Although the implementation of this alternative leaves little latitude for the use of anything other than direct attack fire suppression strategy and tactics, training in the use of minimum impact suppression tactics (MIST) can reduce potential negative impacts to vegetation resulting from suppression activities such as line construction, brush, ladder fuel, and snag removal, and during mop-up activities. Current management practices, such as mowing and the use of herbicide and manual reduction techniques, while being effective methods for maintaining certain habitats and treating invasive species, can create unwanted impacts and accomplish little in enhancing overall species and habitat diversity.

Impacts of Alternative II – Preferred Alternative

Impact Analysis

Severe disturbance events, such as those manifested by unwanted wildland fires or through the action of major insect infestation such as spruce budworm, can have profound impacts upon natural resources, interrupting or setting back the natural succession in many types of vegetation. As a result of these disturbances, other resources may be placed at increased risk due to the increase in fuel loading created by these events. In the intervening years after a major disturbance, understory vegetation tends to proliferate to such an extent that the brush and shrub fuels often provide an effective "ladder" or pathway for fire to readily move into the crowns of the forest. As a result, the potential for a ground fire to move into the canopy of larger trees increases the probability for rapid fire spread through the crown structure of the forest (should environmental conditions be favorable) if a wildland fire ignition occurs. Because some of these upland forests have already begun to show the effects of disease (spruce budworm), storm damage, and natural maturation, an increase in dead and down fuel accumulations can be expected to increase over the next several decades.

In areas where access is readily available, non-fire reduction of dead and down fuels is often the treatment of choice. This is particularly true in those areas where structures are located in close proximity, or where the use of prescribed fire is otherwise contraindicated. This includes locations where sensitive wildlife or vegetative species occur, or in areas where fuel conditions are inappropriate for prescribed fire due to heavy fuel loading. In any case, care would have to be taken so as to not damage forest seedlings and other reproduction in the under story. Minor, short term adverse impacts can be expected, primarily taking the form of compaction and/ or trampling of soils and vegetation by personnel and equipment. These disadvantages are generally quickly overshadowed by the long term beneficial effects of hazardous fuel reduction/ removal. In some areas of the refuge, especially in wilderness, the presence of large numbers of personnel and equipment participating in non-fire hazardous fuel removal activities leads to short term impacts to wilderness values (i.e. noise, impaction of soil, etc).

Prescribed fire can be used very effectively in select sites as a tool to reduce hazardous fuel loading. Its use, on a select basis, serves to achieve the primary objective of hazardous fuel reduction, while at the same time providing some additional benefits. For example; many of the understory associates of the red pine (*Pinus resinosa)* can persist in *open* stands. These

associates provide important food and cover for wildlife. Blueberries (*Vaccinium spp.),* bearberry or Kinnikinnick *(Arctystaphylos uva-ursi),* serviceberries (*Amelanchier spp.*) and raspberries (*Rubus spp.)* all provide important food for birds and wildlife. They are less likely to occur in *closed* stands of red pine where prescribed fire has not been used as a tool to keep stands open (Martin et al 1951). In upland forest systems, the creation of gap openings in the forest canopy is an important benefit. These gaps, or openings in the forest canopy, allow sunlight to reach the previously shaded forest floor, spurring the growth of many herbaceous species, grasses, and woody regeneration. This robust new growth provides a preferred food source for wildlife as well attracting insects and birds to the area. Fire also creates an intensification of nutrient release to the soil from the combustion process, speeding the growth of many species. The production of a viable seedbed necessary for new plant reproduction would also logically follow immediately post-burn. On the negative side of the ledger, this could also result in an adverse invasive species invasion since the newly prepared seedbed would be made available to *all* species. There would also be some short term adverse impacts (mortality and/ or weakening) to fire intolerant species. Estimating the duration of these impacts is difficult to quantify because there are a number of factors that are involved, most of which are highly variable. Factors to be considered are the survivability of some mature species that are fire intolerant in their seedling stage, but that exhibit resistance to fire in their more mature stages of development; the presence of a viable seed-bank in the soil, the environmental conditions following the fire, the ability or inability to prevent the reduction of seedlings by wildlife, and the time interval between prescribed fire treatments. Post-burn activities such as invasive species removal and native species re-vegetation programs, if undertaken, could also determine the duration of the impacts to vegetation.

The positive effects of prescribed fire on herbaceous species and warm season grasses, many of which have a *potential* occurrence range located in the State of Maine (though not yet substantiated at Moosehorn NWR), is well known (Wright 1982, and Fire Effects Information System located at *http://www.fs.fed.us/database/feis*). These include, but are not limited to such species as; common lowbush blueberry (*Vaccinium augustifolium),* little bluestem (*Schizachyrium scoparium var. divergens and Schizachyrium scoparium var. littorale),* switchgrass *(Panicum virgatum),* Indiangrass (*Sorghastrum nutans),* big bluestem *(Andropogon gerardii),* seashore saltgrass (*Distichlis spicata),* orchardgrass (*Dactylis glomerata*), cattail (*Typha latifolia),* saltmeadow cordgrass (*Spartina patens),* freshwater cordgrass *(Spartina pectinata),* rushes *(Juncus spp)* and Canada wild rye (*Elymus canadensis)* . The applications of prescribed fire to representative populations of these species, particularly during the very early spring when most grasses and forbs are still in dormancy, have proven to be most effective in enhancing population growth and vigor in these species. Mechanical processes such as clipping and mowing do little to enhance current populations of native species and may actually contribute to their decline in the long run. On the opposite side, prescribed burns in the spring have been shown to be very effective in killing cool season grasses, particularly those classified as non-natives such as *Poa pratensis and other species of Poa.* (Hensel 1923, Ehrenreich, 1959, Old 1989). The strategy of applying prescribed fire to selected areas on a rotational schedule of between 1-3 years has been proven to be most effective in enhancing native warm season grass populations and in reducing some selected non-natives. In addition, the acreage selected for treatment of this type at the refuge is relatively small. The use of prescribed fire as a maintenance tool to promote the growth of grasses and forbs in selected upland forest and open field habitats of the refuge provides the most environmentally friendly means to prevent further encroachment of woody, shrub and invasive species in those areas where grasslands are to be preserved and

enhanced for critical wildlife habitat (i.e. American Woodcock). Attention to monitoring would provide important information as it relates to the effectiveness of the prescribed burn program in meeting management objectives. Immediate beneficial impacts on these species will be realized and the long term prognosis for moderate to major benefit is a realistic expectation.

It is difficult to appreciate the importance of the role of fire in shaping species composition and forest structure. Plant community and forest structure changes can be slow and are dependent on a wide range of variables such as time of the year, burn severity, burn intensity, vegetation phenology, frequency of burning, and number of successive fires used. An important component of any program utilizing prescribed fire is the development and implementation of a monitoring program in order to observe and quantity results.

Cumulative Effects

No reasonable foreseeable future activity or event would combine with activities as described in this alternative that would contribute to cumulative impacts on vegetation of refuge.

Conclusion

The use in this alternative of prescribed fire, non-fire hazardous fuel reduction, and appropriate management response in wildland fire suppression situations, provides a range of alternatives that maximize the ability of the refuge to manage hazardous fuels in order to promote public safety and enhance natural resource values. The ability to allow natural processes to continue unimpeded by human-induced change, protect upland forests, marsh, and grassland ecosystems and the habitats and wildlife they engender, and promote the establishment and growth of native species, are all critical components of the refuge's mission to protect and enhance natural ecosystems and species diversity. Moderate long term localized beneficial impacts are expected to result from the implementation of this alternative.

The implementation of this alternative would not constitute impairment.

Mitigation

A natural resource management professional would be consulted during planning and development of each of these projects to identify the location of federal and state protected species (if any) and define how they will be protected and managed

Non-fire hazard reduction methods (clippers, loppers, chainsaws/ brush blades, etc) would be used in lieu of other mechanized equipment.

Spot treatments of herbicide may be used to eliminate invasive species in select areas of the refuge. Their application will be done in accordance with the procedures outlined in management plans concerning the reduction of invasive species, and will be guided by USFWS policy.

Treatments involving prescribed fire are guided by *project specific plans* that are developed in order to maximize results as defined in management objectives *and* to ensure that impacts to refuge resources are kept to an absolute minimum. For example, the application of MIST

procedures as outlined in Appendix D helps reduce potential negative impacts to vegetation. In addition, the development and application of carefully constructed prescriptions, or sets of environmental parameters, ensures that the end result of prescribed fire application meets the management objectives identified in the project specific planning document.

Impacts of Alternative III – Appropriate Management Response and Non-Fire Fuels Management

Impact Analysis

Under this alternative, impacts would be similar to those outlined in alternative II. Because prescribed fire activities would *not* be utilized in this alternative, there is potential for increased short term minor to moderate adverse impacts to vegetation and soils resulting from non-fire hazardous fuel reduction. This typically manifests itself in the form of increased foot traffic by personnel and / or the presence of mechanized equipment. Non-fire treatments are generally less effective in favoring or discouraging selected species and typically cost more in the long term. Native warm season grasses, forbs, and upland forest would not benefit from the application of prescribed fire. While hazardous fuels could be reduced through non-fire methods, the quality of treatment achieved would be less than if prescribed fire were utilized as in alternative II. Upland forest reproductive capability would continue to be reduced, until subjected to a disturbance event such as an un-wanted wildland fire or major insect infestation. As a result, the potential for large scale disturbance brought on by susceptibility to insects, storm damage, invasives, and loss of habitat diversity would be slightly increased over that proposed in alternative II.

Cumulative Effects

No reasonable foreseeable future activity or event would combine with activities as described in this alternative that would contribute to cumulative impacts on vegetation of refuge.

Conclusion

The use of non-fire hazardous fuel reduction activities in this alternative would have minor to moderate adverse impacts on vegetation. Some areas would not receive treatment due to lack of appropriate access for personnel and equipment. The use of appropriate management response techniques during wild land fire suppression incidents would afford an increased level of protection and /or benefit for vegetation since fire managers would be able to prioritize suppression responses in selected areas. Non-fire hazardous fuel reduction treatments would cause minor localized changes to the forest canopy cover as well as to vegetation in the forest under-story. However, the ability of upland forests to generate their own reproductive capabilities would be largely dependent upon disturbance events like a wildland fire or a major insect infestation, since non-fire manual treatments are often inappropriate treatment methods, largely because of constraints on personnel, budgets, time, access, etc. The protection and enhancement of existing vegetative communities would not occur to the same extent as demonstrated in alternative II. The inability to utilize the restorative tools afforded by prescribed fire would prevent some of the benefits that typically accrue to native forbs, warm season grasses, forest ecosystems and other associated flora and fauna. The adoption of this alternative does not constitute impairment.

Mitigation

A natural resource management professional would be consulted during planning and development of each of these projects to identify the location of federal or state protected species (if applicable) and define how they will be protected and managed

Non-fire hazard reduction methods (chainsaws/ brush blades, etc) would be used in lieu of other mechanized equipment.

Spot treatments of herbicide may be used to eliminate invasive species present. Their application will be done in accordance with the procedures outlined in management plans concerning the reduction of invasive species, and will be guided by USFWS policy.

5. Wildlife

Affected Environment.

Moosehorn National Wildlife Refuge was established in 1937 as a migratory bird management area, with special emphasis placed on management of the American woodcock. Over the years, the refuge has continued in its primary mission to preserve, protect and enhance habitat for the benefit of this and *many* other wildlife species.

Mammals

Mammalian species that live on the refuge occupy a wide variety of habitats and range in size from small rodents to marine mammals; the latter best represented by harbor seals *(Phoca vitulina)* and Atlantic Harbor Porpoise (*Phocoena phocoena)* that feed in the offshore waters of Dennys and Cobscook Bays (these species will *not* be considered in this analysis since their habitat would not be impacted in any manner from the implementation of a wildland fire management program). The large land mammals most representative of the refuge include the white-tailed deer (*Odocoileus virginianus),* moose (*Alces alces),* black bear (*Euractos americanus),* eastern coyote (*Canis latrans),* red fox *Vulpes fulva),* and bobcat (*Lynx rufus).* Beavers (*Castor canadensis)* deserve special attention due to their ability to alter the landscape and provide habitat for wetland-dependant wildife species. The refuge also supports populations of river otter (*Lutra canadensis),* mink (*Mustela vison),* fisher (*Martes pennanti),* muskrat (*Ondatra zibethicus),* shorttail weasel (*Mustela erminea),* striped skunk (*Mephitis mephitis),* snowshoe hare (*Lepus americanus),* woodchuck *(Marmota monax),* red squirrel (*Tamiasiurus hudsonicus),* gray squirrel (*Sciurus carolinensis),* northern flying squirrel (*Glaucomys sabrinus),* meadow vole (*Microtus pennsylvanicus),* white-footed mouse (*Peromyscus leucopus),* deer mouse (*Peromyscus maniculatis),* woodland jumping mouse (*Napaeozapus insignis),* house mouse (*Mus maculus),* boreal redback vole (*Clethrionomys gapperi),* masked shrew (*Sorex cinereus),* shorttail shrew (*Blarina brevicauda),* and the little brown Myotis bat (*Myotis lucifugus).*

Birds

The refuge provides habitat to more than 220 species of birds (Habitat Management Plan, Draft 2007), including waterfowl, raptors, marsh and water birds, passerines, woodpeckers, and many others. Over 25% of these species are neo-tropical migrants that nest in the refuge's forested habitats. Several species that utilize the refuge for their life activities are listed on the National List of Species of Management Concern (1987) (see section of Species of Concern in this EA): common loon (*Gavia immer*), American bittern (*Botaurus lentiginosus),* northern harrier (*Circus cyaneus husonius),* and red-shouldered hawk (*Buteo lineatus).* The northern goshawk (*Accipiter gentilis)),* which nests on the refuge, is a Federally Listed Category 2 species in Maine. The most common resident bird is the ruffed grouse (*Bonasa umbellus),* which benefits from the presence of the refuge's forest systems and management practices. Of primary concern for the refuge is the presence of the American woodcock (*Scolopax minor).* Moosehorn National Wildlife Refuge was originally designated to protect and enhance populations of this species. Over the years the refuge has utilized adaptive management techniques to protect and enhance habitat for this species, whose populations are increasing (Habitat Management Plan, Draft, 2007).

The ice-free bays around Cobscook Bay provide wintering habitat for black ducks (*Anas rubripes)* and other waterfowl, i.e. common goldeneye *(Glaucionetta clangula Americana),* bufflehead (*Glaucionetta albiola),* long-tailed duck or old-squaw (*Clangula hyemalis),* when inland marshes are frozen. Black duck (*Anas rubripes),* mallard (*Anas platyrhynchos platyrhynchos*), ring-necked duck (*Aythya collaris*), wood duck (*Aix sponsa*), common merganser (*Mergus merganser americanus*), hooded merganser (*Lophodytes cucullatus*), blue-*winged teal (Anas discors), green-winged teal (Anas carolinensis), and Canada geese (Branta canadensis)*also nest on the refuge.

The refuge utilizes a series of natural and human-made fresh-water flowages and impoundments to benefit wildlife; mowing and burning areas along dikes and erecting nest boxes to enhance nesting and breeding conditions for waterfowl. Pied-billed grebe (*Podilymbus podiceps podiceps),* American bittern (*Botaurus lentiginosus*), sora (*Porzana Carolina*), and Virginia rail (*Rallus limicola limicola*) nest on refuge impoundments. They are most common in the Barn Meadow and Magurrewock Marshes. Common loons (*Gavia immer*), usually nest on Vose Pond, Bearce Lake, and Conic Lake. Great blue herons (*Ardea herodias*), and double crested cormorants (*Phalacrocorax auritus*), are frequently observed foraging in refuge wetlands during spring and through the fall. Other species that are periodically observed include the great egret (*Casmerodius albus egretta*), snowy egret (*Leucophox thula thula*), cattle egret (*Bubulcus ibis*), green heron (*Butorides virescens virescens*), and the glossy ibis (*Plegadis falcinellus*).

American woodcock (*Scolopax minor*), killdeer (*Chadradrius vociferus*), spotted sandpipers (*Actitis macularia*), and Wilson's snipe nest on the refuge. The extensive tidal flats of Cobscook Bay provide internationally significant "staging areas" for more than 20 species of migrating shorebirds including the red knot (*Calidris canutus*) which is classified as a highly imperiled species), whimbrel (*Numenius phaeopus*), a species of high concern, sanderling (*Crocethia alba*), high concern, ruddy turnstone (*Arenaria interpres*), high concern, as well as large numbers of semi-palmated plover (*Charadrius semipalmatus*) and black-bellied plover

(*Squatarola squatarola*). In addition to the semi-palmated plover, least (*Erolia minutilla)* and white-rumped sandpipers (*Erolia fusciollis)* (U.S Shorebird Conservation Plan, August 2004 Update) also utilize the refuge as a place to feed and build energy reserves before flying on to their wintering grounds in Central and South America.

Cobscook Bay supports the highest nesting density of bald eagles (*Haliaeetus leucocephalus)* in the northeastern United States, with four pairs found on the Edmunds Division of the refuge (USFWS 1990). Three eagle nesting territories are located on the Baring Division of the refuge.

Extensive habitat on the refuge provides nesting and breeding habitat for species such as the northern harrier (*Circus cyaneus*) and the American kestrel (*Falco sparveruis).*

Fish

At least 26 species of freshwater fish have been identified in refuge watercourses and ponds. Self-sustaining populations of brook trout occur in several streams on both divisions of the refuge. Smallmouth bass and chain pickerel are common in refuge streams, lakes, and ponds. . The Dennys and St. Croix rivers support Atlantic salmon, American Shad, alewives, American eels, soft-shelled clams, periwinkles, marine worms, urchins, and scallops. The waters of Cobscook Bay provide habitat for twelve saltwater species of fish. Harvestable populations of soft-shelled clams, mussels, and periwinkles are found in the mudflats of the intertidal zone.

Reptiles and Amphibians

Twenty-two species of reptiles and amphibians are known to occur on the refuge. Painted (*Chrysemys picta)* and snapping turtles (*Chelydra serpentine)* are common in most of the refuge wetlands. Of the five species of snakes that occur at Moosehorn NWR, the most remarkable is the northern water snake (*Natrix sipedon sipedon)*, which resides primarily in the Magurrewock Marsh watershed. This is apparently a somewhat isolated population (Habitat Management Plan 2005). Five species of salamanders occur on the refuge including the spotted (*Ambystoma maculatum)* and blue-spotted salamanders (*Ambystoma laterala)* that breed in vernal pools. Nine species of frogs and toads are present including the American toad *(Bufo americanus)*, mink frog (*Rana septentrionalis)*, and leopard frog (*Rana pipiens)*. The lack of abundance and variety in the reptile population is likely the result of seasonal temperature variations that can fall to minus 35 degrees F during the long winter months (Moosehorn NWR Brochure 2007).

Methodology. Information based upon Moosehorn National Wildlife Refuge Draft Habitat Management Plan (2007), Draft Comprehensive Conservation Plan (2005) and other species inventories found in assorted refuge documents. Predictions about short- and long term site impacts were based on this information.

All available information on wildlife was compiled. Intensity of effects are defined in Table 1 on page 20.

Cumulative – Impacts, though negligible, add up through time becoming minor to major and may impose changes upon wildlife.

Regulations and Policies. Current laws and policies require that the following conditions be achieved in the refuge:

Desired Conditions: Promote natural wildlife populations, minimize degradation, destruction, or loss of habitat and/ species, encourage species diversity, and maintain select wildlife habitat to the maximum extent practicable.

Source – Source – Moosehorn NWR Enabling Legislation (Executive Order 7650, 1937), USFWS Service Handbook 611 FW1, National Environmental Policy Act, Draft Comprehensive Conservation Plan (2005), Habitat Management Plan, Draft (2007).

Impacts of Alternative I - No Action

Impact Analysis

The implementation of this alternative would call for the suppression of wildland fires at the smallest possible acreage. Direct adverse impacts of wildland fires would include limited loss of habitat through displacement for short periods following fires as well as possible mortality to some species, particularly those that are not mobile enough to escape or obtain shelter below ground. Birds and larger mammals would easily escape fire. Fires that occur during nesting season, although uncommon, may consume nests, particularly those on the ground, or cause abandonment of nests. Direct impacts upon animal populations would be localized, short term, and negligible to minor.

The after-effects of many fires are responsible for the creation or renewal of habitat for some amphibians, small mammals, and birds. Since fire often causes changes in vegetation community structure through the removal of lower to mid-level layers of vegetation, the open habitat favored by many large mammals and avian predators is created, especially the American woodcock. Other indirect impacts may include an increase in mast production, herbaceous foliage, and grasses. Indirect impacts would be localized, short term, negligible to minor and either adverse or beneficial.

Fire suppression activities result in limited disturbance to small mammals, some reptiles and amphibians, and ground-nesting birds primarily through fireline construction and the use of off-road vehicles. Direct and indirect impacts would be localized, short term, and negligible to minor.

With the implementation of this alternative, no hazardous fuel reduction activities of any kind would occur. The use of aggressive suppression strategies would allow hazard fuel levels to accumulate over time, increasing the potential for long term moderate to major impacts on forest structure and hence on wildlife. Wildland fires would exhibit fire behavior (greater intensity and duration time) driven by the presence of excess fuels, both on the ground (brush, needles, twigs and logs) and in the form of snags (standing dead trees). The potential for fires to occur in the forest canopy, particularly in coniferous species, is greatly increased due to the presence of a “fuel ladder” (continuous fuels from the forest floor to the canopy). If fires of this type were to occur, changes in forest structure would have negligible to moderate short term impacts upon

wildlife. Succession of open areas would continue, being held in check only by mechanical methods such as mowing or disturbances like insects or storms. As a result, species diversity, particularly of avian species, would probably slightly decline due to gradual loss of habitat. Marsh habitat might also decline, particularly if invasive species are allowed to effect changes upon natives, thus also leading to potential decline in habitat for many animal species.

Cumulative Effects

Pressure on estuarine and saltwater resources, including the harvesting of waterfowl, fish, clams, oysters, and scallops outside of the refuge will likely continue, perhaps at increased levels due to the same projected increases in human population surrounding the refuge It is reasonable to assume that some wildlife populations will decline in both number and diversity as a result of shrinkage in suitable habitat brought on by development. As this occurs, the presence of suitable habitat at Moosehorn NWR becomes more important for many species.

Although the cumulative effects of acid rain and other air borne pollutants on wildlife are relatively unknown, both of these phenomenon are known to have detrimental effects on some vegetation types that are used by wildlife for forage and cover. It is reasonable to assume that, barring a reduction in presence of these occurrences, wildlife populations may be negatively impacted through a loss in some vegetative species diversity brought on by the effects of acid rain and ozone, both products of industry outside the refuge boundary.

Conclusion

This alternative could have moderate and potentially cumulative, over long periods of time, impacts on wildlife. Aggressive wildland fire suppression techniques, coupled with a lack of hazardous fuel removal and ecosystem restorative processes such as prescribed fire, may point the way towards adverse impacts on some vegetative/ forest structure and wildlife habitat. In the absence of disturbance, open areas and fields would slowly diminish in both size and ecological diversity with an attendant loss in wildlife attributes. The direct impacts of this alternative are minor to moderate and short term to long term in nature. The implementation of this alternative does not constitute impairment.

Mitigation

None

Impacts of Alternative II – Preferred Alternative

Impact Analysis

Under this alternative the application of a variety of strategy and tactics regarding the reduction of hazardous fuels and habitat enhancement would occur. The cumulative impacts of these could have negligible to minor short term adverse impacts on wildlife, particularly in regard to the mortality of some individuals during prescribed fire operations. In addition, the short term modification of habitat resulting from increased human traffic during the implementation phase of non-fire hazard fuel reduction, could negatively impact wildlife habitat in the short term. In

the long term, increased diversity and abundance of wildlife would occur through improvement and expansion of habitat. The improvement of native grass and other herbaceous species habitat in marshes, old fields, and other terrestrial open areas would provide increased cover, nesting areas and food sources for many avian species and other wildlife. Gap openings in the upland forest canopy that have been produced through the effects of prescribed fire and non-fire hazardous fuel reduction would provide opportunities for new forbs and succulent growth to occur. This would provide increased reproduction and nutrient availability and would be accompanied by overall habitat improvement for some species. Immediately following a prescribed burn, many species of wildlife would actually be attracted to the areas just burned. Predators would more easily find prey due to the removal of vegetative cover and leaf litter. Fire damaged trees would provide new homes for many insect species and thus would attract insectivorous birds to the area. Some species however, would avoid burned areas due to the lack of adequate cover to protect them from predators. Generally these impacts would last one growing season. The expected increase in the population of forbs, small mammals, and insects would attract a variety of birds and other wildlife to the area. Long term moderate beneficial impacts would accrue as a result of the implementation of this alternative. In addition, prescribed fire could be used to reduce the potential for stand-replacing wildland fires, thereby protecting existing habitat and the wildlife who currently reside in these areas.

Cumulative Effects

The potential cumulative effects of acid rain and ozone pollution on wildlife are relatively unknown. Both of these phenomena are known to have detrimental effects on some vegetation that wildlife use for forage and cover. It is reasonable to assume that, barring a reduction in presence of these occurrences, wildlife populations may be negatively impacted through a loss in vegetative species diversity. With the implementation of this alternative, restoration of some declining species may be possible, negating the overall detrimental impacts of acid rain and ozone from industrial sources outside of the refuge.

Conclusion

This alternative would provide negligible to minor short term adverse impacts on wildlife during the implementation phase of non-fire hazardous fuel reduction or prescribed fire projects. However, in the long term, moderate beneficial impacts on wildlife diversity would occur. These benefits would accrue largely through the restoration and maintenance of marsh and upland forest habitats. Of particular note is the potential for the continued restoration and enhancement of American woodcock habitat, a prime management goal of the refuge. The implementation of this alternative does not constitute impairment.

Mitigation

During prescribed fire operations, larger animals can easily leave the area of a fire, while small mammals, amphibians, and reptiles can burrow or flee to escape. Ground fires can locally impact non-flying insect populations in the short term, but most non-flying insects can also burrow and survive low intensity prescribed fires. Since prescribed fire burn units are rather small in size and will be burned at different time periods, any loss of individuals during prescribed fire operations

would have a negligible short term impact on the overall abundance and diversity of wildlife. Prescribed burns would be implemented in such a manner that natural mosaics of burned and un-burned fuels would be present within the boundaries of a burn unit; a process that closely mimics natural fire. The presence of un-burned areas adjacent to burn units provides ample habitat for any wildlife temporarily displaced by prescribed fire. In addition, prescribed fires can be implemented during times of the year when many species are dormant or are otherwise not engaged in breeding and nesting activities, thus reducing overall impacts.

Impacts of Alternative III – Appropriate Management Response and Non-Fire Fuels Management

Impact Analysis

As stated in the evaluation of Alternative I, the lack of ability to use prescribed fire could have negligible to minor adverse impacts on wildlife and associated habitat. Prescribed fire tends to be the most natural and cost-effective way to reduce hazardous fuel loadings and reduce invasive species that potentially threaten upland forest structure, native marsh grasses and native warm-season grasses. Herbaceous species respond well to fire and their propagation is more difficult to achieve through strictly non-fire methods, though some progress towards that goal may be achieved through the manipulation of forest structure, and to a lesser degree by open fields management (Covington and Moore, 1992) that provides habitat for many wildlife species.

Cumulative Effects

Although the cumulative effects of acid rain and ozone in the atmosphere on wildlife are relatively unknown, both of these phenomenon are known to have detrimental effects on some vegetation types utilized by wildlife for forage and cover. It is reasonable to assume that, barring a reduction in presence of these occurrences, wildlife populations may be negatively effected directly or indirectly through a loss in some vegetative species diversity. The implementation of this alternative might be helpful in restoring some of those vegetative species, though probably not to the extent available in the alternative that promulgates the use of prescribed fire to enhance native species diversity. As a result, a potential net loss in species richness could be expected to occur over time with the implementation of this alternative.

Conclusion

This alternative would have minor to moderate adverse impacts on wildlife in the long term. Non-fire hazard fuel reduction activities used as a stand-alone process can be utilized to minimize or eliminate negative impacts of undesirable wildland fire; however the lack of ability to use prescribed fire reduces the potential for enhancement of ecosystem diversity and does little to assist the reproductive processes necessary for some wildlife species to flourish. Despite the fact that this alternative is not as effective as alternative II, its implementation does provide minor opportunities for beneficial impact upon wildlife in the short term. The implementation of this alternative does not constitute impairment.

Mitigation

To the extent practicable, hazardous fuel reduction activities can be undertaken during those times of the year and in those locations where impacts from foot traffic and cutting and removal of materials would be minimized. This typically means that these activities would occur during the non-growing/ reproductive season.

6. SOILS

Affected Environment.

Moosehorn National Wildlife Refuge is located in terrain that consists of rolling hills, large ledge outcrops, and stream valleys; the result of the late Pleistocene or Wisconsin glaciation. A total of 54 soil types can be found on the Baring Division of the refuge and 44 have been identified on the Edmunds Division. Combinations of all of these soil types can be found intermingled throughout the refuge. The fifteen most common soil types for each Division of the refuge are listed in Table 3 in their descending order of extent.

Soils vary from sandy loam to clay and peat (Table 4). The two major soil associations include Lyman-Scantic-Peru group and the Marlow-Peru-Lyman group. The deep, well-drained, stony Marlow soils and the shallow, well-drained Lyman soils occur on crests and upper slopes of ridges. Peru soils are deep, moderately well drained, and developed in very firm glacial till. The deep, poorly drained Scantic soils have a seasonal high water table and are considered wetland soils (USFWS 1990b).

Table 4

Most Common Soils Mapped on the Moosehorn National Wildlife Refuge
From Washington County Soil Survey (2004)

Soil Code	Soil Name	Origin	Drainage
Baring Division			
DWC	Dixfield-Turnbridge-Colonel Complex	Firm Glacial Till	Moderately Well Drained
LYC	Lyman-Turnbridge-Abram Complex	Glacial Till	Somewhat Excessively Drained
BRB	Brayton-Colonel Association	Firm Glacial Till	Somewhat Poorly Drained
DTC	Dixfield-Marlow-Turnbridge Complex	Glacial Till	Moderately Well Drained
DHB	Dixfield-Colonel Complex	Firm Glacial Till	Moderately Well Drained
WF	Wonsqueak Bucksport Soils	Highly Decomposed Organic Material	Very Poorly Drained
LUE	Lyman-Abram-Turnbridge Complex	Glacial Till	Somewhat Excessively Drained
HSC	Hermon-Monadnock-Skerry Complex	Glacial Till	Well Drained
STC	Skerry-Colonel-Turnbridge	Loamy Glacial Till	Somewhat Poorly Drained

	Complex		
BW	Bucksport and Wonsqueak Soils	Highly Decomposed Organic Material	Very Poorly Drained
KW	Kinsman-Wonsqueak Association	Glaciofluvial Sands	Poorly Drained
Sa	Scantic Silt Loam	Glaciomarine Deposits	Poorly Drained
BTB	Brayton-Colonel Association	Firm Glacial Till	Poorly Drained
SOB	Skerry-Colonel Complex	Firm Glacial Till	Moderately Well Drained
LCB	Lamoine-Buxton-Scantic Complex	Glaciomarine Deposits	Somewhat Poorly Drained
Edmunds Division			
LCB	Lamoine-Buxton-Scantic Complex	Glaciomarine Deposits	Somewhat Poorly Drained
HXC	Hogback-Rawsonville-Abram Complex	Glacial Deposits	Well Drained
RNC	Rawsonville-Lamoine-Hogback Complex	Glacial Till	Well Drained
BRB	Brayton-Colonel Association	Firm Glacial Till	Somewhat Poorly Drained
LKB	Lamoine-Rawsonville-Scantic Complex	Glaciolacustrine and Glaciomarine Deposits	Somewhat Poorly Drained
NCB	Naskeag-Turnbridge-Abram Complex	Glacial Till	Poorly Drained
DWC	Dixfield-Turnbridge-Colonel Complex	Firm Glacial Till	Moderately Well Drained
LYC	Lyman-Turnbridge-Abram Complex	Glacial Till	Somewhat Excessively Drained
SF	Scantic-Biddeford Association	Glaciomarine Deposits	Poorly Drained
BW	Bucksport and Wonsqueak Soils	Highly Decomposed Organic Material	Very Poorly Drained
LTB	Lamoine-Turnbridge-Scantic Complex	Glaciomarine Deposits	Somewhat Poorly Drained
TLC	Turnbridge-Lamoine-Lyman Complex	Glacial Till	Well Drained
LSB	Lamoine-Scantic-Colonel Complex	Glaciomarine Deposits	Somewhat Poorly Drained
STC	Skerry-Colonel-Turnbridge Complex	Stony Glacial Till	Moderately Well Drained
CRC	Colton-Adams Complex	Glaciofluvial Sands and Gravels	Excessively Drained

Methodology. All available information on soils was compiled from digital soils maps of Washington County, Maine provided by the Natural Resource Conservation Service (NRCS) (2004), Fire Management Plan (Moosehorn National Wildlife Refuge, 1998), and the Moosehorn National Wildlife Refuge Habitat Management Plan, Draft, 2007). In addition, other refuge documents and studies were referred to. Predictions about short- and long term site impacts were based on this information.

All available information on soils was compiled. Intensity of effects are defined in Table 1 on page 20.

Cumulative – Impacts, though negligible, may add up though time becoming minor to major and may be irreversible

Regulations and Policies. Current laws and policies require that the following conditions be achieved at the refuge:

Desired Condition: Inventory and protection of soil resources, including frequent testing and monitoring of soils, to maintain and enhance the existing condition.

Source – USFWS Policy and Legislation, 80 Stat. 927; 16 U.S.C. 668dd-668ee**,** National Wildlife Refuge System Administration Act of 1966.

Impacts of Alternative I - No-Action

Impact Analysis

Under the no-action alternative, aggressive fire suppression activities could occur that would cause minor to moderate temporary soil stability impacts. More importantly, they would provide considerable potential for displacement and even destruction of plant species struggling to maintain a foothold in areas where soil strata is shallow. Without appropriate vegetative cover, soils could be exposed by intense wildland fires, and be more susceptible to erosion until grasses and/or forbs re-establish on the site. Aggressive wildland fire suppression actions could have even more adverse impacts to soils. The establishment and maintenance of native forbs and grasses have been shown to reduce erosion; however this would be difficult to accomplish without the use of prescribed fire, a tool not considered for use in this alternative. On the positive side, threats from wildland fires that exhibit enough size and intensity to directly impact soils are relatively infrequent and may not occur except during periods of extended and extreme drought. The pre-settlement fire cycle for forests and soils of the type found at Moosehorn NWR may have averaged 150 to 300 years (Heinselman, 1978).

Cumulative Effects

No reasonable foreseeable future activity or event would combine with activities as described in this alternative that would contribute to cumulative impacts on soils of the refuge.

Conclusion

Then implementation of this alternative calls for aggressive suppression of wildland fires. These suppression activities could have temporary minor to moderate impacts on soil stability and thus increase the potential for damage to herbaceous species and the potential for increased erosion. Despite this potential, in the eastern United States and particularly in the refuge ecosystems, even under severe conditions, soils are unlikely to be damaged seriously by the direct effects of the wildfires themselves (Kozlowski et al, 1974). The adoption of this alternative does not constitute impairment.

Mitigation

Re-seeding and fireline rehabilitation activities could be undertaken as soon as possible after a wildland fire occurrence.

Impacts of Alternative II – Preferred Alternative

Impact Analysis

Under the preferred alternative, activities relating to fire management would occur that could temporarily impact soil stability. Some vegetative cover can be expected to be removed as the result of wildland and prescribed fire activities. As a result, soils can be temporarily exposed to the effects of weather and be more susceptible to erosion until vegetation is re-established. Through the utilization of appropriate management response wildland fire suppression strategies and tactics, fire managers possess the ability to minimize the impacts associated with suppression activities, primarily through pre-identification and avoidance. Often it is possible to utilize pre-existing breaks in fuel such as trails, streams, roads, or areas of sparse vegetation, as natural fuel breaks, eliminating the need to construct handline. The use of this type of strategy and tactic is particularly relevant in areas like Moosehorn NWR, where, even under the best of conditions, many plants struggle to maintain a tenuous foothold on sparse soils. The implementation of minimal ground disturbing methods of line construction such as establishment of wet lines, cold-trailing, and burn-out operations contribute to a significant reduction in soil disturbance. Prescribed fire impacts can be mitigated by varying the intensity of the fire and burning during times of year that facilitate natural re-vegetation. The establishment and maintenance of herbaceous plants and grasses have been shown to reduce erosion. The use of prescribed burning is an effective tool in helping establish and enhance many types of grasses and herbaceous plants. The restoration and enhancement of existing upland forests would likely lead to a more open understory and reduce overall fire danger, removing a potential long term threat to increased erosion should a wildland fire occur. In addition these types of forest will support a variety of vegetation types and enhance overall ecosystem variability and ecosystem health.

Cumulative Effects

No reasonable foreseeable future activity or event would combine with activities as described in this alternative that would contribute to cumulative impacts on soils of refuge.

Conclusion

Under this alternative fire management activities would occur that could have temporary negligible to minor adverse or beneficial impacts on soil erosion. Most of the adverse impacts can be mitigated. The adoption of this alternative does not constitute impairment.

Mitigation

Wildland fire suppression techniques implemented as a part of the appropriate management response would be designed to protect sensitive soils. This would occur primarily through the

avoidance of traditional hand line construction, instead substituting less obtrusive methods such as the use of water and foam to stop fire spread. Avoidance of sensitive soil areas altogether would contribute to the protection of soil resources. The ability to balance the use of prescribed fire and non-fire treatments would allow managers to mitigate negative impacts effectively, particularly in those areas where access to personnel and equipment is limited and/ or potentially harmful to soil resources.

Any soil series found in sensitive areas (i.e. ridge tops), requires careful management practices so as to minimize damage. This would best be achieved through total avoidance, or the use of less invasive non-fire methods of fuel reduction. Because the primary soil types of the refuge are frequently intermixed, any heavy mechanized equipment use associated with hazardous fuel reduction activities would be confined to dry periods of the year and only in areas where rutting potential was minimized. These procedures would help to minimize any potential damage to soils.

Prescribed fire would be used in those situations where hazardous fuels could safely be consumed without threatening the integrity of soils. This would generally confine the use of prescribed fire to those areas where moderate to light concentrations (< 25 tons / acre) of fuel are located, and where fuels are continuous enough to allow for the types of fire behavior necessary to achieve management objectives identified for the prescribed burn.

Impacts of Alternative III – Appropriate Management Response and Non-Fire Fuels Management

Impact Analysis

As with alternative II, wildland fire suppression actions could be initiated utilizing those strategies and tactics that minimize impacts through the implementation of appropriate management response techniques. Actual wildland fire effects could be mitigated through rehabilitation of the area with an appropriate mixture of grass seed and/ or other desirable herbaceous species soon after the fire. There would be no direct impact on soils from prescribed fire from this alternative; however, the inability to use prescribed fire could lead to the accumulation of increased fuel and additional disturbance to soil resources through the use of increased non-fire treatments that utilize mechanical equipment and/ or personnel.

Cumulative Effects

Same as Alternatives I and II.

Conclusion

This alternative would potentially have temporary negligible to minor adverse impacts on soils. The ability to utilize appropriate management response techniques during fire suppression would largely eliminate activities that contribute to soil erosion. Since prescribed fire would not be used as a management tool in this alternative, there would be no impacts, either beneficial or adverse, from its implementation. However, the increase in hazardous fuel reduction necessary to offset the inability to use prescribed fire as a reduction tool could lead to increased adverse impacts in

the long term to soil resources. The majority of these impacts would result from the cumulative effects of personnel and equipment traveling on soils and through the employment of mechanized equipment.

Mitigation

Same as Alternative II, except no prescribed fire.

7. Wetlands and Riparian Resources

Affected Environment.

Moosehorn National Wildlife Refuge contains a highly diverse assortment of natural resources related to water. Wetlands, streams, lakes, rivers, vernal pools, salt marshes, swamps, bogs, freshwater impoundments, flowages, rocky Atlantic coastline, and other riparian resources can all be found within the boundaries of the refuge. Over 4, 401 acres (approximately 18% of the refuge) of water-based resources are distributed throughout the refuge (Table 4). The presence of these resources is critical to the refuge's mission to protect and enhance habitat for a diverse range of wildlife species. They provide the secure areas where many species find their food, establish nests, reproduce and raise their young, rest and recuperate during seasonal migration, and otherwise engage in the wide variety of biological activities that are essential to their respective life processes. The protection, and where possible, enhancement of these invaluable resources is mandated as the primary mission of the Moosehorn National Wildlife Refuge.

Wetlands

By law, Congress has entrusted certain national resources to the USFWS (hence Moosehorn NWR) for conservation and protection. One of these major "trust resources" are the wetland areas found within the boundaries of the refuge. Refuge wetlands include 10 natural lakes, and dozens of impoundments, beaver ponds, marshes, streams, rivers, and peat bog areas. There are 58 managed impoundments on the refuge; 45 in the Baring Division and 13 in the Edmunds Division. There are 32 unmanaged natural marshes and bogs found on the refuge. The open-water lakes range in size from 20 to 295 acres. These wetlands support a mix of open water

Table 5. Wetland Classifications of Moosehorn NWR.

Land Cover Type	Total Acres (%)	Baring Division Acres (%)	Edmunds Division Acres (%)
Wetlands			
Shrub Swamp	889 (3%)	706 (4%)	183 (2%)
Graminoid Marsh	831 (3%)	713 (4%)	118 (1%)
Open Water	822 (3%)	731 (4%)	91 (1%)
Beaver Marsh/Pond/Bog	451 (2%)	295 (1%)	156 (2%)

Red Maple Swamp	341 (1%)	236 (1%)	105 (1%)
Northern White Cedar Swamp	319 (1%)	186 (1%)	133 (2%)
Peat Bog	280 (1%)	152 (1%)	128 (1%)
Conifer Swamp	196 (1%)	93 (<1%)	103 (1%)
Ledge/Rocky Shoreline	104 (<1%)	0 (0%)	104 (1%)
Tidal Flat	60 (<1%)	0 (0%)	60 (1%)
Saltmarsh	55 (<1%)	0 (0%)	55 (1%)
Treed Peat Bog	53 (<1%)	52 (<1%)	1 (<1%)
Total Wetlands	**4,401 (18%)**	**3,164 (16%)**	**1,237 (14%)**

and aquatic vegetation that includes sedges, pondweeds and cattails. These areas provide the habitat needs of a wide variety of species. Open lakes and impoundments provide the majority of habitat for waterfowl (i.e. ducks, geese, etc) and related species such as eagles and osprey, as well as for mammals like moose, beaver and muskrat. Upland management related to wetlands generally is related to impoundments and flowages and focuses on habitat for American woodcock breeding, waterfowl foraging, grassland bird breeding, and bald eagle and osprey nesting structures. In these areas, natural waterfowl foods (i.e. seeds and tubers of wetland plants) have been supplemented by seeding of species such as millet and wild rice. Mowing and prescribed burning have also been used as management tools to enhance vegetation and seed production in some of these areas. Guidance for these operations is provided by the Refuge's Marsh and Water Management Plan (MWMP 1989).

Rivers, Streams, and Associated Riparian Areas

Rivers and streams associated with riparian areas are managed to maintain water quality and the biological integrity that sustains brook trout, freshwater mussels, and other aquatic and riparian flora and fauna. Moosehorn and Magurrewock streams are the two largest stream drainages in the Baring Division. Hobart stream is the primary drainage in the Edmunds Division. Moosehorn NWR has approximately 20 streams, 13 of which are large enough to support populations of native brook trout. Several important trout streams, including Cranberry Brook and Mahar Stream, depend upon a continual outflow from refuge impoundments. Fish are an important part of refuge aquatic systems and provide a prey base for bald eagle, osprey, common loon, river otter, and other wildlife. Several impoundments have fishways including Middle Magurrewock, Upper Magurrewock, Tyler Flowage, and Howard Mill. Anadromous fish such as Atlantic salmon and alewives are often able to make their way into upper marshes.

Riparian areas are found adjacent to bodies of open water and non-forested wetlands that are often rich in species and possess dynamic and complex biophysical processes. Riparian areas along rivers provide important structural components, including large nest and roost trees for eagle and ospreys and cavity trees for wood ducks, hooded mergansers and songbirds. Riparian areas often contain a mix of native shrubs including alder, elderberry, and viburnum that provide food and cover for nesting and migrating songbirds.

Vernal Pools

Vernal pool communities are important to the health, integrity, and biodiversity of ecosystems at the refuge. Despite their small size, patchiness, and ephemeral nature of vernal pools their value is significant. For example, amphibians, such as wood frogs and salamanders, utilize these areas for a full range of life activities. Vernal pools are imbedded throughout the refuge's forest matrix.

Freshwater Lakes

Major lakes in the Baring Division include the Meddybemps (6,765 acres; the refuge owns *only the shoreline* along Meddybemps Lake) and Bearce (275 acres). This portion of the refuge lies adjacent to the St. Croix River, which forms the international boundary with New Brunswick, Canada. The western portion of the Baring Division is within the Dennys River watershed.

Rocky Coastline

Coastal Maine and Cobscook Bay in particular, supports a biologically rich ecosystem. The Edmunds Division of Moosehorn NWR encompasses more than 18 miles of rocky shoreline along Dennys and Whiting Bays in Cobscook Bay with tidal fluctuations up to 24 feet twice a day. Although a relatively small portion of the area is within the boundary of the refuge, it is considered a vitally important contribution to the Cobscook Bay ecosystem. The diversity and abundance of marine life in Cobscook Bay is a result of the tremendous tides bringing nutrient rich water from the Gulf of Maine. Cobscook Bay is one of the most important areas in the entire state of Maine for fall migrating shorebirds that have been listed as species of concern (Clark and Niles 2000):Black-bellied plover, sanderling, semipalmated sandpiper, least sandpiper, greater and lesser yellowlegs, and short-billed dowitchers. It is estimated that 25% of the entire state of Maine's population of wintering black ducks can be found on Cobscook Bay. The Bay also supports the highest density of bald eagles in the northeastern United States.

Methodology. All available information on wetland and floodplains was compiled from the Moosehorn National Wildlife Refuge Habitat Management Plan, Draft (2007), Comprehensive Conservation Plan, Draft (2005), National Wetlands Inventory Maps (2004), Habitat Management Work Plan (2007). Locations of wetlands were compared with locations of potential prescribed and non-fire fuel modification projects to assist in the determination of potential impacts. Predictions about impacts were based on this information.

All available information on wetlands and riparian were compiled. Intensity of effects are defined in Table 1 on page 20.

Cumulative- Impacts may accrue through the passage of time, increasing the intensity of impacts and imposing changes upon wetland structure and habitat.

Regulations and Policies. Current laws and policies require that the following conditions be achieved in refuges:

Desired Condition: Minimize destruction, loss, or degradation of wetlands and riparian areas and preserve their natural and beneficial values.

Source: USFWS Organic Act; Clean Water Act; Executive Order 11988; Executive Order 11990 Protection of Wetlands; USFWS Management Policy.

Impacts of Alternative I - No Action

Impact Analysis

The implementation of this alternative requires that suppression operations be directed towards keeping wildland fires to the smallest possible size. The use of aggressive suppression operations could have minor to moderate localized adverse short term impacts on wetlands. This would primarily occur as a direct result of fireline construction, whether by hand or by mechanized equipment, in or near wetland areas. Use of firefighting foams and chemical suppressant agents can also have negative impacts on water quality in wetland areas. The direct impacts of fire on wetlands and floodplains would vary with fire intensity and size. The fires themselves would probably not have any direct adverse impacts on wetland structure or function, though they could lead to a reduction in aboveground vegetation and biomass, and, in some cases, allow invasive species to re-populate some areas (i.e. multiflora rose). Indirect impacts include increased runoff into areas where wetlands are located.

During the summer months, wetland areas often provide a physical environment that is conducive to the creation of environmental conditions whereby relative humidity and fuel moisture are markedly increased. These factors may work individually or in unison to exert a dampening influence relative to the ignition, propagation, and intensity of wildland fires. Though historically wildland fires occur in the refuge at a frequency of approximately one fire per year, the fire history in wetland areas at the refuge is even less frequent. By contrast, statistics for some states show a larger number of wildfire acreages burned in marsh habitat than any other type. This apparent contradiction may be the result of statistics accumulated during years of drought or other anomalies in climate. They might also be a reflection of the differences in ignition potential that exists between areas where there is considerable human presence as opposed to an area where natural (lightning) is the primary ignition source. These differences could also be the result of a relatively higher flammability potential for some marsh fuel types. For example, in areas where more volatile marsh species are found in abundance (i.e. outside of the refuge), for example the invasive common reed (*Phragmites australis),* the potential for wildland fire ignition and fire spread is much greater than with many native marsh species found on the refuge.

Cumulative Effects

There is consensus among the scientific community that global climate change, occurring in part, as a result of emissions of carbon dioxide and other greenhouse gases from human activities will lead to significant impacts across the United States. This includes sea-level rise adding stress to coastal communities and ecosystems (Wigley 1991). The effect of climate change on wetland systems and wildlife is expected to be variable and species specific. Climate changes on vegetation may, in the long run, may favor deciduous forests in lieu of the present dominant coniferous forest. This could lead to changes in fire potential in some areas. Uncertainty about the potential future effects of climate change requires refuges to utilize adaptive management techniques (i.e. adjusting regulations, shifts in habitat management objectives and techniques) to maintain healthy ecosystems (Inkley et al 2004).

The production and presence of heavy metals (primarily mercury) in the atmosphere, provides opportunities for airborne transmission to locations found at some distance from points of production. The area of Maine in which the refuge is located, referred to as Downeast Maine, has some of the highest concentrations of heavy metals among national wildlife refuges. Reasons for this relate to a location downwind from major sources of atmospheric pollution; a history of point source pollution in the immediate area (i.e. tanneries); and several site specific factors that enhance methymercury production including abundant shoreline wetlands, and small lakes with large watersheds. In addition, fluctuating water levels are now documented as creating more methylmercury in wetland ecosystems than those produced by stable water levels (Evers and DeSorbo, Biodiversity Research Institute, 2005). It is possible that impacts from heavy metals on vegetation and wildlife could lead to changes in forest understory vegetation structure with attendant changes in wildland fire potential. Acid precipitation also has exerted documented negative impacts on refuge resources (Moosehorn NWR Habitat Management Plan Draft, 2006). Over time, acid deposition affects the chemical properties of soils and likely affects the health of some tree species. As soils become more acidic, calcium and magnesium (important for tree nutrition) become less available for trees, and aluminum, which is toxic to trees, becomes more available. Many scientists believe that acid precipitation is the most significant factor affecting forest regeneration (Drohan et.al. 1997). As forest structure changes, so does its potential response to wildland fire.

Conclusion – The direct impacts of this alternative would be localized, short term, and minor to moderate. The use of aggressive wildland fire suppression in these areas can have detrimental effects on vegetation and the wildlife that utilizes these ecosystems for their habitat. None of the activities in this alternative constitute impairment.

Mitigation

Areas impacted by wildland fire and suppression operations can be re-seeded with native vegetation as soon as possible after a wildland fire event in order to restore pre-fire conditions. Although it may not be practicable in all cases, avoidance altogether of wetlands during wildland fire suppression operations may be desirable.

Impacts of Alternative II – Preferred Alternative

Impact Analysis

The potential for moderate to major impacts caused by wildland fire occurrence in wetlands is diminished by the implementation of the preferred alternative. Under this alternative, prescribed fire, non-fire hazardous fuel reduction, and appropriate management response fire suppression activities would occur that, although still capable of imposing short term negligible to minor adverse impacts on wetlands, provide a useful management tool whereby important wetland systems can be preserved and even enhanced in the long term through the use of integrated fire management techniques as described in this alternative. Prescribed burns and non-fire methods of fuel reduction and vegetation management can be designed to minimize or eliminate impacts to wetland areas, and in fact, may provide minor to moderate benefit to wetlands habitat in the long term. The use of prescribed fire and non-fire techniques allows refuge managers the opportunity to reduce hazard fuels and manipulate vegetation in wetland environments at the locations and times when negative impacts are either absent altogether or negligible. Prescribed fire would not impact wetland hydrologic functioning, although the removal of vegetative biomass often results in opportunities for the invigoration of native species. For example, some species that prefer mesic habitat, for example common reed (*Phragmites australis*) and Morrow's honeysuckle (*Lonicera morrowii*), can be reduced in density through the effective use of appropriately timed prescribed burning, possibly in combination with herbicide use. Plant species composition changes little with fire. Fire does promote plants with strong vegetative habits such as grasses and sedges. Prescribed fires conducted at the appropriate time of the year, may stimulate dormant buds and create vigorous growth, often exemplified by the growth of new shoots. Removal of litter increases habitat available for seed germination and long dormant achenes in the soil seed bank may germinate. These activities can be planned during advantageous times of the year so as to maximize results while at the same time exerting negligible impacts on nesting birds and other species that inhabit wetland areas. Wildland fire suppression operations utilizing appropriate management response strategy and tactics can be managed to minimize impacts on wetlands. The use of appropriate management response techniques allows fire managers the ability to avoid areas where fireline suppression activities might do more harm than the effects of the actual wildfire itself.

Wetland areas would generally not be the object of non-fire hazard fuel projects, though small wetlands could be involved if they were located adjacent to historic structures and /or other refuge structures needing protection. These types of projects would involve very small wetland areas (< 1 acre) and would primarily provide access to the actual work area. The direct adverse impacts of these activities would take the form of negligible localized disturbance resulting from foot and vehicular traffic. The potential for impacts would be mitigated through avoidance where possible, or by utilizing less invasive methods of hand cutting and removal. Indirect adverse impacts could include the formation of ruts and the trampling of vegetation caused by vehicle and foot travel. These impacts would generally be localized, negligible to minor, and short – term.

Cumulative Effects

The same as in Alternative I.

Conclusion

This alternative could have localized, negligible to minor short term adverse or beneficial impacts on wetlands. The management prescriptions for prescribed fire and non-fire treatments can minimize or eliminate negative impacts on wetlands, while at the same time providing for habitat improvement. Appropriate management response for wildland fire suppression will help minimize, and in most case eliminate altogether adverse impacts on wetland areas. The indirect impacts would be localized, short term, adverse or beneficial, and negligible to minor. No impairment of refuge resources is indicated.

Mitigation

Same as Alternative I.

Impacts of Alternative III – Appropriate Management Response and Non-Fire Fuels Management

Impact Analysis

Under this alternative, activities would occur that would have localized, negligible to minor adverse impacts on wetlands. The impacts attributable to the implementation of this alternative would be similar to those described in alternative II, *except* there would be no impacts as the result of prescribed fire. Although non-fire fuel reduction can be designed to minimize or eliminate impacts to wetland areas, it does not provide the same level of ecological benefit in many species that prescribed fire provides. Since prescribed fire will not be used in this alternative, an increased reliance on non-fire treatments will likely create an elevated potential for disturbance of wetlands. This will typically manifest itself in the form of increased foot travel by suppression and project crews as well as impacts caused by mechanized equipment and/ or the use of mechanical devices and chemicals. Wildland fires and suppression operations could still be managed through the appropriate management response mode to allow management to minimize detrimental effects of suppression operations in sensitive areas. Wildland fire occurrences under this alternative may increase over time, since fuel reduction and vegetation modification will most likely proceed at a slower pace that those identified in alternative II.

Cumulative Effects

The same as Alternatives I and II.

Conclusion

This alternative could have negligible to minor, localized and adverse direct impacts on wetlands. An increased reliance on non-fire vegetation and hazard fuel treatments has the

potential to lead to more disturbances of wetlands through increased impacts caused by foot travel and the use of mechanized equipment and chemicals. The inability to use such techniques as prescribed fire, a process that replicates natural processes, limits the ability of refuge management to restore and enhance wetlands vegetation and wildlife. Accordingly, the indirect impacts associated with the implementation of this alternative would be localized, negligible to minor, short term, and adverse or beneficial. There is no impairment of refuge resources indicated.

Mitigation

Management prescriptions for non-fire hazard fuel reduction and vegetation management treatments can be designed to minimize impacts on wetlands. This can be accomplished in a variety of ways, including varying seasonal timing of treatments in order to minimize impacts on vegetation and nesting species, applying herbicides only in approved locations according to USFWS management protocols or through avoidance strategies where benefits accrued through a limited treatment protocol would not outweigh the impacts caused by non-fire treatment methods.

8. Threatened, Endangered and Species of Concern

Affected Environment

Threatened and Endangered Species

Moosehorn National Wildlife Refuge currently contains only one known occurrence of a *federally* listed threatened or endangered species. The Atlantic Salmon (*Salmo salar*), is found in the waters of Cobscook Bay located in the Edmunds Division of the refuge. Federal and state programs support the Atlantic salmon fishery in the Dennys and St. Croix Rivers. The Atlantic salmon population in the Dennys River is a Federally Listed Category 2 Species in Maine. The America eel (*Anguilla rostrata)*, although no longer considered for Federal listing, is still an important species of concern (see next section). No recent population estimates for eels on the refuge are available, however, when fisheries surveys were conducted in the mid-1980s eels were common in most refuge waters. Impacts from a fire management program are highly unlikely to affect either of these species who spend their lives in water. As a result they will not be discussed further in this assessment.

Resources of Concern

The USFWS is entrusted by Congress to conserve and protect migratory birds and fish, federally listed threatened and endangered species, inter-jurisdictional fishes, wetlands, and certain marine mammals (i.e., “trust species”). In addition to this System mission, each refuge has one or more purposes for which it was established that guide its management goals and objectives. Further, refuges support other elements of biological diversity including invertebrates, rare plants, unique natural communities, and ecological processes that contribute to biological integrity and environmental health at the refuge, ecosystem, and broader scales (USFWS 1999, 2003). In keeping with this mission, Moosehorn National Wildlife Refuge has identified a number of

resources of concern (Table 6) as being a primary focus for management mission (as identified in its current Habitat Management Plan [HMP] Draft, 2007).

Table 6 lists the high and moderate priority resources of concern for Moosehorn NWR using the process described above.

High Priority Habitat Types	Associated Focal Species
Early Successional/Young Forest/Shrubland Mosaic	**American woodcock**, chestnut-sided warbler, American redstart, Canada warbler, whippoorwill, common nighthawk, mourning warbler
Freshwater Emergent Wetlands	**American black duck**, ring-necked duck, pied-billed grebe, sora, Virginia rail, marshbirds
Other Freshwater Habitats (vernal pool, bog, lakeshore)	Spotted salamander, blue-spotted salamander, wood frog
Intertidal and Tidal Mudflats and Tidal Creeks	American black duck, nesting, **feeding and staging migratory waterfowl and shorebirds**. America eel, Alewife
Salt marsh	**Nelson's sharp-tailed sparrow,** American black duck
Rocky Coast and Islands	Staging migratory shorebirds, nesting bald eagles
Rivers and Streams and Associated Riparian Areas	**American black duck**, cavity nesting waterfowl, beaver, **American woodcock**, Canada warbler, northern parula, brook trout, America eel, freshwater mussels
Spruce-Fir Forest	**Bay-breasted warbler**, Canada warbler, **Cape May warbler**, Northern parula, spruce grouse
Northern Hardwood-Spruce Forest	**American woodcock**, Blackburnian and **Canada warbler**, American redstart, veery, pileated woodpecker

The Moosehorn National Wildlife Refuge Habitat Management Plan (Draft 2007) has identified a series of resource management activities that have been earmarked as being of the highest priority. One of these identified issues is the need to protect and manage rare, threatened, and endangered species, and species of concern. The known and perceived threats to these species vary in intensity, and include a range of causative factors that include recreational activities, disruptions to natural coastal ecosystem processes, and interactions with both native and non-native and invasive species. Several high-profile species, among others, such as the American woodcock (*Scolopax minor*), bald eagle (*Haliaeetus leucocephalus)*, and American black duck (*Anas rubripes)* are being actively managed by the refuge.

When the refuge was legislated in 1937 as a migratory bird refuge, the conservation of the American woodcock was considered to be one of the primary justifications for refuge establishment. That commitment to preservation and management has carried forth to the present day. The American woodcock is listed as the highest priority species in the Atlantic Shorebird

Conservation Plan (USFWS 2004c). Although the number of breeding pairs at Moosehorn has increased over time, the overall trend in the state of Maine is still on the negative side. The major cause for these declines are thought to be loss and degradation of habitat on the breeding and wintering grounds brought on by forest succession and land use changes (Kelley 2003). Habitat that supports viable woodcock populations also provides nesting habitat for other species of concern including; the chestnut-sided warbler (*Dendroica pensylvanica*), Canada warbler (*Wilsonia canadensis*), common nighthawk (*Chordeiles minor*), purple finch (*Carpodacus cassinii)*, veery (*Hylocichla ffuscescens*), whip-poor-will (*Caprimulgus vociferous)*, willow flycatcher (*Empidomax traillii*), and ruffed grouse (*Bonasa umbellus*). In addition, this same early successional shrubland habitat provides important foraging habitat for spring and fall migrating birds.

The largest group of bird species of continental importance in the Northern Forest Avifaunal Biome is associated with coniferous forest (Rich et al 2004). Spruce fir bird associations that either occur or could occur on Moosehorn NWR include: bay-breasted warbler (*Dendoica castanea*), black-backed woodpecker (*Picoides arcticus*), boreal chickadee (*Parus hudsonicus*). Cape May warbler (*Dendroica tigrina*), gray jay (*Perisoreus canadensis*), northern parula warbler (*Parula americana*), olive-sided flycatcher (*Nuttallornis borealis*), rusty blackbird (*Euphagus carolinus*), spruce grouse (*Canachites canadensis*), and yellow-bellied flycatcher (*Empidonax flaviventris*). These species vary in their preference for age and density of forest, degree of association with wetlands and tolerance for hardwoods or mixed forests (Rich et al 2004).

The bay-breasted warbler is a *highest* priority in BCR 14. It favors mature spruce-fir forest and populations have been closely tied with spruce budworm infestations that create openings in forest systems. The control of these infestations seems to have resulted in a decline in bay breasted warbler populations (Williams 1996).

The Cape May warbler is a species of concern in BCR 14 (Rich et al 2004). Cape May warblers occur in boreal forests that have some openings, and prefer to feed upon the forest pest spruce budworm. Although it does feed on other insects, its populations will ebb and flow consistent with outbreaks of spruce budworm in spruce-fir forests.

The northern parula warbler is associated with the mature and moist forests and forested riparian habitats dominated by spruce, hemlock and fir with an abundance of lichens (especially *Usnea spp*) that they use in nest-building. Since these lichens are sensitive to air pollution (DeGraaf and Yamasaki 2001), it is possible that degradation of air quality could have an impact on species populations.

The Canada warbler is declining across much of its range and is listed as *highest* priority in BCR 14 (Dettmers 2004). The species breeds in a range of habitat types including deciduous forested swamps, cool, moist, mature forest and can occur in northern hardwood forested areas (DeGraaf and Ymasaki 2001). According to the USFWS NWRS Region 5 Landbird point count data through 2005, Moosehorn NWR recorded the greatest frequency of Canada warblers on point counts and accounted for 36.5% of all Canada warblers tallied by refuges in the region.

The blackburnian warbler (*Dendroica fusca*) is a *moderate* priority species within BCR 14 (Dettmers 2004). Approximately 25% of the global population occurs in the region. Blackburnian warblers are found in higher density in more upland mixed forests than in wet bottomland spruce-fir forest. The removal of large conifers decreases populations of this species.

Located along the Atlantic migratory flyway, Moosehorn National Wildlife Refuge is renowned for its abundant and diverse bird habitat. More then 220 bird species make their year-round homes in the area during their twice-yearly transcontinental migration.

The American black duck (*Anas rubripes)* is a species of concern identified in the North American Waterfowl Management Plan because of the historic decline in their population, with habitat loss an important contributing factor. Black duck also is a species of highest priority in the Atlantic Northern Forest Bird Conservation Region (BCR 14) (Dettmers 2004). Black ducks winter in Maine; pairs arrive on inland streams and wetlands as ice begins to recede in March. Black ducks are generalists in their nesting requirements; they nest on the ground up to 1 mile from brood-rearing habitat. Nests are initiated in April and the peak hatch is from June 1-10. Minimizing human disturbance from late March through mid July is important, as they are quite intolerant of human disturbance during the pre-laying through brood stages. Freshwater emergent marshes, swamps, and streams provide critical habitat during the breeding season. The number of black duck pairs breeding at Moosehorn is unknown, however brood production is monitored annually on subset of refuge impoundments.

The strong tides of Cobscook bay keep water open in winter, creating an important area for wintering waterfowl along the Atlantic Flyway. In some years a quarter of the Maine's wintering black duck population is found in Cobscook Bay. The ducks follow the tide in, foraging on invertebrates in the intertidal rockweed and foraging on the mudflats as the tide recedes. Ox Cove and Bellier Cover in Denny's Bay are noted as important areas for black ducks within Cobscook Bay (Daigle 2001).

Although no longer a federally listed species, the American bald eagle (*Haliaeetus leucocephalus)* is still a preeminent species of concern residing at Moosehorn National Wildlife Refuge. Important refuge goals reflect the importance of maintaining and preserving nesting habitat for this species. Both Divisions of the refuge are used extensively by bald eagles throughout the year for feeding and roosting; up to 80 birds were counted at one feeding site in the mid-1980s. Three traditional bald eagle nest sites are located on the Baring Division and three are on or adjacent to the Edmunds Division (USFWS 2005). Cobscook Bay on the refuge has the highest density of nesting bald eagles in the northeastern United States (MDIFW 2005).

The northern goshawk (*Accipiter gentilis)*, a species of concern in the state of Maine, is a rarely seen raptor found on the refuge. An occupant of mature forested habitat, it feeds on grouse, squirrels, hares, and even crows and small birds.

Rare Plants and Natural Communities

There are no known federally threatened or endangered plant species at Moosehorn National Wildlife Refuge. A comprehensive botanical survey of the Refuge has not been conducted.

However, one State threatened plant, Vasey's Pondweed (*Potamogeton vaseyi)* has been identified; a specimen was collected from Popple Flowage in 2002. During the summers of 2006 and 2007 a clump of Showy Lady's-slipper (*Cypripedium reginae)* was discovered in a grassy opening just west of the Charlotte Road in Baring. This species is considered rare in Maine. Identifications of other rare and/or unusual plants have been documented in the past, but no further assessments have been completed as of the current time.

The salt marshes in Cobscook Bay State Park (lands owned by the USFWS but managed as a Maine State Park) support a population of Gaspe Arrow Grass (*Triglochin gaspense),* which is a rare plant (S1) in Maine.

Although there are currently no records of the plant existing at the refuge, early successional habitat in the Edmunds Wilderness Area has the potential to support Canada Mountain Rice-Grass (*Oryzopsis canadensis),* which is a rare (S2) plant in the state of Maine.

In most cases, little is known about plant population dynamics and their interactions with other species of flora and fauna. For this reason, Moosehorn National Refuge has established as one of its management priorities the identification, protection, and monitoring of these species of concern. Portions of both divisions of the refuge were evaluated in 1998 for possible inclusion in a statewide ecological reserve program. Reconnaissance was coordinated by the Maine Natural Areas Program. No rare natural communities were discovered during this assessment.

Methodology: Impacts to threatened and endangered species and species of concern were qualitatively assessed by means of literature review of the effects of fire on the species discussed in this assessment. This was achieved through consultation with biologists and other agencies, review of refuge management documents such as the Moosehorn National Wildlife Refuge Habitat Management Plan, Draft 2007), Comprehensive Conservation Plan, Draft 2005, and the documents below:

- Partners in Flight Physiographic Area 28
- Bird Conservation Region 14
- Bird Conservation Plans (shorebird, waterbird, waterfowl, landbird)
- Federal Threatened and Endangered Species list
- State Threatened and Endangered Species lists
- Northeast States Non-game Technical Committee
- State Comprehensive Wildlife Conservation Plans

For the purpose of developing a list of priority plant species and natural communities, the following sources were referenced:

- Maine Natural Heritage Program
- Maine Comprehensive Wildlife Conservation Plan
- The Nature Conservancy Eco-region Plans

Extensive use of the U.S. Department of Agriculture's Fire Effects Information System (FEIS 2005), as well as associated, species lists, plans, research documents and studies were undertaken

as a part of this assessment. The lack of detailed and specific information for some species discussed in this section of the assessment made it necessary for the author of this document to exercise considerable professional judgment during the preparation of this section of the assessment. Information about plant and animal species that have been listed as federally threatened, endangered or that are state listed species of concern, and that live either on or in close proximity to Moosehorn National Wildlife Refuge have been derived from a variety of sources including: staff of Moosehorn Natural Wildlife Refuge, Maine Department of Natural Resources, and the Nature Conservancy.

All available information on threatened, endangered, and species of concern was compiled. Intensity of effects are defined in Table 1 on page 21.

Cumulative: Impacts on threatened, endangered, and species of concern may accrue through the passage of time, potentially imposing changes upon the species and/ or their habitat.

Regulations and Policies. Current laws and policies require that the following conditions be achieved in the refuge:

Desired Condition: Minimize destruction, loss, or degradation of rare and endangered species and species of concern and preserve their natural habitat to the extent possible.

Source: Endangered Species Act of 1973, as amended (16 USC 1531 et seq.), Bald Eagle Act (16 USC 668), USFWS Policies State of Maine Protection Policies.

Impacts of Alternative I - No Action

Impact Analysis

The principal management objective of this alternative, where all wildland fires are aggressively suppressed, foregoes any activity to manage wildland fire in a pro-active manner, other than by those methods that might be enacted through seasonal preparation and training of response personnel. During the frequent intervals in which no wildland fires occur, direct impacts upon threatened and endangered species and species of concern is minimal, possibly even non-existent. However, because suppression operations are aimed at keeping wildland fires to the smallest possible size, the use of aggressive suppression tactics could have minor to moderate long term direct and indirect adverse impacts on listed species when wildland fires do occur. The fire history in this part of the country bears this out. While large-scale wildland fires do not occur often, when they do occur their magnitude is such that forest stand-replacement fires occur with all of the attendant impacts upon vegetation and wildlife. While this alternative could potentially reduce exposure of listed species to the direct impacts of a wildland fire, the exclusion of all fire from the ecosystem would perpetuate the ongoing, long term increase in hazardous fuels, creating the potential for high intensity fires that could, at least in the short term, create a decline in the size of some refuge vegetation communities and the accompanying effects on wildlife in general and listed species specifically..

Under this alternative, there is the potential for buildup of hazardous fuels through a continued

use of a suppression-only fire policy. The increased fuel accumulations that occur over time could fuel wildland fires that burn with greater intensity and whose effects upon forest vegetation could lead to virtual elimination of the herbaceous layer as well as portions of the forest canopy itself, markedly changing the structure of forest ecosystems for extended periods of time. Since large spruce and fir trees contribute important attributes toward the life processes for many mammals and birds in the Moosehorn ecosystem, populations would undoubtedly be negatively impacted, at least in the short term until reproduction could begin post-fire; a process that can take decades to reach completion.

The presence of large-scale intense wildland fires fueled by large quantities of fuel and furthered by the presence of environmental conditions such as long term drought and high winds, exert tremendous impacts upon soil resources in all areas. Generally, only mesic soils are able to withstand the negative impacts of the intense heat generated by these types of fires. For most species of vegetation and insect life that lives within the soil strata zone is subjected to those same intense environmental conditions, often resulting in widespread mortality. Avian species living in these areas would be forced to travel outside of the immediate area in order to find food and cover. Some prey species might actually benefit in the short term, as the removal of ground vegetative cover would make prey species easier to detect and accumulate.

The implementation of aggressive wildland fire suppression could have direct adverse impacts on all species. This would occur as the result of the implementation of suppression operations where vehicle and foot traffic could potentially disrupt nesting sites, burrows or immature animals that were incapable of escaping the disturbance(s). In the worst case, a loss of individuals could occur if fire suppression operations were implemented at times of the year when nesting and/ or fledging were occurring. A mitigating factor that might help reduce these impacts is that the refuge regulates the off-road use of firefighting vehicles. Only in situations where threats to life or property exist can a heavy vehicle be driven off-road. As a result, it is unlikely that these impacts would occur. In addition, refuge personnel have marked nesting populations of sensitive bird populations (i.e. bald eagle), so firefighting crews would be able to avoid them altogether under normal firefighting operations. Indirect impacts of firefighting personnel and smoke produced by a fire in close proximity could disrupt populations, but the impacts would be transitory and minor. In the context of the Endangered Species Act, the impacts of wildland fire and fire suppression operations would be *no effect.*

Most of the species discussed at the outset of this discussion of alternative I, share the preference for the varied (mature forest, successional forest, marsh, wetland, and successional shrubland and grass field habitats) offered by the Moosehorn NWR. All of these habitat types may be susceptible to the potential short term adverse impacts of wildland fire, particularly during periods of extended drought and/or when nesting and breeding activities are taking place during the spring (Mar-April-May) months. The greatest potential direct adverse impacts of wildland fire would be the destruction of nests. Fire suppression operations would likely create little or no direct adverse impact since the nests of species like bald eagles and osprey are built either directly over to or relatively close to the water. Indirect impacts would include the short term duration of smoke and the presence of suppression personnel and equipment in the area. Some species, like the bald eagle, would likely benefit from an increased ability to detect prey species such as mice, voles and other small mammals after the passage of a wildland fire. Others, such as

the American woodcock and many of the warblers (spp) likely find an increased abundance of arthropods for their food supply; largely created by the passage of the fire and its effects on the surrounding vegetation. Overall, the direct adverse impacts of wildland fire on all of the aforementioned species would be localized, short term, and negligible to minor.

In the long term, the continued suppression of wildland fire engendered through the implementation of this alternative could have potential impacts on overall habitat diversity, thus creating changes that might not favor the species in question. For example, the continued suppression of fire would likely remove the potential for snag creation that bald eagles prefer for their nesting and hunting activities. Since many snags are created by wildland fires, suppression of all fires and lack of prescribed fire would reduce the potential for snag development and thus, have negative impacts on bald eagles. Many species, such as the black-backed woodpecker, and most of the warblers (.spp) depend upon arthropods as a major food source. The creation of snags and the perpetuation of openings in vegetative cover provide excellent habitat for arthropods, which in turn, serve as a food source for the aforementioned species. A continuation of aggressive fire suppression under this alternative, which limits the development of snags and openings or gaps in vegetation, could have long term impacts upon many of the species noted. Perhaps even more important, the continued suppression of fires allows the development of a vegetative structure that is supportive of fires that have the potential to burn with greater intensity and duration. This is the result of the natural accumulation of fuels that would otherwise be removed through a more natural fire regime of more frequent fires of smaller size and lower intensity. Indirect impacts are localized, short to long term, and minor to moderate. In the context of the Endangered Species Act, the impacts of wildland fire and aggressive fire suppression operations would be; *may affect, but not likely to adversely affect.*

In the context of the Endangered Species Act, the impacts of wildland fire and fire suppression operations on the Atlantic salmon would be; *no effect*.

State species of concern such as Vasey's pondweed (*Potamogeton vaseyi)* and Showy Lady's slipper *(Cypripedium reginae)* occupy habitat niches where, under normal conditions, wildland fires are highly unlikely to occur. Their preference for moist conditions, or as in the case of the pondweed a riparian habitat, make it highly unlikely that fire would be sustained in the ecosystem in which they function. Although no information has been recorded concerning the fire ecology of these individual species, other species of the same genus and that occupy similar habitats have shown no propensity to be exposed to fire. Indirect impacts may include disturbance by firefighting vehicles, equipment, and personnel as well as loss of individuals due to the aforementioned activities. Refuge policy limits off-road use of vehicles except in the most exigent of emergencies (as well as some administrative uses), so the potential for the loss of any individuals due to these types of impacts is reduced. The direct and indirect impacts of wildland fire and fire suppression on these species would be localized, short term, adverse and negligible. In the context of the Endangered Species Act, the impacts of wildland fire and fire suppression operations would be; *no effect.*

Reptiles and amphibians such as the northern water snake (*Natrix sipedon serpentina),* gray tree-frog (*Hyla versicolor),* spotted salamander (*Ambystoma maculatum),* red-backed salamander (*Plethodon cinereus),* red-spotted newt (*Diemictylus viridescens),* northern two-lined salamander

(*Eurycea bislineata),* blue-spotted salamander (*Ambystoma laterala),* American toad (*Bufo americanus),* and wood frog (*Rana sylvatica)* occupy habitat that can support wildland fire under the extreme e environmental conditions. The most obvious direct impact from a wildland fire is the threat posed by the close proximity or passage of the flaming front of a fire. While this certainly does pose a potential threat, Russell (and others 1999) have found that there are very few reports of fire caused injury or mortality to herpetofauna, even to those animals, particularly amphibians, that have somewhat limited mobility. The vulnerability of snakes to fire may increase while they are in ecdysis, but even under those conditions, injury potential in minimal. For example, of a large number of snakes marked prior to a fire in Florida, only two were injured and those were in mid-ecdysis. No dead or injured amphibians or reptiles were found after understory burning in a pine forest in Florida (Means and Campbell 1981). Because these species live in and close to mesic and wetland habitats, they have the advantage of being able to quickly access areas where they are safe from heat and flames. In addition, these types of habitat burn less often and less severely than upland sites. Wildland fires also burn in a mosaic pattern with small microsite changes being responsible for leaving patches or "islands" of un-burned fuels within a fire perimeter. These areas serve as refugios from the heat and flames produced by wildlfire. These species then are unlikely to be affected by direct impacts of a wildland fire. Indirect impacts related to the suppression effort are manifested in the presence of firefighting personnel and equipment in the area, though all of these species are capable of physically leaving the area or hiding until suppression is complete. After a fire has passed, these species are more at risk from the presence of predators, since vegetative cover is likely to have been reduced by the fire, thus limiting hiding places and exposing the species to predation. In the context of the Endangered Species Act, the impacts of wildland fire and fire suppression would range from: *no effect* to *may affect, but unlikely to adversely affect.*

If retardants or foam suppressant used in fire suppression were spilled or misapplied in the vicinity of any of these species, they could conceivably have a direct effect, but it is uncertain whether this would be either a positive or a negative effect. In either case, the likelihood of this occurring is remote since the refuge has a policy of allowing no chemical retardant or suppressant within 300 yards of any wetland, water or riparian resource (and then only with the expressed permission of the Refuge Manager). Populations of all of the species of concern fall within the range of these protection zones and are therefore afforded protection from the negative impacts of chemical retardants and suppressants.

Cumulative Effects

There is consensus among the scientific community that global climate change, occurring in part, as a result of emissions of carbon dioxide and other greenhouse gases from human activities will lead to significant impacts across the United States. This includes sea-level rise adding stress to coastal communities and ecosystems (Wigley 1991). The effect of climate change on wetland systems and wildlife is expected to be variable and species specific. Climate changes on vegetation may, in the long run, favor deciduous forests in lieu of the present dominant coniferous forest. This could lead to changes in potential for wildland fires due to changes in fuel structure and availability. Uncertainty about the potential future effects of climate change requires refuges to utilize adaptive management techniques (i.e. adjusting regulations, shifts in

habitat management objectives and techniques) to maintain healthy ecosystems (Inkley et al 2004).

The production and presence of heavy metals (primarily mercury) in the atmosphere, provides opportunities for airborne transmission to locations found at some distance from points of production. The area of Maine in which the refuge is located, referred to as Downeast Maine, has some of the highest concentrations of heavy metals among national wildlife refuges. Reasons for this relate to a location downwind from major sources of atmospheric pollution; a history of point source pollution in the immediate area (i.e. tanneries); and several site specific factors that enhance methymercury production including abundant shoreline wetlands, and small lakes with large watersheds. In addition, fluctuating water levels are now documented as creating more methylmercury in wetland ecosystems than those produced by stable water levels (Evers and DeSorbo, Biodiversity Research Institute, 2005). It is possible that impacts from heavy metals on vegetation and wildlife could likely lead to changes in forest understory vegetation structure with attendant changes in wildland fire potential. Acid precipitation also has exerted documented negative impacts on refuge resources (Moosehorn NWR Habitat Management Plan Draft, 2006). Over time, acid deposition affects the chemical properties of soils and likely affects the health of some tree species. As soils become more acidic, calcium and magnesium (important for tree nutrition) become less available for trees, and aluminum, which is toxic to trees, becomes more available. As forest structure changes, so does its potential response to wildland fire. Many scientists believe that acid precipitation is the most significant factor affecting forest regeneration and forest health (Drohan et.al. 1997).

The cumulative impacts of the no-action alternative on species of concern (threatened, endangered, and sensitive) would be short to long term, localized, and minor to moderate.

Mitigation

Under this alternative, the following mitigation measures would be implemented:

- The locations of all sensitive plant and animals, or any other listed species identified as being at risk due to a wildland fire, would be protected from the effects of those incidents chiefly through avoidance during fire suppression operations.
- Maps of all known locations of species of concern will be made available for all personnel responding to wildland fire incidents.
- Minimum Impact Suppression Tactics (MIST) will be taught at all refuge fire training sessions.
- If retardants or foam suppressant used in fire suppression were spilled or misapplied in the vicinity of any of these species, they could conceivably have a direct effect, but it is uncertain whether this would be either a positive or a negative effect. In either case, the likelihood of this occurring is remote since the refuge has a policy of allowing no chemical retardant or suppressant within 300 yards of any wetland, water or riparian resource. Populations of all federal and state listed species fall within the range of these protection zones and are therefore afforded protection from the negative impacts of chemical retardants and suppressants.

Impacts of Alternative II – Preferred Alternative

Impact Analysis

The impacts of wildland fire and fire suppression on threatened, endangered, and species of concern would be similar, though lessened in overall impact, to those described in alternative I. The implementation of the preferred alternative could also be expected to cause an increase in acreage burned by wildland fire. The slight increase in acreage could be expected to result from the ability to utilize fire suppression strategies that allow suppression forces options to take advantage of natural breaks in terrain and/ or fuels (i.e. streams, riparian zones, trails, roads, areas of sparsely vegetated fuels, etc) in order to stop a fires spread. As the result of using this strategy, the potential for ground disturbance as a result of fire suppression activities would be reduced. The necessity of using more aggressive techniques that require the construction of handline directly along a fires perimeter would be diminished in most cases. Due to the fire control policies of the past, where strict suppression by aggressive attack was the only alternative available to suppression forces, wildland fuels, particularly those dead and down fuels on the forest floor and mid-strata fuels like brush and scrub, have increased to levels that can be expected to provide ignition and fuel sources for wildland fires that will burn with greater intensity and for longer duration. Adverse impacts to vegetation and wildlife are more likely to occur during the initial stages of the implementation of this alternative due to this unnatural build-up of fuels. These impacts can be mitigated through the effective implementation of a prescribed fire program that takes advantage of environmental prescriptions that allow reductions in fuel levels while at the same time keeping the adverse impacts of fire to a minimum. Prescribed burns have the additional advantage of being able to be implemented at times when species of concern are least likely to be impacted. For example, prescribed burns would only be conducted during those times of the year when breeding and nesting activities of the concerned species were complete, or when phenological changes in vegetation were such that the use of prescribed fire would be expected to achieve desired results.

Generally, this alternative would have impacts upon some species of concern that can best be classified as long term, and if successfully implemented, largely beneficial. Through a thoughtful and well-executed program of prescribed fire and the utilization of non-fire hazardous fuel and invasive species reduction, this alternative would allow refuge management the opportunity to make marked progress in the direction of restoring vital ecosystem components and allowing the refuge to more closely mimic the natural fire regime that was likely found in the area now occupied by the refuge. For reasons discussed in the previous alternative, species of concern such as the bald eagle, American woodcock, black duck and Canada warbler would benefit from the restoration of upland forest and marsh ecosystems by allowing more favorable habitat for nesting, breeding, and hunting activities. These habitats would also be further protected from the effects of catastrophic wildland fire by removing accumulations of dead fuel on the ground as well as mid-story vegetation that has accumulated through many years of aggressive fire suppression.

Another important aspect of the implementation of the preferred alternative includes the use of the integrated management approach to wildland fuels. This allows refuge management the option of using prescribed fire *and* non-fire methods of hazardous fuel reduction to meet

management objectives. Either of these components may be employed individually, or in combination with other treatments, in a sequential integrated treatment program, dependent upon the individual needs of a specific species and/ or a specific site. Under the auspices of this alternative, a proposed annual treatment plan would be implemented. When subjected to the treatments of prescribed fire and non-fire treatments, listed species would likely suffer negligible to minor temporary adverse impacts. These would chiefly take the form of temporary effects of smoke and human presence during the implementation phase of any treatment. In the long term, the implementation of this alternative would likely benefit most species through a reduction in invasives and accompanying increase in native species that provide levels of protection, forage and cover more in keeping with natural ecosystems. For example, significant reductions in invasive species such as multiflora rose (*Rosa multiflora*), purple loosestrife (*Lythrum salicaria)* and reed canarygrass (*Phalaris arundinacea),* species that are often located in wetland habitats, would allow natural wetland and upland forest-edge regeneration to occur, restoring natural vegetative habitat for many plant and animal species. Non-fire methods of fuel reduction are most commonly used in and around refuge structures and cultural features in order to protect them from unplanned wildfires. The woody material thus treated can be disposed of in a number of ways, including chipping on-site, scattering, or by being arranged in piles for later removal or burning.

In the context of the Endangered Species Act, the impacts of the preferred alternative on these species would be; *no effect.*

The bald eagle, black duck, American woodcock, Canada warbler, Blackburnian warbler, Parula warbler, Bay-breasted warbler, Cape May warbler, gray jay, ruffed grouse, and others may all potentially be found in areas where prescribed burns may be implemented. It is unlikely than any large-scale non-fire hazardous reduction of fuels would take place in the habitat of any of these species. The most likely direct impacts of prescribed fire would likely be a loss of nests. During prescribed burns these potential impacts can be easily mitigated by avoiding burning during those times of the year when nesting activities are occurring. If prescribed burning were indicated during those times of the year when nests were being occupied, nests of the larger species (i.e. bald eagle) could be located, marked, and otherwise avoided altogether. In those cases where this was not possible, flammable fuels could be removed from around nests so as to protect them from direct flame impingement. Indirect impacts created by the smoke and the presence of personnel during burning operations would be short term and negligible to minor in their impacts. Some of the other indirect impacts would be beneficial and include reductions in marsh biomass (particularly invasives), better access to prey, invigoration of most herbaceous and grammenoid species (particularly the warm –season varieties), reduction of shrub mid-story layers that contribute to forest flammability, the creation of opportunities for an increase in arthropods through snag development, and creation of snags for nesting and hunting activities. The latter indirect impacts are generally localized, mid to long term and minor to moderate, adverse to beneficial in their intensity. For these species considered from the standpoint of the Endangered Species Act, the impacts would be; *may affect, but not likely to adversely affect.*

Reptiles and amphibians such as the northern water snake (*Natrix sipedon serpentina),* gray tree-frog (*Hyla versicolor),* spotted salamander (*Ambystoma maculatum),* red-backed salamander (*Plethodon cinereus),* red-spotted newt (*Diemictylus viridescens),* northern two-lined salamander

(*Eurycea bislineata),* blue-spotted salamander (*Ambystoma laterala),* American toad (*Bufo americanus),* and wood frog (*Rana sylvatica)* occupy habitat that can support wildland fire under the extreme e environmental conditions. The most obvious direct impact from a wildland fire is the threat posed by the close proximity or passage of the flaming front of a fire. While this certainly does pose a potential threat, Russell (and others 1999) have found that there are very few reports of fire caused injury or mortality to herpetofauna, even to those animals, particularly amphibians, that have somewhat limited mobility. The vulnerability of snakes to fire may increase while they are in ecdysis, but even under those conditions, injury potential in minimal. For example, of a large number of snakes marked prior to a fire in Florida, only two were injured and those were in mid-ecdysis. No dead or injured amphibians or reptiles were found after understory burning in a pine forest in Florida (Means and Campbell 1981). Because these species live in and close to mesic and wetland habitats, they have the advantage of being able to quickly access areas where they are safe from heat and flames. In addition, these types of habitat burn less often and less severely than upland sites. Wildland fires also burn in a mosaic pattern with small microsite changes being responsible for leaving patches or "islands" of un-burned fuels within a fire perimeter. These areas serve as refugios from the heat and flames produced by wildlfire. These species then are unlikely to be affected by direct impacts of a wildland fire. Indirect impacts related to the suppression effort are manifested in the presence of firefighting personnel and equipment in the area, though all of these species are capable of physically leaving the area or hiding until suppression is complete. After a fire has passed, these species are more at risk from the presence of predators, since vegetative cover is likely to have been reduced by the fire, thus limiting hiding places and exposing the species to predation. In the context of the Endangered Species Act, the impacts of wildland fire and fire suppression would range from: *no effect* to *may affect, but unlikely to adversely affect.*

Many of the grass and sedge species on the refuge occupy habitat niches where, under the appropriate environmental conditions (low humidity, high winds, low fuel moisture), wildland fire may occur. Prescribed fire may also be implemented for resource benefit in some of these same habitats. The direct adverse impacts of wildland fire may include consumption of large quantities of aboveground biomass. This would lead to a reduction in nesting and feeding habitat for some species. Although no information has been recorded concerning the fire ecology of each individual species, other species of the same genus that occupy similar habitats have developed adaptations that allow then to survive fire (e.g. sprouting from rhizomes) and, in some cases, even thrive after fire. Some indirect impacts of fire may also be beneficial as competing vegetation (invasive and/ or exotic) may also be reduced by fire. Prescribed fire provides positive responses in nutrient re-cycling and helps reduce invasive species, though care must be taken in this regard since some invasives quickly and aggressively colonize areas that have been burned by fire. In those cases, the advantage of the preferred alternative lies in its ability to utilize combined and synergistic application of prescribed fire and non-fire (herbicide and mechanical reduction) as a means to achieve beneficial results for a particular species. Indirect impacts may include disturbance by firefighting vehicles, equipment, and personnel as well as loss of individuals due to the aforementioned activities. These negatives may be almost completely avoided during prescribed fire operations since they are carefully pre-planned to include reduction of impacts in sensitive areas. In addition, refuge policy limits off-road use of vehicles in most areas with the exception of the most exigent of emergencies. As a result, the potential for the loss of any individuals due to these types of impacts is markedly reduced. The direct and

indirect impacts of wildland fire, appropriate management response fire suppression, and prescribed and non-fire on these species would be localized, short term, adverse or beneficial, and negligible to minor. In the context of the Endangered Species Act, the impacts of wildland fire and fire suppression operations would be; *may affect, but not likely to adversely affect.*

Cumulative Effects

The cumulative effects of the preferred alternative are the same as those described in alternative I.

Conclusion

The direct and indirect impacts of the preferred alternative on species of concern range from negligible impacts on some species to localized, short term, adverse or beneficial, and negligible to minor impacts on other species. In the context of the Endangered Species Act, the impacts of the preferred alternative would be; *no effect* or *may affect, but unlikely to adversely affect.*

Mitigation

- All sensitive plant locations, or any other species of concern identified as being at risk due to a wildland fire, would be protected from the effects of those incidents chiefly through avoidance during fire suppression operations.
- In order to ensure that they are not impacted, all sensitive plant locations, or other listed species identified as being present in or near the close proximity (generally <100 feet) to a prescribed burn unit, would receive mitigation as described in the individual prescribed burn plan prepared for that specific burn.
- Fire management personnel would provide the Refuge manager and Wildlife Biologist with copies of prescribed burn plans far enough in advance to allow a detailed survey of the area before implementation.
- Fire management staff would inform the Refuge Manager of wildland fire suppression activities as soon as possible.
- Maps of all known locations of species of concern would be made available for all personnel responding to wildland fire incidents.
- Minimum Impact Suppression Tactics (MIST) will be taught at all refuge and cooperating agency fire training sessions.
- Management prescriptions for prescribed fire and non-fire treatments can be developed and implemented so as to minimize or eliminate negative impacts on wetlands and upland forests, while at the same time providing for habitat improvement.
- The use of appropriate management response strategies and tactics for wildland fire suppression would help minimize, and in most cases, eliminate adverse impacts on wetland and upland forest ecosystems.
- If retardants or foam suppressant used in fire suppression were spilled or misapplied in the vicinity of any of these species, they could conceivably have a direct effect, but it is uncertain whether this would be either a positive or a negative effect. In either case, the likelihood of this occurring is remote since the refuge has a policy of

allowing no chemical retardant or suppressant within 300 yards of any wetland, water or riparian resource. Populations of all federal and state listed species fall within the range of these protection zones and are therefore afforded protection from the negative impacts of chemical retardants and suppressants.

Impacts of Alternative III – Appropriate Management Response and Non-Fire Fuels Management

Impact Analysis

With the implementation of this alternative, activities would occur that would create direct and indirect impacts upon threatened, endangered, and species of concern that would be the same as those which would occur under the preferred alternative, except that any impacts attributable to the implementation of prescribed fire would *not* occur. Although non-fire fuel reductions can be designed to minimize or eliminate impacts to endangered, threatened, and species of concern, they do not allow for the same level of ecological benefit that the use of prescribed fire engenders. Since prescribed fire will not be used in this alternative, an increased reliance on non-fire treatments will likely create an elevated potential for disturbance of forest and wetland ecosystems. This typically manifests itself in the form of increased foot travel by suppression and project crews as well as impacts caused by mechanized equipment and/ or the use of mechanical devices and/ or chemical herbicides. The use of some herbicides is contraindicated in many areas where wetlands are located. Wildland fires and suppression operations could still be managed through the appropriate management response mode to allow management to minimize detrimental effects of suppression operations in sensitive areas. Wildland fire occurrences under this alternative may increase over time, since fuel reduction and vegetation modification will most likely proceed at a slower pace than those identified in the preferred alternative. In the context of the Endangered Species Act, the impacts of this alternative on threatened, endangered, and species of concern, range from; *no effect* to *may affect, but unlikely to adversely affect.*

Cumulative Effects

Cumulative effects are the same as for Alternatives I and II.

Conclusion

The direct and indirect impacts of this alternative on threatened, endangered, and species of concern at Moosehorn National Wildlife Refuge ranges from no impacts on some species to localized, short term adverse or beneficial, and negligible to minor impacts on other species. An increased reliance on non-fire vegetation and hazard fuel treatments to create improved habitat and ecosystem functioning for some species has the potential to lead to increased disturbance of ecosystems through impacts caused by foot travel and the use of mechanized equipment and chemicals. These activities are self-limiting in the sense that their use only has applicability in a narrowly defined set of circumstances. As a result, increased impacts can be mitigated through limitation of application of non-fire methods of fuel reduction, or limiting these activities only to areas where impacts have little or no effect due to the nature of the treatment area (i.e. a previously developed area where no species are present). The inability to use prescribed fire, an

activity that replicates natural processes, limits the ability of refuge staff to restore and enhance some wetland and upland forest systems that serve as important areas where threatened, endangered, and species of concern live, nest, breed, and/ or find their food.

Mitigation

Management prescriptions for non-fire hazard fuel reduction and vegetation management treatments that may impact some species can be designed to minimize those impacts on species of concern. This is primarily accomplished through the manipulation of select portions of wetland and upland forest habitat. This can be accomplished in a variety of ways, including varying the seasonal timing in order to minimize impacts on vegetation or on nesting species, or by avoiding those areas altogether where benefits accrued through a limited treatment protocol would not outweigh the impacts caused by non-fire treatment methods.

- All sensitive plant locations, or any other species of concern identified as being at risk due to a wildland fire, would be protected from the effects of those incidents chiefly through avoidance during fire suppression operations.
- In order to ensure that they are not impacted, all sensitive plant locations, or other listed species identified as being present in or near the close proximity (generally <100 feet) to a non-fire hazard fuel reduction project, would receive mitigation as described in the project plan prepared for that specific project.
- Fire management staff would inform the Refuge Manager of wildland fire suppression activities as soon as possible.
- Maps of all known locations of T&E species and species of concern would be made available for all personnel responding to wildland fire incidents.
- Minimum Impact Suppression Tactics (MIST) will be taught at all refuge and cooperating agency fire training sessions.
- Management prescriptions for non-fire treatments can be developed and implemented so as to minimize or eliminate negative impacts on wetlands and upland forests, while at the same time providing for habitat improvement.
- The use of appropriate management response strategies and tactics for wildland fire suppression would help minimize, and in most cases, eliminate adverse impacts on wetland and upland forest ecosystems.
- If retardants or foam suppressant used in fire suppression were spilled or misapplied in the vicinity of any of these species, they could conceivably have a direct effect, but it is uncertain whether this would be either a positive or a negative effect. In either case, the likelihood of this occurring is remote since the refuge has a policy of allowing no chemical retardant or suppressant within 300 yards of any wetland (also requires approval of the Refuge Manager), water or riparian resource. Populations of all known federal and state listed species fall within the range of these protection zones and are therefore afforded protection from the negative impacts of chemical retardants and suppressants.

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(To be added)

State Agencies

(To be added)

REFERENCES

Abrams, M.D. 1992. **Fire and the Development of Oak Forests**. Bioscience. 42: 346-353.

Abrams, M.D. 1998. **The Red Maple Paradox**. Bioscience 48:355-364.

Anderson, Hal E., 1982. **Aids to Determining Fuel Models For Estimating Fire Behavior**, USDA For. Ser. GTR INT-122

Anderson, R.C. Laren E. Brown. 1983. **Comparative Effects of Fire on Trees in a Midwestern Savannah and Adjacent Forest.** Bulletin of the Torrey Botanical Club 110:1 P87

Aquilani, S. LeBlanc, D. Morrell, T. 2000. **Effects of Prescribed Surface Fires on Ground and Shrub Nesting Neotropical Migratory Birds in a Mature Indiana Oak Forest,** USA, Natural Areas Journal 20:4.

Bailey, Robert G. 1995, **Description of the Eco Regions of the U.S.,** Internet Access, www.fs.fed.us.

Braun, E.L. 2001. **Deciduous Forests of Eastern North America**. The Blackburn Press, Caldwell New Jersey.

Brose, P. H., Van Lear, D.H., Keyser, P.D. 1999. **A Shelterwood Burn Technique for Regenerating Productive Upland Oak Sites in the Piedmont Region**. Southern Journal of Applied Forestry, Vol. 23, No. 3, August 1999.

Calijouw, Caren. 1996. **Role of Fire in Wetland and Riparian Systems",** National Advanced Resource Technology Center, Fire in Ecosystem Management, Marana, Arizona.

1979. **Classification of Wetlands and Deepwater Habitats of the United States.** United States Fish and Wildlife Service, United States Department of the Interior.

Covington, W.W. and M.M. Moore. 1992. **Post settlement Changes in Natural Fire Regimes: Implications for Restoration of Old-Growth Ponderosa Pine Forests.** In: Kaufmann, Merrill R.; Moir, W.H.; Bassett, Richard L., technical coordinators. Old-growth forests in the southwest and Rocky Mountain regions: Proceedings of a workshop; 1992 March 9-13; Portal, AZ. Gen. Tech. Rep. RM-213. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 81-99.

Cronin, W. 1983. **Changes in the Land. Indians, Colonists, and the Ecology of New England**. Hill and Wang, New York. 241pp.

Cross, Diana H.; Fleming, Karen L. 1989. **Control of Phragmites or Common Reed.** Fish and Wildlife Leaflet 13.4.12. Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service. 5 p.

Day, G.M. 1953. The Indian as an Ecological Factor in the Northeastern Forest.

DeGraaf, Richard M.; Scott, Virgil E.; Hamre, R.H.; (and others). **Forest and Rangeland Birds of the United States: Natural History and Habitat Use.** Agriculture Handbook. 688. Washington DC: U.S. Department of Agriculture, Forest Service. 625 p.

Denevan, W.M., ed. 1992. **The Native Population of the Americas in 1492**. 2nd ed. Univ. Wisconsin Press, Madison. 398 pp.

Dickson, J.G., and J.C. Huntley. 1987. **Riparian Zones and Wildlife in Southern Forests: The Problem and Squirrel Relationships.** In: O.E. Maughan, ed. Maning Southern Forests for Wildlife and Fish. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, 37-39.

Dobyns, H.F. 1983. **Their Number Became Thinned**. Univ. Tennessee Press, Knoxville. 378 pp.

Drohan, Joy R.; Sharpe, William E. 1997**. Long term Changes in Forest Soil Acidity,** USA Water, Air, and Soil Pollution 95: 299-311

Ehrenreich, J.H. 1959. **Effect of burning and Clipping on Growth of a Native Prairie in Iowa**. Journal of Range Management. 12 pp. 133-137.

Eyre, F.H., ed. 1980. **Forest Cover Types of the United States and Canada**. Washington, D.C.: Society of American Foresters Report.

Finch, Deborah M., 1991. **Population Ecology, Habitat Requirements, and Conservation of Neotropical Migratory Birds**. Rocky Mountain Forest and Range Experiement Station, GTR RM-205.

Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis [2005, May 27].

Hagan III, John M., 1992. **Ecology and Conservation of Neotropical Migrant Landbirds**, Smithsonian Institution Press, 609pp.

Hamel, Paul B., and Buckner, E. R. **How Far Could a Squirrel Travel in the Treetops? A Pre-history of the Southern Forest.** Transactions of the 63rd North American Wildlife and Natural resources Conference; 1998. March 20-25, Orlando, FL. Washington D.C: Wildlife Management Institute: pp 309-315.

Heinselman, Miron L. 1978. **Fire Intensity and Frequency as Factors in the Distribution and Structure of Northern Ecosystems**, USDA Forest Service, 1981 Proceedings of the Conference, Fire Regimes and Ecosystem Properties, GTR WO-26. 51pp.

Hensel, R.L. 1923. **Recent Studies on the Effects of Burning on Grassland Vegetation**. Ecology 4: pp. 183-188.

Inkley, D.B., M.G. Anderson, A.R. Blaustein, V.R. Burkett, B. Felzer, B. Griffith, J. Price, and T.L. Root. 2004. **Global Climate Change and Wildlife in North America**. Wildlife Society Technical Review 04-2. The Wildlife Society, Bethesda, Maryland, USA. 26pp.

Jackson, Jerome A.; Lennartz, Michael R.; Hooper, Robert G. 1979. **Tree age and Cavity Initiation by Red-Cockaded Woodpeckers**. Journal of Forestry. 77(2): 102-103.

Johnsgard, Paul A. 1990**. Hawks, Eagles, and Falcons**. Washington D.C. Smithsonian Institution Press. 403 p.

Johnston, D.W., and E.P. Odum. 1956. **Breeding Bird Populations in Relation to Plant Succession on the Piedmont of Georgia.** Ecology. 37: 50-62.

Jones, A.T., and K.C. Ryan (editors). 1986. **Wildland Fire in Ecosystems: Effects of Fire on Cultural resources and Archeology.** General Technical Report No. RMRS-GTR-42-Vol.3. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, Colorado.

Keever, Catherine. 1953**. Composition of Oak-Chestnut Forest**. Ecology, Vol. 34, No. 1:44-54.

Komarek, E. V. 1974. **Introduction to Lightning Ecology**. In: Proceedings, Annual Tall Timbers Fire Ecology Conference; 1973 March 22-23; Tallahassee, FL. No. 13. Tallahassee, FL: Tall Timbers Research Station: 421-427.

Kozlowski, T.T. ;Ahlgren, C.E. 1974. **Fire and Ecosystems.** New York: Academic Press. 542 p.

Kopas, Frank A.1991. **Soil Survey of Washington County, Maine.** United States Department of Agriculture, Soil Conservation Service, Pennsylvania State University Agriculture Experiment Station and Agricultural Extension Service, Pennsylvania Department of Agriculture, State Soil and Water Conservation Commission.

Kricher, John C. and Morrison, Gordon. 1988. **Eastern Forests**. Houghton Mifflin Company, Boston, Massachusetts.

Landers, J. Larry. 1987. **Prescribed Burning for Managing Wildlife in Southeastern pine forests. I**n: Dickson, James G.; Maughan, O. Eugene, eds. Managing Southern Forests for Wildlife and Fish: A Proceedings; [Date of conference unknown]; [Location of conference unknown]. Gen. Tech. Rep. SO-65. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station: 19-27.

Lyon, L.J., H.S. Crawford, E. Czuhai, R.L. Fredriksen, R.F. Harlow, L.J. Metz, and H.A. Pearson. 1978. **Effects of Fire on Fauna.** National Fire Effects Workshop, Denver, CO. April 1978.

Means, D. Bruce; Campbell, Howard W. 1981. **Effects of Prescribed Burning on Amphibians and Reptiles.** In: Wood, Gene E., ed. Prescribed Fire and Wildlife in Southern Forests; Proceedings of a Symposium; 1981 April 6-8; Myrtle beach, SC. Georgetown, SC: The Belle W. Baruch Forest Science Institute of Clemson University: 89-96.

Murphy, Heather. 1991**. Fires and Imperiled Species**. Women in Natural Resources. 13(2): 11.

Niering W.A. and R.S. Warren. 1977. **Our Dynamic Tidal Marshes: Vegetation Changes as Revealed by Peat Analysis**. The Connecticut Arboretum. Bulletin 22.

Pease, Maurice, H., 1968. **Summary Report on the Geology and Mineral Resources of the Edmunds Unit, Moosehorn National Wildlife Refuge, Washington County, ME,** US Geological Survey Bull. 1260-P. 18pp.

Pilliod, D.S., R.B. Bury, E.J. Hyde, C.A. Pearl, and P.S. Corn. 2003. **Fire and Amphibians in North America.** Forest Ecology and Management. 178: 163-181.

Pyne, Stephan J. 1982**. Fire in America: A Cultural History of Wildland and Rural Fire.** Princeton University Press, Princeton, N.J. 654 pp.

Regelbrugge, J.C. and D.W. Smith. 1994. **Postfire Tree Mortality in Relation to Wildfire Severity in Mixed Oak Forests in the Blue Ridge of Virginia.** Northern Journal of Applied Forestry. Vol. 11, No. 3. pp. 90-97.

Rothermel, Richard C., 1983. **How to Predict the Spread and Intensity of Forest and Range Fires,** USDA For. Ser. GTR INT-143.

Russell, K.R., D.H. Van Lear, and D.C. Guynn. 1999. **Prescribed Fire Effects on Herpetofauna: Review and Management Implications.** Wildlife Society Bulletin. 27:374-384.

Scholl, E.R., and T.A. Waldrop. 1999. **Photos for Estimating Fuel Loadings Before and After Prescribed Burning in the Upper Coastal Plain of the Southeast.** Asheville, NC. USDA Forest Service, Southern Research Station, Report Number; General technical Report GTR-SRS-26.

Schurbon, J.M., and J.E. Fauth. 2003. **Effects of Prescribed Burning on Amphibian Diversity in a Southeastern U.S. National Forest.** Conservation Biology 17: 1338-1349.

Schneierd K.J. and D.M. Pence, 1992. **Migratory nongame birds of management concern in the Northeast.** U.S. Dep. Inter., Fish and Wildl. Serv., Newton Corner, Massachusetts. 400pp.

Schwartz, M., Heim, J. 1996. **Effects of a Prescribed Fire on Degraded Forest Vegetation.** Natural Areas Journal 16:3.

Sepik, Greg F., 1981**. A Landowner's Guide to Woodcock Management in the Northeast**. Maine Agricultural Experiment Station, Univ. of Maine, Misellaneous Report #253, 23pp.

Shay, Jennifer M.; Shay, C. Thomas. 1986. **Prairie Marshes in Western Canada, with Specific Reference to the Ecology of Five Emergent Macrophytes.** Canadian Journal of Botany. 64: 443-454.

Stanturf, J.A., D.D. Wade, T.A. Walrdop, D.K. Kennard, and G.L. Achtmeier. 2002. **Fire in Southern Forest Landscapes.** *In* Wear, D.N. and J.G. Greis, eds. 2002. Southern Forest Resource Assessment. Gen Tech Rep. SRS-53. USDA, Forest Service, Southern research Station. Asheville, N.C. 635p.

Sullivan, B.T, C.J. Fettig, W.J. Otrosina, M.J. Dalusky, and C.W. Berisford. 2003. **Association Between Severity of Prescribed Burns and Subsequent Activity of Conifer-Infested Beetles in Stands of Longleaf Pine.** Forest Ecology and Management. 185: 327-340.

Thompson, D. J.; Shay, J. M. 1985. **The Effects of Fire on Phragmites Australis in the Delta Marsh, Manitoba.** Canadian Journal of Botany. 63: 1864-1869.

U.S. Department of the Interior, Fish and Wildlife Service. **Endangered and Threatened Wildlife and Plants:** August 29, 1992. 50 CFR 17.11 and 17.12. Washington DC. 38 p.

Van Lear, D.H. 2000. **Recent Advances in the Silvicultural Use of Prescribed Fire.** Fire and Forest Ecology, Tall Timbers Fire Ecology Conference Proceedings,. No. 21. Tall Timbers research Station, Tallahassee, FL.

Wade, D.D.; Brock, B.L.; Brose, P.H.; Grace, J.B.; Hoch, G.A.; Patterson III, W.A. 2000. **Fire in Eastern Ecosystems.** In: Brown, J.K. Smith, J.K., eds., ed. **Wildland Fire in Ecosystems: Effects of Fire on Flora.** GTR RMRS-42, Ogden, UT; USDA Forest Service, Rocky Mountain Research Station: 2 : 53-96.

Waldrop, T.A., W.D. Glass, S. Rideout, V.B. Shelburne, H.H. Mohr, and R.J. Phillips. 2004. **An Evaluation of Fuel Reduction Treatments Across a Landscape Gradient In Piedmont Forests: Preliminary Results of the National Fire Surrogate Study.** In: K.F. Connor, ed. Proceedings of the 12th Biennial Southern Silviculture Research Conference. General technical Report, SRS-71. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern research Station.

Wright, Henry A., and Arthur Bailey. 1982**. Fire Ecology**. John Wiley and Sons, New York, New York.

Wein, R.W., Moore, J.M., 1977. **Fire History and Rotations in New Brunswick Acadian Forest**. Can. J. For. Res., 7:285-294.

Wigley, T.M.L. & Raper, S.C.B. in **Climate Change: Science, Impacts and Policy** (eds Jager, J & Ferguson, H.L.) 231-242)Cambridge University Press, 1991).

Woehler, E.E. 1979. **Establishment of Native Warm-Season Grasses in Wisconsin**. Research Rept. 102, NL54 #29, Wisconsin Dept. of Nat. Res., Madison, WI. 17pp.

SUPPORTING REFERENCES

Department of Interior Manual (620 DM 1)

US Fish and Wildlife Service Refuge Manual

Moosehorn National Wildlife Refuge Annual Narrative Reports 1952-1994

Moosehorn National Wildlife Refuge Fire Management Plan, 1998.

Moosehorn National Wildlife Refuge Forest Management Plan, 1985 and 1993.

Moosehorn National Wildlife Refuge Wilderness Management Plan, 1979.

Moosehorn National Wildlife Refuge Marsh and Water Management Plan (MWMP 1989).

Fire Management Handbook, 2006

Fire Effects Guide, National Wildfire Coordinating Group

Environmental Assessment, Proposal to Protect Wildlife Habitat Adjacent to Moosehorn National Wildlife Refuge, Washington County, Maine. March 1980. US Fish & Wildlife Service

National Park Service Western Region Fire Monitoring Handbook, 2003, Prepared by the Western Region Prescribed and Natural Fire Monitoring Task Force.

Hierl, L A, C.S. Loftin, J.R. Longcore, and D.G. McAuley. 2004. A multivariate assessment of wetland habitat conditions in Moosehorn National Wildlife Refuge. Final Project Report, Maine Cooperative Fish and Wildlife research Unit. Orono, Maine.

J.R. Longcore and D.G. McAuley. 1986. Evaluation of annual waterfowl productivity (especially black ducks) on managed refuge impoundments. Un-published Refuge Management Study Report.

US Fish and Wildlife Service. 2007. Draft Habitat Management Plan, Moosehorn National Wildlife Refuge.

Smith, Jane Kapler. 2008. Prescribed burning experiments in red and eastern white pine forests of eastern Ontario. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2008, February 26].

Carey, Jennifer H. 1993. Pinus resinosa. In: Fire Effects Information System, [Online].

U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2008, February 26].

Allen, Arthur W.; Jordan, Peter A.; Terrell, James W. 1987. Habitat suitability index models: moose, Lake Superior region. Biol. Rep. 82 (10.155). Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service. 47 p. [11710]

Rudolf, Paul O. 1990. Pinus resinosa Ait. red pine. In: Burns, Russell M.; Honkala, Barbara H., technical coordinators. Silvics of North America. Volume 1. Conifers. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture, Forest Service: 442-455. [13246]

Bergeron, Yves; Brisson, Jacques. 1990. Fire regime in red pine stands at the northern limit of the species range. Ecology. 71(4): 1352-1364. [11819]

Heinselman, Miron L. 1973. Fire in the virgin forests of the Boundary Waters Canoe Area, Minnesota. Quaternary Research. 3: 329-382. [282]

Van Wagner, C. E. 1971. Fire and red pine. In: Proceedings, annual Tall Timbers fire ecology conference; 1970 August 20-21; Fredericton, NB. No. 10. Tallahassee, FL: Tall Timbers Research Station: 211-219. [18940]

Crane, M. F. 1991. Arctostaphylos uva-ursi. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service,
Rocky Mountain Research Station, Fire Sciences Laboratory (Producer).
Available: http://www.fs.fed.us/database/feis/ [2008, February 26].

Martin, Alexander C.; Zim, Herbert S.; Nelson, Arnold L. 1951. American wildlife and plants. New York: McGraw-Hill Book Company, Inc. 500 p.[4021]

Maine Natural Areas Program (MNAP), website, www.mainenaturalareas.org

APPENDIX A

Glossary of Terms Used in Wildland Fire Management

The terminology used in wildland fire management is constantly evolving with new advances in technology and changes in operational policy. A continually updated and complete **Glossary of Wildland Fire Terminology** is available on the Internet at the following address:

http://www.nwcg.gov/pms/pubs/glossary/index.htm

NOTE: For convenience, a truncated version is included in this Environmental Assessment. It contains only those words, terms, and phrases that might prove helpful in clarifying the basic concepts discussed in this assessment.

Agency Administrator. The appropriate level manager having organizational responsibility for management of an administrative unit.

AMR (Appropriate Management Response). Specific actions taken in response to a wildland fire to implement protection and fire use objectives.

(BI) (Burning Index). A number combining the spread and energy release component related to the contribution of fire behavior to the effort of containing a fire.

Class of Fire (area of wildland fires)

Class A - ¼ acre or less.
Class B - more than ¼ but less than 10 acres.
Class C - 10 acres to 100 acres.
Class D - 100 to 300 acres.
Class E - 300 to 1,000 acres.
Class F - 1,000 to 5,000 acres.
Class G - 5,000 acres or more.

ERC (Energy Release Component). A number related to the available energy (BTU) per unit area (square foot) within the flaming front at the head of a fire. It is generated by the National Fire Danger Rating System, a computer model of fire weather and its effect on fuels. The ERC incorporates thousand hour dead fuel moistures and live fuel moistures; day to day variations are caused by changes in the moisture content of the various fuel classes. The ERC is derived from predictions of (1) the rate of heat release per unit area during flaming combustion and (2) the duration of flaming.

Extended attack. A fire that escapes initial attack, in which initial attack forces are reinforced by additional forces.

Fire effects. Any consequences to the vegetation or the environment resulting from fire, whether neutral, detrimental, or beneficial.

FLI (Fireline Intensity). The amount of heat produced by the fastest moving part of a fire. Usually compared by reference to the length of the flames.

Fire Management. All activities related to the prudent management of people and equipment to prevent or suppress wildland fire and to use fire under prescribed conditions to achieve land and resource management objectives.

FMP (Fire Management Plan). A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational procedures such as preparedness plans, preplanned dispatch plans, prescribed fire plans, and prevention plans.

Fuels. Materials that are burned in a fire; primarily grass, surface litter, duff, logs, stumps, brush, foliage, and live trees.

Fuel loading. Amount of burnable fuel on a site, usually expressed in pounds/acre or tons/acre.

Hazard fuels. Those vegetative fuels which, when ignited, threaten public safety, structures and facilities, cultural resources, natural resources, natural processes, and other values at risk.

IA (Initial Attack). An aggressive suppression action consistent with firefighter and public safety and values to be protected.

KBDI (Keetch - Byram Drought Index). An indicator of drought on the availability of fuel to burn in the heavier fuels and litter and duff layers.

Maintenance burn. A fire set by agency personnel to remove debris; i.e., leaves from drainage ditches or cuttings from tree pruning. Such a fire does not have a resource management objective.

NFDRS (National Fire Danger Rating System) A uniform fire danger rating system that focuses on the environmental factors that control the moisture content of fuels.

NFDRS Fuel Model. One of 20 mathematical models used by the National Fire Danger Rating System to predict fire danger. The models were developed by the US Forest Service and are general in nature rather than site specific.

NFFL (National Forest Fire Laboratory).

NFFL Fuel Model. One of 13 mathematical models used to predict fire behavior within the conditions of their validity. The models were developed by US Forest Service personnel at the Northern Forest Fire Laboratory, Missoula, Montana.

Prescription. Measurable criteria that define conditions under which a prescribed fire may be ignited, guide selection of appropriate management responses, and indicate other required actions.

Prescribed fire. Any fire ignited by management actions to meet specific objectives. A written, approved prescribed fire plan must exist, and NEPA requirements (where applicable) must be met, prior to ignition.

Preparedness. Activities that lead to a safe, efficient, and cost-effective fire management program in support of land and resource management objectives through appropriate planning and coordination.

Prevention. Activities directed at reducing the incidence of fires, including public education, law enforcement, personal contact, and reduction of fuel hazards (fuels management).

RAWS Station. A telemetered weather station that transmits hourly observations of gathered weather data 24 times per day. Observations are automatically delivered to an archived database and are used in making fire danger predictions through NFDRS.

Rehabilitation. Efforts undertaken within three years of a wildland fire to repair or improve fire damaged lands unlikely to recover to management approved conditions or to repair or replace minor facilities damaged by fire.

Suppression. All the work of extinguishing or confining a fire beginning with its discovery.

Wildfire. An unwanted wildland fire.

Wildland fire. Any non structure fire, other than prescribed fire, that occurs on the wildland.

WFSA (Wildland Fire Situation Analysis). A decision-making process that evaluates alternative wildfire suppression strategies against selected environmental, social, political, and economic criteria and provides a record of those decisions.

WUI (Wildland-Urban Interface). The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.

Appendix B

Prescribed Fire/ Non-Fire Treatment Units

Moosehorn National Wildlife Refuge

2007-2010 Moosehorn NWR Prescribed/ Non-Fire Treatments

TREAT-MENT TYPE	BURN UNITS IN PRIORITY ORDER	ACRES	OBJECTIVES	RX	NON FIRE/ FUEL	FUEL MODEL	OTHER
Grass	Middle Barn Meadow	20	Enhance wildlife habitat by: maintaining fields in early successional habitat; stimulating native grasses and herbaceous species; re-cycling nutrients in the soil.	**X**		1	
Grass	Charlotte Rd. RR HQ Rd. South	10	Enhance wildlife habitat by: maintaining fields in early successional habitat; stimulating native grasses and herbaceous species; re-cycling nutrients in the soil.	**X**		1	
Grass	Snare Meadow Field	.5	Enhance wildlife habitat by: maintaining fields in early successional habitat; stimulating native grasses and herbaceous species; re-cycling nutrients in the soil.	**X**		1	
Grass	Well House Field	.3	Enhance wildlife habitat by: maintaining fields in early successional habitat; stimulating native grasses and herbaceous species; re-cycling nutrients in the soil.	**X**		1	
Grass	HQ Field	3	Enhance wildlife habitat by: maintaining fields in early successional habitat; stimulating native grasses and herbaceous species; re-cycling nutrients in the soil.	**X**		1	
Grass	YCC Field	4	Enhance wildlife habitat by: maintaining fields in early successional habitat; stimulating native grasses and herbaceous species; re-cycling nutrients in the soil.	**X**		1	
Grass	Barn Meadow Extension	.5	Enhance wildlife habitat by: maintaining fields in early successional habitat; stimulating native grasses and herbaceous species; re-cycling nutrients in the soil.	**X**		1	
Grass	Bills Hill	5	Enhance wildlife habitat by: maintaining fields in early successional habitat; stimulating native grasses and herbaceous species; re-cycling nutrients in the	**X**		1	

			soil.				
Cattail	Nat Smith Marsh	15	Increase the species diversity of native plants in the marsh and increase the amount of open water for wildlife benefit.	**X**		3	
Blue Berry	Field 10	5	Maintain vegetative cover at density and height for optimal woodcock use; prevent woody species encroachment	**X**		1/5	
Blue Berry	Field 1	5	Maintain vegetative cover at density and height for optimal woodcock use; prevent woody species encroachment	**X**		1/5	
Blue Berry	Fields 39/40	5	Maintain vegetative cover at density and height for optimal woodcock use; prevent woody species encroachment	**X**		1/5	
Red Pine	HQ. Rd (RP1)	1.6	Reduce accumulation of needle cast and dead woody fuels present on the unit. Provide site preparation for desired vegetation such as low bush blueberry. Reduce the possibility of insect infestation by removing the insulating ground cover of pine needles..	**X**		9	
Red Pine	Headquarters Rd. Stand (RP2)	2.0	Reduce accumulation of needle cast and dead woody fuels present on the unit. Provide site preparation for desired vegetation such as low bush blueberry. Reduce the possibility of insect infestation by Removing the insulating ground layer of pine needles.	**X**		9	
Red Pine	Raven Trail Stand ((RP3)	7.4	Reduce accumulation of needle cast and dead woody fuels present on the unit. Provide site preparation for desired vegetation such as low bush blueberry. Reduce the possibility of insect infestation by removing the insulating ground cover of pine needles.	**X**		9	
Red Pine	US Route 1 South Stand (RP4)	1.5	Reduce accumulation of needle cast and dead woody fuels present on the unit. Provide site preparation for desired vegetation such as low bush blueberry. Reduce the possibility of insect infestation by removing the insulating ground cover of pine needles.	**X**		9	
	US Route 1	1.5	Reduce accumulation of needle	**X**		9	

Red Pine	North Stand (RP5)		cast and dead woody fuels present on the unit. Provide site preparation for desired vegetation such as low bush blueberry. Reduce the possibility of insect infestation by removing the insulating ground cover of pine needles.				
Slash	Charlotte Rd. Red Pine Slash Unit	5.4	Reduce hazardous fuel conditions to an acceptable level for resource protection from wildland fire. Stimulate hardwood regeneration through slash reduction, and site preparation. Regenerating forested habitat will benefit a wide variety of wildlife species, including white-tailed deer, moose, American woodcock, and numerous nesting neo-tropical migratory songbirds. Perpetuate the migratory bird resource, along with other wildlife species that require or utilize early successional aspen, birch and alder habitat including American woodcock. Maintain habitat diversity, both horizontally and vertically by maximizing the number of vegetative age class representation on the refuge.	**X**	**X**	10/13	
Slash	Weir Rd.	10	Reduce hazardous fuel conditions to an acceptable level for resource protection from wildland fire. Stimulate hardwood regeneration through slash reduction, and site preparation. Regenerating forested habitat will benefit a wide variety of wildlife species, including white-tailed deer, moose, American woodcock, and numerous nesting neo-tropical migratory songbirds. Perpetuate the migratory bird resource, along with other wildlife species that require or utilize early successional aspen, birch and alder habitat including American woodcock. Maintain habitat diversity, both horizontally and vertically by maximizing the number of vegetative age class representation on the refuge.	**X**	**X**	10	
	Snare	3.4	Reduce hazardous fuel conditions	**X**	**X**	10	

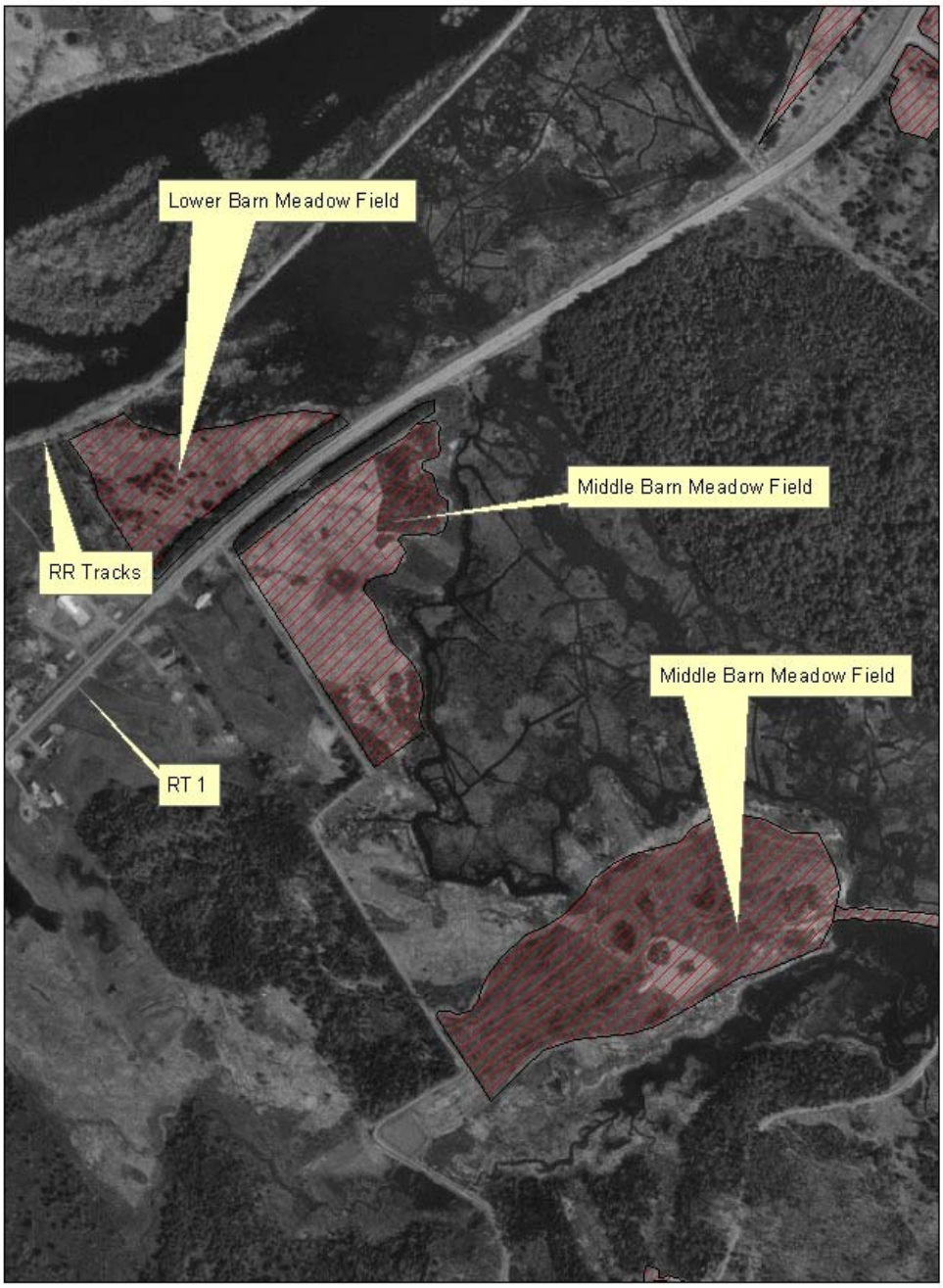
Slash	Meadow Woodcock Roosting Field		to an acceptable level for resource protection from wildland fire. Stimulate hardwood regeneration through slash reduction, and site preparation. Regenerating forested habitat will benefit a wide variety of wildlife species, including white-tailed deer, moose, American woodcock, and numerous nesting neo-tropical migratory songbirds. Perpetuate the migratory bird resource, along with other wildlife species that require or utilize early successional aspen, birch and alder habitat including American woodcock. Maintain habitat diversity, both horizontally and vertically by maximizing the number of vegetative age class representation on the refuge.				
Hazard Fuel Reduction	Various	38.5	Reduce hazardous fuels (mowing) along select roads and maintain refuge roads as viable fire breaks. Utilize a 30-ft buffer on either side of the road.		**X**	1/5	
Vegetation Mgt (fields)	Various	96	Enhance wildlife habitat by: maintaining fields in early successional habitat. Grass and brushy fields are managed through haying (lease) and/or mowing during the summer or fall months.		**X**	1/3/5	
	Total Acres.	238.3					

NOTE: This schedule is a representation of work to be accomplished when *optimal* conditions are present. A variety of factors may develop (budgetary, environmental, personnel availability, etc) that could preclude any or all of these projects being accomplished in the timeframe outlined in this schedule. Projects as outlined *do* represent an accurate description of the location and types of fire management activities scheduled for accomplishment. These projects will be implemented utilizing a variety of fire management techniques, either individually or in combination, including prescribed fire, non-fire hazard fuel reduction and vegetation management, to implement changes in vegetation structure for wildlife and ecosystem benefit. Many of these projects are applied on a rotational basis.

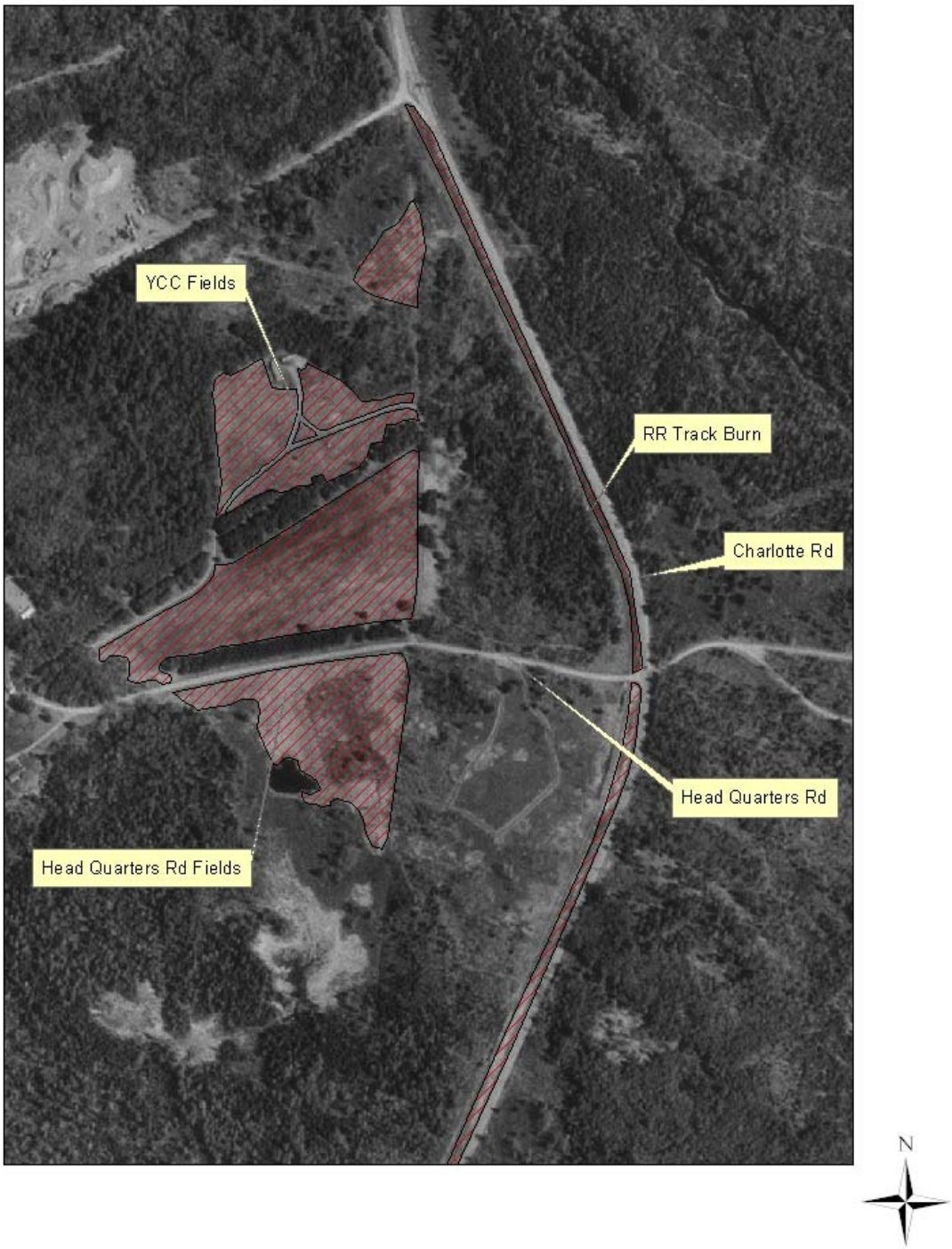
APPENDIX C

FIRE AND NON-FIRE PROJECT MAPS

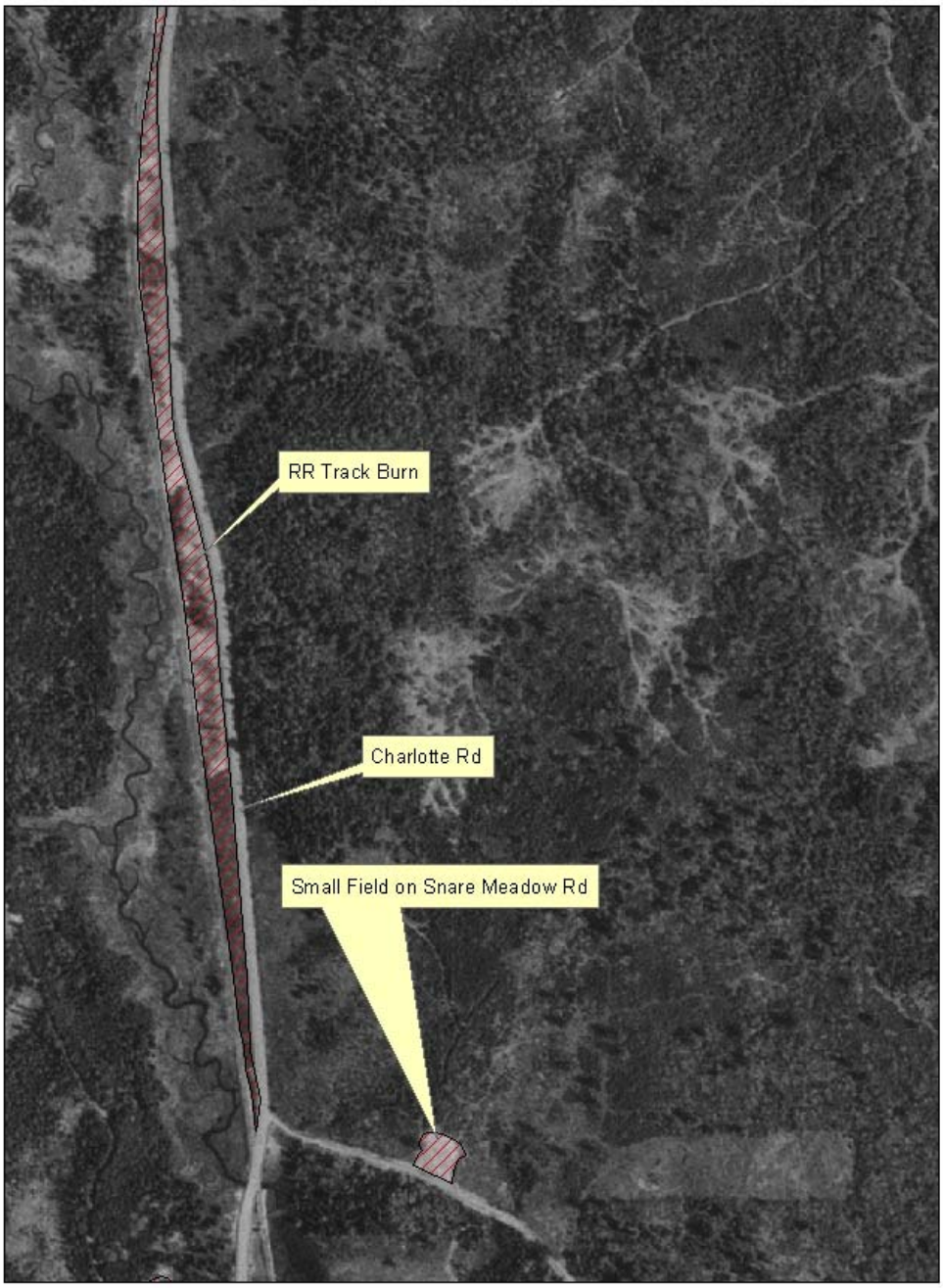
Northern Grass Units Barn Meadow Fields



Head Qaurtes Road and YCC Fields

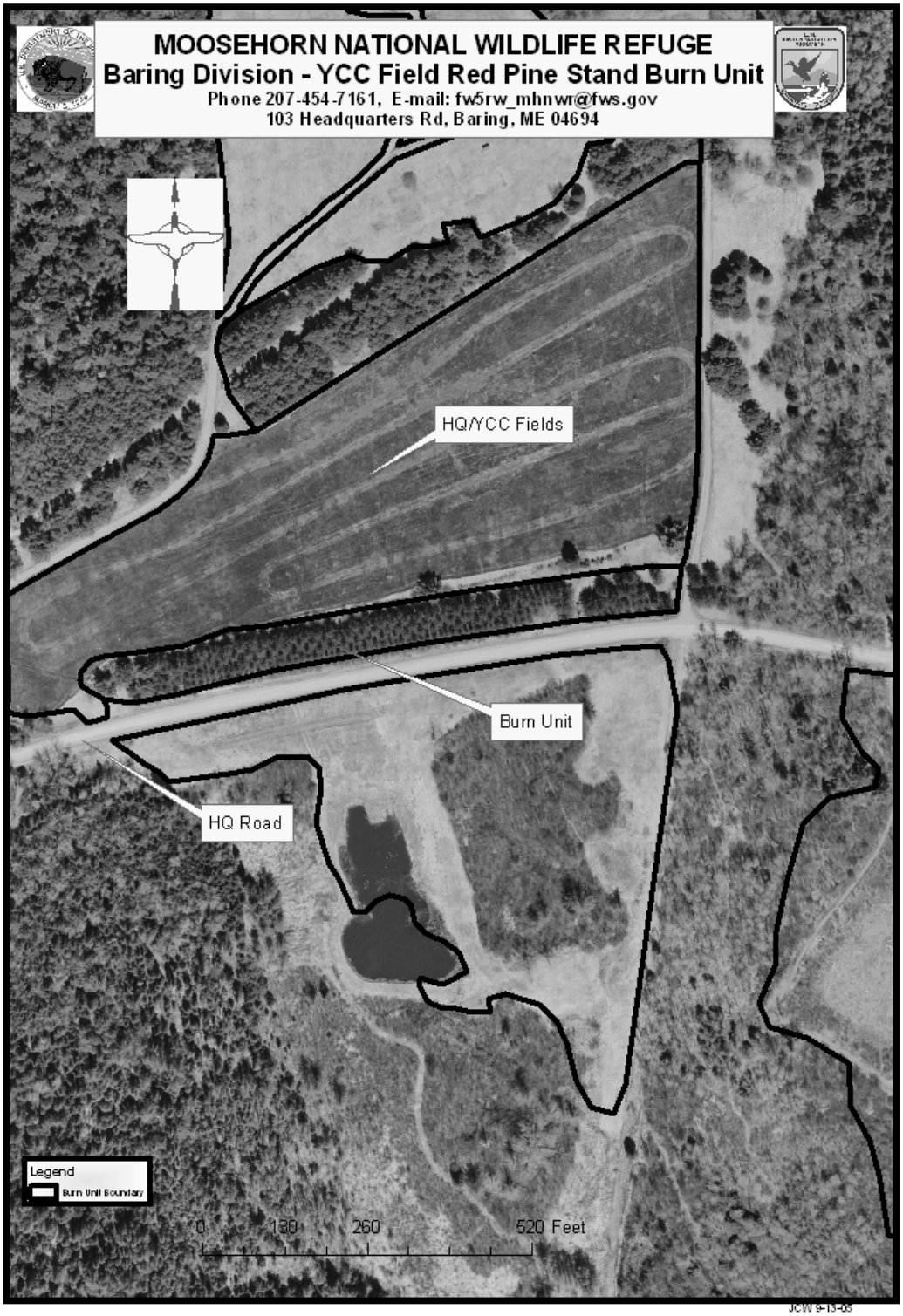


Head Qaurtes Road and YCC Fields

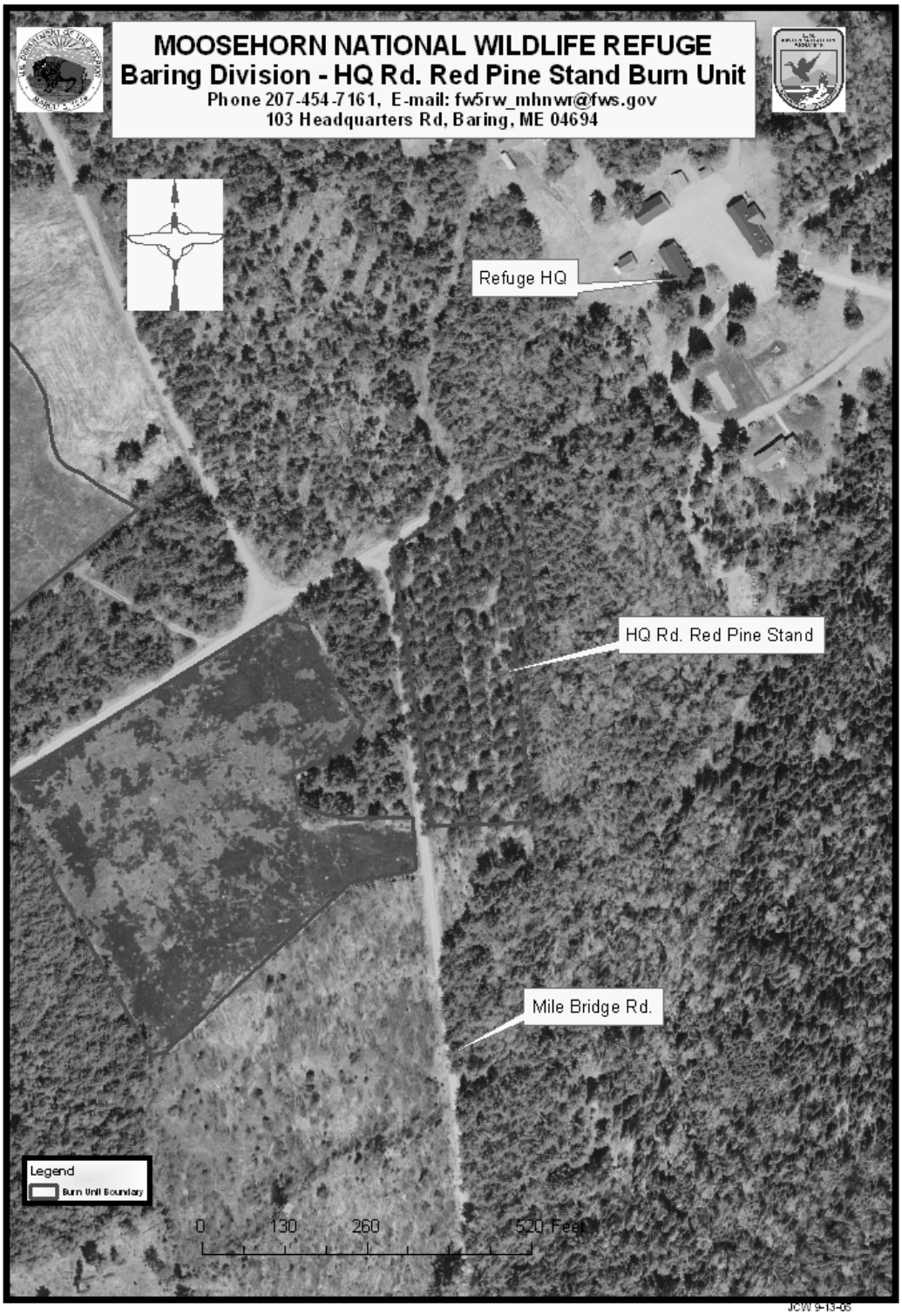


Northern Blueberry and Hydro Axe Units

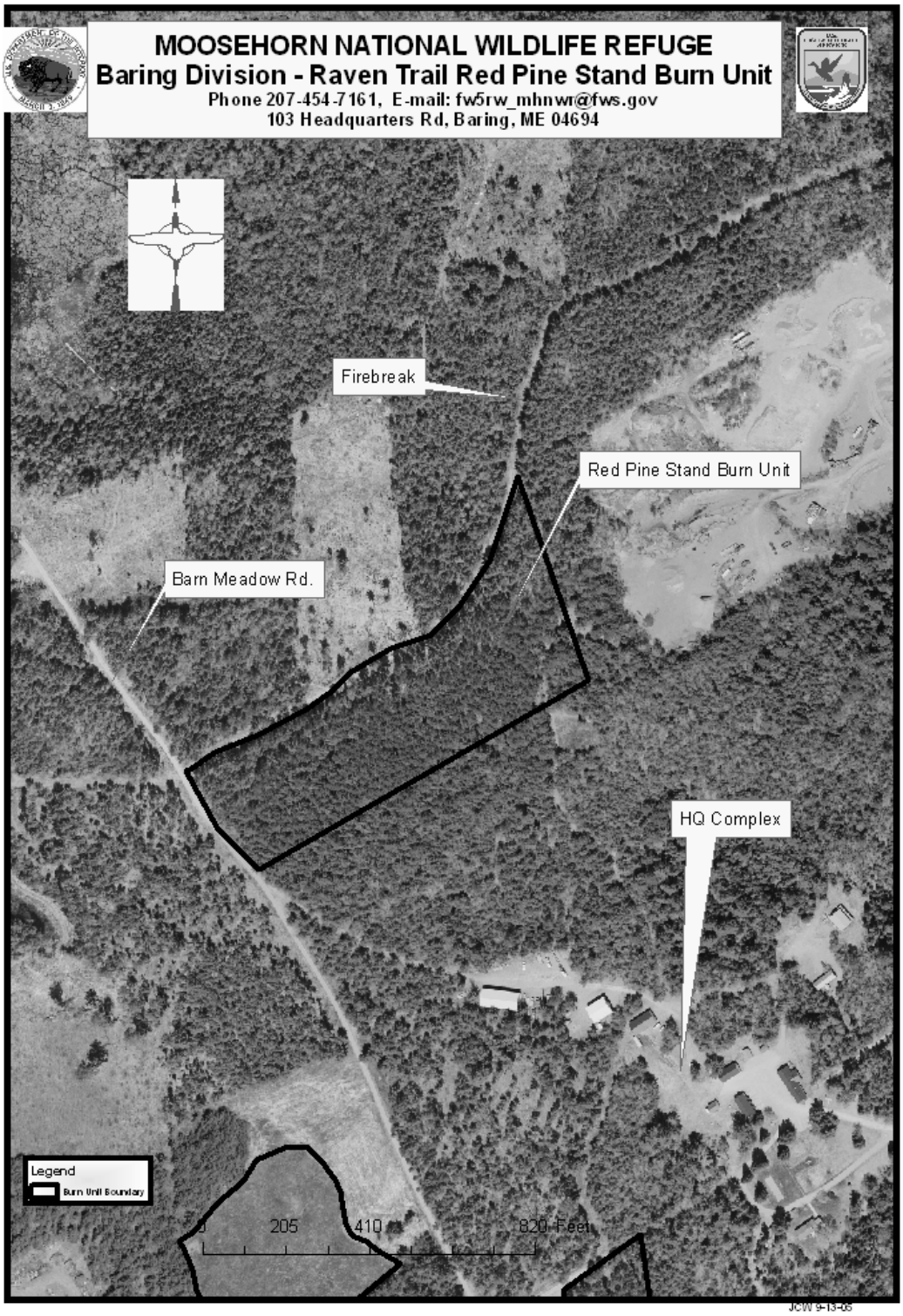
RED PINE UNIT RP1



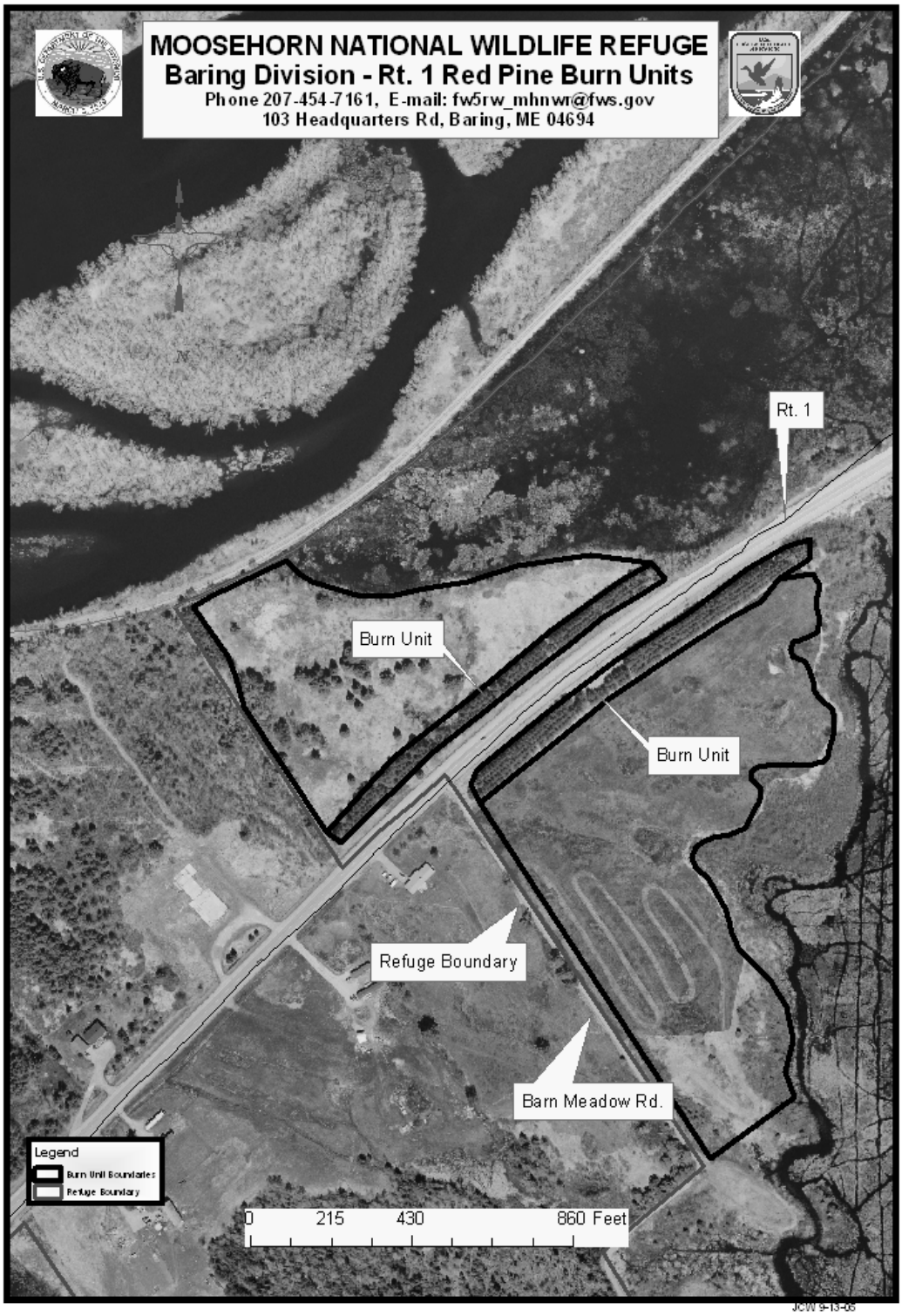
RED PINE UNIT RP2



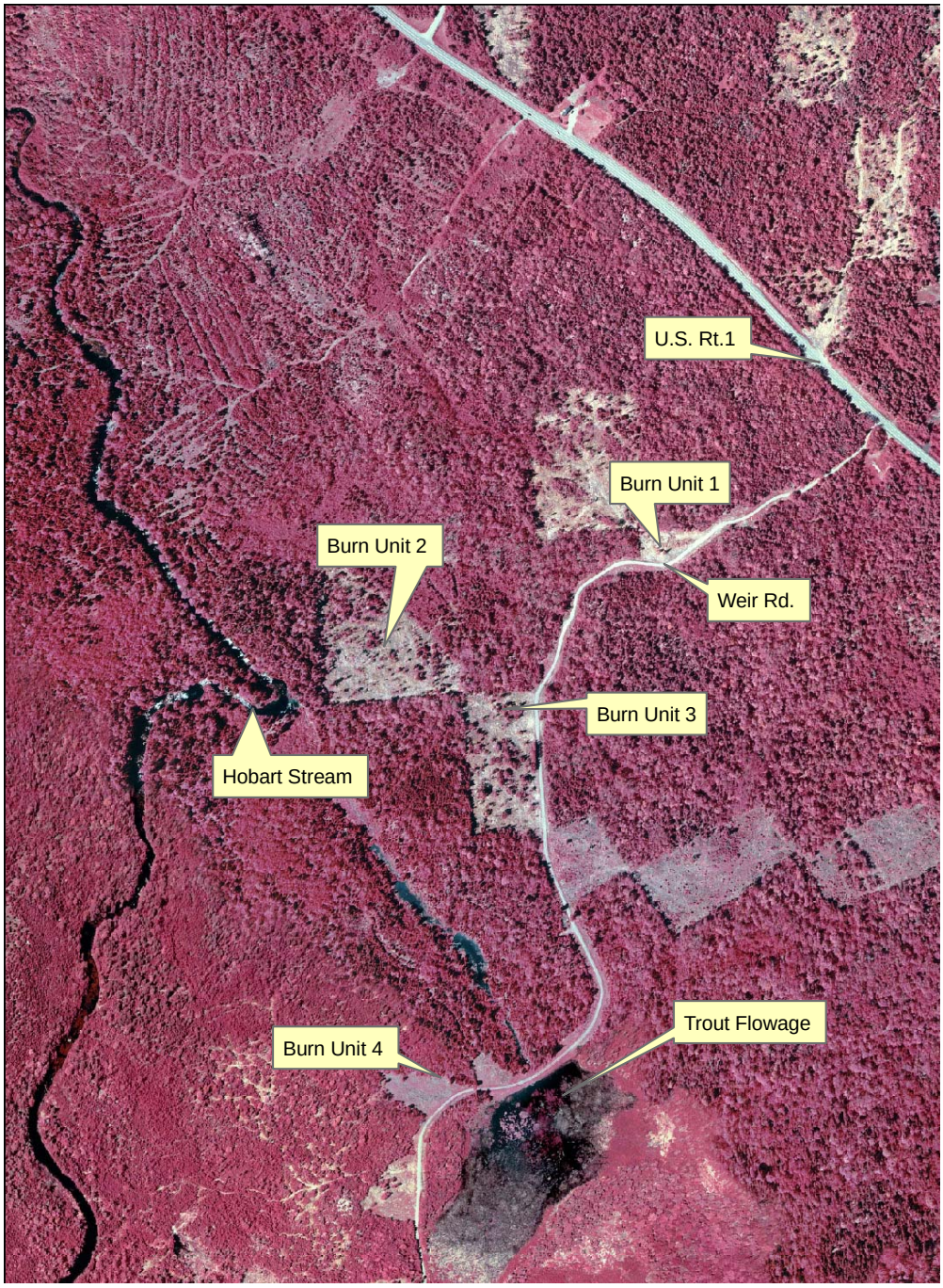
RED PINE UNIT RP3

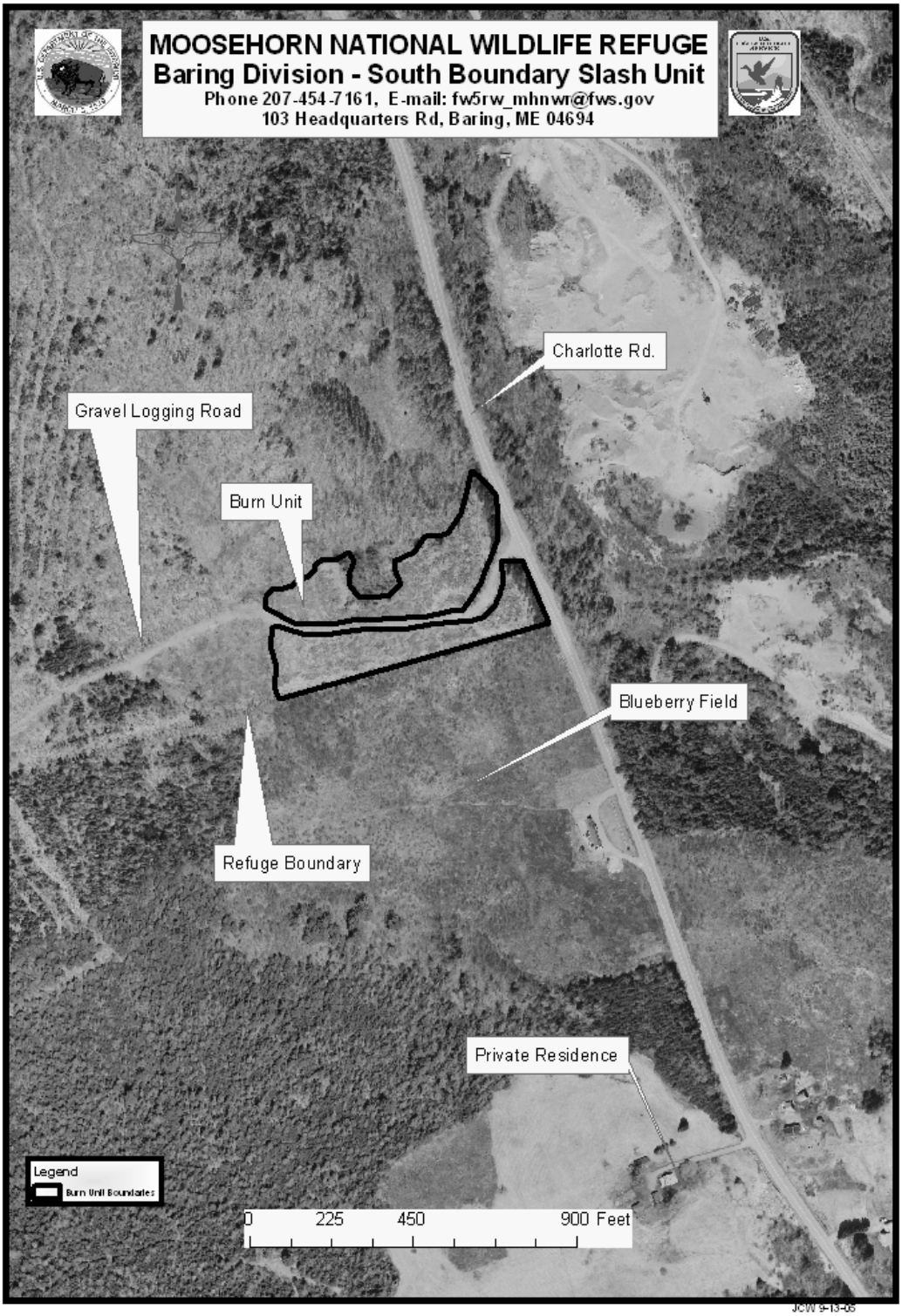


RED PINE UNIT RP4 (SOUTH) AND RP5 (NORTH)



Weir Rd Slash Units




MOOSEHORN NATIONAL WILDLIFE REFUGE
Baring Division - South Boundary Slash Unit
Phone 207-454-7161, E-mail: fw5rw_mhnwr@fws.gov
103 Headquarters Rd, Baring, ME 04694
Charlotte Rd.
Gravel Logging Road
Burn Unit
Blueberry Field
Refuge Boundary
Private Residence
Legend
Burn Unit Boundaries
0
225
450
900 Feet
JCW 9-13-06

Appendix D

MINIMUM IMPACT SUPPRESSION TACTICS (MIST)

The change in emphasis from fire control to fire management has added a new perspective to the role of fire manager and firefighter. The old objective of putting the fire "dead-out", by a specified period of time has been replaced by the need to make unique decisions for each fire start, to consider the land and resource objectives, and to decide the appropriate management response and tactics which result in minimum costs and resource damage. Fire management activities within the refuge will be carried out in a manner that minimizes impacts to refuge natural and cultural resources. Incident facilities, when practical, will be located outside of natural and historic zones. Suppression forces will choose methods and equipment commensurate with suppression needs and a strategy that will least alter the landscape or disturb refuge resources. Of primary importance is the need to impress upon suppression forces the minimum impact suppression guidelines found in RM-18, Chapter 9. These guidelines reflect the commitment of the refuge to the preservation ethic in firefighting practices; they are not an excuse to relax normal safe firefighting practices. Techniques and policies of minimum impact firefighting that will be used in the refuge include (but are not limited to):

a. Minimize use of retardant. The refuge's aquatic ecosystem requires protection for various reasons. The streams support a diverse fish population with state-listed species, plus some of the most diverse aquatic insect populations in the area. **As a result, it will be standard practice to keep chemical retardant use at <u>least</u> 300 yards from any water source.**

b. Cold-trailing the fire edge when practical.

c. Use of natural firebreaks or wetlines wherever possible (in lieu of handline construction). Waterbars will be constructed on all handlines on steep slopes (15%>).

d. Use of soaker hose or foggers in mop-up to avoid "boring" and hydraulic action on soils.

e. Firelines kept to the minimum width needed to allow backfiring, burnout, or the creation of a safe blackline. Natural barriers should be used wherever possible.

f. Minimal tree-falling. Snags within or adjacent to firelines will be removed only if they show evidence of fire, present hazard to firefighters, or constitute a legitimate threat to the fireline integrity. Living trees will be undisturbed whenever possible. Lower branches will be limbed whenever possible to remove ladder fuels rather than removing the tree.

g. Maximize archeological protection measures in order to protect cultural resources.

h. Debris scattered or removed as prescribed by the Resource Advisor.

i. All firelines, camps, or other disturbance in visually sensitive areas will be rehabilitated to maintain a natural appearance.

j. After the fire emergency is over, transport of personnel, equipment, and trash out of the refuge that is consistent with resource management objectives.

k. Engines used only on established roads within refuge boundaries, unless approval from the Refuge Manager has been obtained to leave park roads.

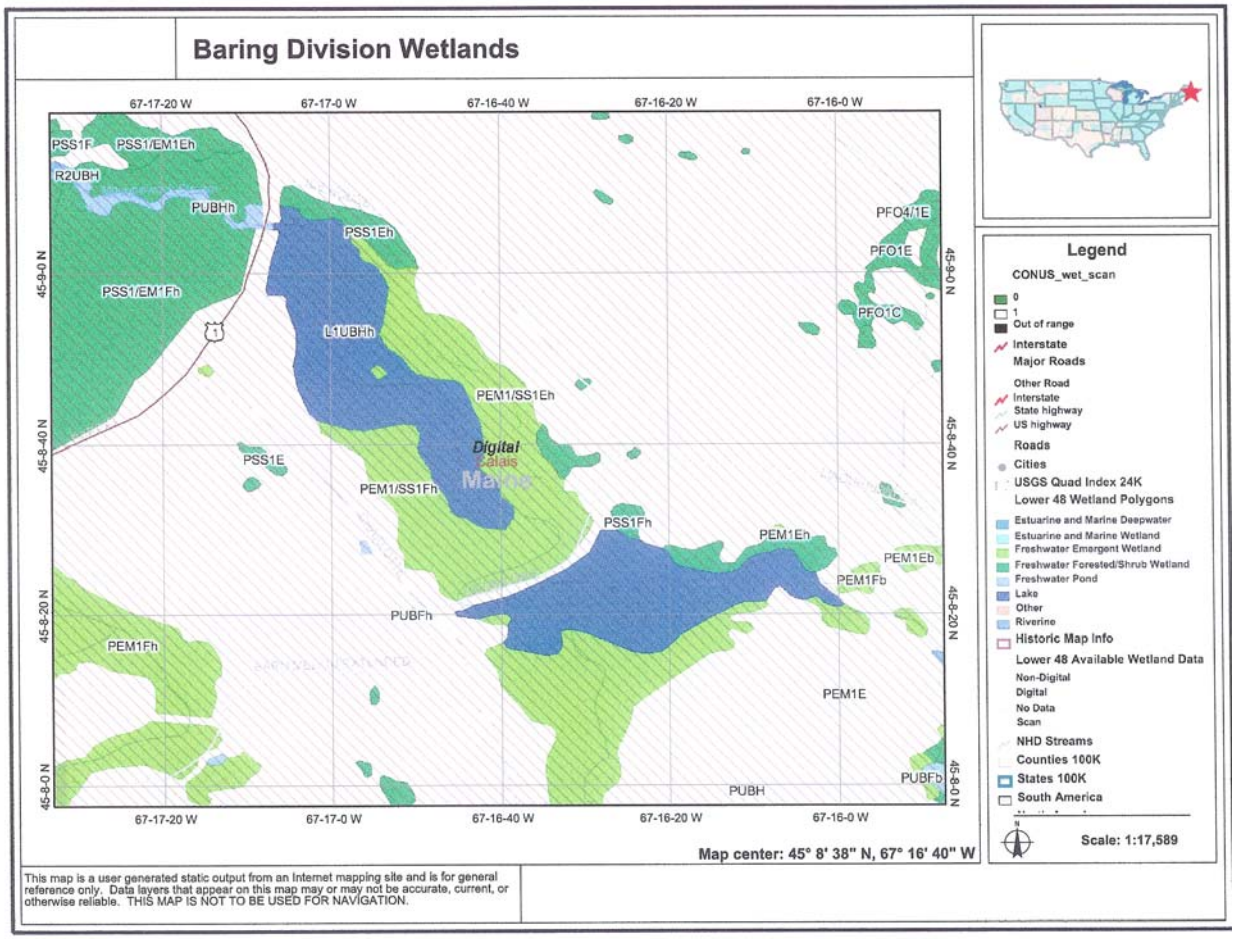
l. Bulldozers allowed only with written authorization from the Refuge Manager, who may authorize their use when high value resources are at risk. In these cases, Archeologists, Para-archeologists and/or Resource Advisors will be assigned to dozers (if possible) to minimize damage to resources.

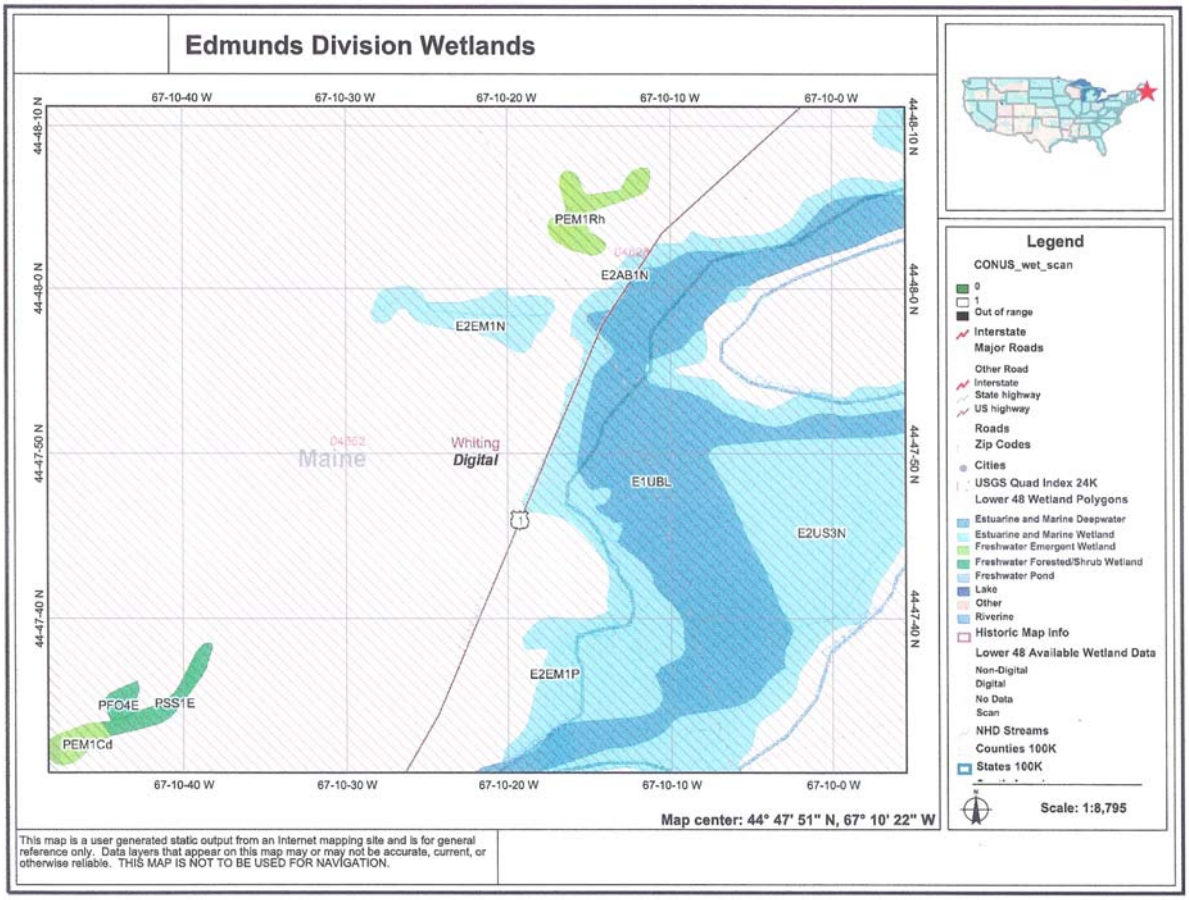
m. Utilize a "consumption strategy" when dealing with mop-up operations. This minimizes the exposure of firefighters to the physical hazards present along fire lines, i.e.; falling snags, rolling material, stump holes, etc., and allows for opportunities for the fire to consume fuels inside of the line without placing firefighters at unnecessary risk. Firefighters can monitor particularly hazardous areas along the line by initiating patrol actions from outside the line. Maximize the opportunity for the fire to consume fuels inside of the line without extensive mop-up activity by crews. The use of this strategy does NOT imply that the fire is left to its own devices, but rather that a coordinated approach of mop-up activity is utilized that allows for minimum exposure to firefighters during this phase of the fire suppression effort.

Appendix E

Moosehorn National Wildlife Refuge

Wetland Maps


Baring Division Wetlands
67-17-20 W
67-17-0 W
67-16-40 W
67-16-20 W
67-16-0 W
45-9-0 N
45-8-40 N
45-8-20 N
45-8-0 N
PSS1F
PSS1/EM1Eh
R2UBH
PUBHh
PSS1Eh
PSS1/EM1Fh
L1UBHh
PEM1/SS1Eh
PSS1E
PEM1/SS1Fh
PSS1Fh
PEM1Eh
PEM1Eb
PEM1Fb
PUBFh
PEM1Fh
PEM1E
PUBH
PUBFb
PFO4/1E
PFO1E
PFO1C
Digital
Calais
Map center: 45° 8' 38" N, 67° 16' 40" W
Legend
CONUS_wet_scan
0
1
Out of range
Interstate
Major Roads
Other Road
Interstate
State highway
US highway
Roads
Cities
USGS Quad Index 24K
Lower 48 Wetland Polygons
Estuarine and Marine Deepwater
Estuarine and Marine Wetland
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Other
Riverine
Historic Map Info
Lower 48 Available Wetland Data
Non-Digital
Digital
No Data
Scan
NHD Streams
Counties 100K
States 100K
South America
Scale: 1:17,589
This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.


Edmunds Division Wetlands
67-10-40 W
67-10-30 W
67-10-20 W
67-10-10 W
67-10-0 W
44-48-10 N
44-48-0 N
44-47-50 N
44-47-40 N
PEM1Rh
E2AB1N
E2EM1N
Maine
Whiting
Digital
E1UBL
E2US3N
E2EM1P
PFO4E
PSS1E
PEM1Cd
Map center: 44° 47' 51" N, 67° 10' 22" W
Legend
CONUS_wet_scan
0
1
Out of range
Interstate
Major Roads
Other Road
Interstate
State highway
US highway
Roads
Zip Codes
Cities
USGS Quad Index 24K
Lower 48 Wetland Polygons
Estuarine and Marine Deepwater
Estuarine and Marine Wetland
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Other
Riverine
Historic Map Info
Lower 48 Available Wetland Data
Non-Digital
Digital
No Data
Scan
NHD Streams
Counties 100K
States 100K
Scale: 1:8,795
This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.

APPENDIX F

Moosehorn National Wildlife Refuge
Species List (Abridged)

Plants

Agrimony (*Agrimonia gryposepala*)
Alfalfa (*Medicago sativa)*
Arrowhead (*Sagittaria latifolia)*
Aster (*Sp.)*
Beaked hazelnut (*Corylus cornuta)*
Birdsfoot trefoil (*Lotus corniculatus)*
Blackberry (*Rubus allegheniensis)*
Black-eyed Susan (*Rusbeckia serotina)*
Bladderwort, common (*Utricularia macrorhiza)*
Blue bead lily (*Clintonia borealis*)
Blueberry, lowbush (*Vaccinium angustifolium)*
Blue toad flax (*Linaria canadensis)*
Boneset (*Eupatorium perfoliatum*)
Bunchberry (*Cornus canadensis*)
Bur reed (*Sparganium sp*.)
Buttercup, tall (*Ranunculus acris*)
Canada mayflower (*Maianthemum canadense*)
Cardinal flower (*Lobelia cardinalis*)
Cat-tail broad leaved (*Typha latifolia*)
Cinquefoil, common (*Potentilla simplex*)
Rough-fruited (*Potentilla recta*)
Clover, hop (*Trifolium agrarium*)
rabbit foot (*T. arvense*)
red (*T. pretense*)
white (*T. repens*)
white, sweet (*Melilotus officinalis*)
Cranberry, large (*Vaccinium macrocarpon*)
Cherry, black (*Prunus serotina*)
choke (*P. virginiana*)
pin (*P. pensylvanica*)
Daisy fleabane (*Erigeron annuus*)
Dandelion, common (*Taraxacum officinale*)
Dewberry (*Rubus occidentalis*)
Digbane, spreading (*Apocynum androsaemifolium*)
Elder, common (*Sambucus canadensis*)
Fireweed (*Chamaenerion angustifolium*)
Gall of the Earth (*Prenanthes trifoliolata*)
Geranium, wild (*Geranium maculatum*)
Goldenrod, Canada (*Solidago canadensis*)
Rough-stemmed (*S. rugosa*)
Lance-leaved (*Euthamia graminifolia*)
Hawkweed, field (*Hieracium pratense*)
Hawkweed, orange (*Hieracium aurantiacum*)
Honeysuckle, trumpet *(Lonicera sempervirens*)
Iris, larger blue-flag (*Iris versicolor*)
Jewelweed (*Impatiens sp*.)
Labrador tea (*Rhododendron groenlandicum*)
Leatherleaf (*Chamaedaphne calyculata*)

Mallow (*Malva sp*.)
Meadow rue, tall *(Thalictrum polygamum*)
Meadowsweet (*Spiraea latifolia*)
Motherwort (*Leonurus cardiaca*)
Mullein, common (*Verbascum thapsus*)
Ox-eye daisy (*Chrysanthemum leucanthemum*)
Pearly everlasting (*Anaphlis margaritacea*)
Pickerelweed (*Pontederia cordata*)
Pineapple weed (*Matricaria matricarioides*)
Pinesap (*Monotropa hypopithys*)
Pitcher plant (*Sarracenia purpurea*)
Plantain, common (*Plantago major*)
Primrose, common evening (*Oenothera biennis*)
small sundrops (*O. perennis*)
Purple bush clover (*Lespedeza sp*.)
Pyrola, round-leaved (*Pyrola rotundifolia*)
Raspberry (*Rubus idaeus*)
Rose, pasture (*Rosa Carolina*)
Rose pogonia (*Pogonia ophioglossoides*)
Rosemary, bog (*Andromedia polifolia var. glaucophylla*)
Sarsaparilla, wild (*Aralia nudicaulis*)
Sedum, live-forever (*Sedum purpureum*)
Self-heal (*Prunella vulgaris*)
Serviceberry (*Amelanchier laevis*)
Sheep laurel (*Kalmia angustifolia*)
Sheep sorrel (*Rumex acetosella*)
Sow thistle, field (*Sonchus arvensis*)
Spatterdock (*Nuphar variegatum*)
Speedwell, common (*Veronica officinalis*)
Starflower (*Trientalis borealis*)
Steeplebush (*Spirea tomentosa*)
St. Johnswort, common (*Hypericum perforatum*)
dwarf *(H. mutilum*)
pale (*H. ellipticum*)
Stitchwort, common (*Stellaria graminea*)
Strawberry, wild (*Fragaria virginiana*)
Sundew, round-leaved (*Drosera rotundiflia*)
spatulate-leaved (*D. intermedia*)
Sweetfern (*Comptonia peregrina*)
Sweetgale (*Myrica gale*)
Swamp candle (*Lysimachia terrestris*)
Teaberry, (*Gaultheria procumbrens*)
Trailing arbutus (*Epigaea repens*)
Twinflower (*Linnaea borealis*)
Valerian, common (*Valeriana officinalis*)
Vetch, cow (*Vicia cracca*)
crown (*Coronilla Varia*)
Water-shield (*Brasenia schreberi*)
Wood sorrel, yellow (*Oxalis europaea*)
Yarrow (*Achillea millefolia*)
Yellow goatsbeard (*Tragopogon pratensis*)
Yellow rattlebox (*Crotalaria sagittalis*)

Ferns

Bracken (*Pteridium aquilinum*)

Interupted (*Osmunda claytoniana*)
Rock polypody (*Polypodium virginiana*)
Royal (*Osmunda regalis*)
Sensitive (*Onoclea sensibilis*)
Woodfern (*Dryopteris spp*.)

Trees

Alder, smooth (Alnus serrulata)
Apple (Malus sp.)
Ash, brown (black) (Fraxinus nigra)
White (F. americana)
Aspen, big-tooth (Populus grandidentata)
Quaking, (P. tremuloides)
Birch, gray (Betula populifolia)
paper (B. papyrifera)
Cedar, northern white (Thuja occidentalis)
Dogwood, alternate leaved (Cornus alternifolia)
Fir, balsam (Abies balsamea)
Hawthorn (Crataegus spp.)
Maple, red (Acer rubrum)
Striped, (A. pensylvanicum)
Mountain ash, American (Sorbus americana)
Oak, northern red (Quercus rubra)
Pine, red (Pinus resinosa)
white (Pinus strobus)
Spruce, red (Picea rubens)
Sumac, staghorn (Rhus hirta)

Grasses, Sedges, Rushes

Many species, unidentified.

Bryophytes

Liverworts:

Bazzania trilobata
Conocephalum conicum
Ptilidium pulcherrimim

Mosses

Atrichum spp.
Dicranum spp.
Hylocomium splendens
Hypnum imponens
Mnium hornum
Pleaurozium schreberi
Polytrichum spp.
Ptilium crista-castrensis
Sphagnum spp. including:
affine
centrale
girgensohnii
squarrosum

Tetraphis pellucida
Ulota crispa

Lichens

British soldiers (*Cladonia cristatella*)
Lung (*Lobaria pulmonaria*)
Old Man's beard (*Usnea spp*.)
Pixie cups (*Cladonia borealis*)
Reindeer, (*Cladonia rangiferina*)
(*C. stellaris*)
Smoky-eye boulder (*Porpidia albocaerulescens*)
Crumpled rag (*Platismatia tuckermanii)*

Birds (including evidence of "sign")

American black duck
American crow
American goldfinch
American robin
American woodcock
Bald eagle
Black-capped chickadee
Broad-winged hawk
Canada goose
Cedar waxwing
Common grackle
Common raven
Dark-eyed junco
Great blue heron
Hermit thrush
Northern harrier
Ovenbird
Pileated woodpecker
Red-breasted nuthatch
Red-winged blackbird
Sparrows:
- chipping
- Nelson's sharp-tailed
- song
- white-throated

Turkey vulture
Warblers
- Canada
- black-throated green warbler
- chestnut-sided
- common yellowthroat
- northern parula
- pine

Mammals (including evidence of "sign")

Black bear
Beaver
Coyote
Deer

Mink
Moose
Otter
Raccoon
Red fox
Red squirrel
Snowshoe hare

Reptiles

Garter snake

Amphibians

Spring peeper

Insects

Backswimmer
Bee (spp.)
Butterfly
    Banded purple (white admiral)
    Fritillary, Aphrodite
        smaller spp.
    Giant swallowtail
    Monarch
    Red admiral
    Silvery blue
    Sulfur
    Tiger swallowtail
Carpenter ants
Damselfly spp.
    needlepoint damselfly
Deer fly
Dragonfly spp., incl Green darner
Leaf hopper
Moth spp.
Spittle bug