White Mountain National Forest

Appendix G
Biological Evaluation

Biological Evaluation

of the

White Mountain National Forest
Land and Resource Management Plan Revision

on

Federal Endangered, Threatened, and Proposed Species
and Regional Forester Sensitive Species

Grafton, Carroll, and Coos Counties, New Hampshire; and Oxford County, Maine

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Contents

Chapter 1 – Introduction

This Biological Assessment is prepared in accordance with direction provided in the United States Department of Agriculture Forest Service (USFS) Manual 2672.42 and Section 7 of the Endangered Species Act (ESA). It addresses potential effects of the revised White Mountain National Forest (WMNF) Land and Resource Management Plan (Forest Plan) on federally endangered, threatened, and proposed species and Regional Forester Sensitive Species (RFSS) that may occur within the Forest. Federally endangered and threatened species are those determined for eligibility based on guidelines listed by the United States Department of Interior Fish and Wildlife Service (USFWS) under Section 4 of the Endangered Species Act. The USFS cooperated with the USFWS to determine which federally listed species to evaluate in this Biological Assessment (USFWS 2003a).

Species included on the Regional Forester Sensitive Species list must occur on Forest Service land or within the proclamation boundary of the Forest and meet at least one of the following criteria: 1) are a candidate for federal listing under ESA; 2) have been delisted under ESA within the last five years; 3) have a global (G), national (N), or trinomial (T) rank of 1, 2, or 3 from the Association of Biodiversity Information; or 4) are otherwise considered "at risk" on the Forest, with rationale documented in a Risk Evaluation. Development of the most recent RFSS list for the White Mountain National Forest (USFS 2000) incorporated comments from state Natural Heritage programs, state wildlife agencies, local interest groups, and other cooperators.

Proposed Management Action

The proposed management action is the revision of the WMNF Forest Plan, as amended. The Forest Plan does not identify site-specific actions, but provides a framework in which future activities may be implemented. Goals and objectives form the basis for project implementation to make progress towards the desired future condition, while standards and guidelines provide more detailed direction on how project activities may be conducted. The Forest is "zoned" into a number of Management Areas, each with a different resource emphasis, although much overlap can exist.

The Forest Plan was originally approved in 1986, following a lengthy public involvement and analysis process. A total of eight amendments have since been incorporated into the Forest Plan. The National Forest Management Act requires National Forests to revise their plans every fifteen years.

The current analysis to revise the Forest Plan includes four alternatives, based on public and specialist input. Three main issues were identified and can be summarized as: 1) the amount and types of timber harvest to occur; 2) the amount and types of recreation opportunities to be provided; and 3) where different management actions may occur on the Forest. The issues may be reviewed in detail in Chapter 1 of the Draft Environmental Impact Statement.

From these issues, four alternatives were crafted and are described in detail in Chapter 2 of the Draft Environmental Impact Statement. They may be summarized as follows:

Alternative 1

This is the current Forest Plan, as amended, with some updates to standards and guidelines. These updates are unrelated to the issues and were added to make this alternative more consistent with the other alternatives. Examples of updated standards and guidelines that may relate to threatened, endangered, and sensitive (TES) species (and are common to all alternatives) include direction on:

- Invasive species prevention and eradication
- Focused attention on rock climbing activities
- Mitigation for construction of cell towers, wind turbines, and other tall structures
- Limits on new construction in the alpine zone
- Protection of vernal pools and other watershed and riparian features

Alternative 1 proposes a total annual sale quantity of 35 million board feet in each of the first two decades of Forest Plan implementation. Approximately 79 percent of the harvest would be even-aged prescriptions, with 21 percent being uneven-aged. In the first two decades, regeneration treatments would be implemented on some 34,000 acres. Management Areas 2.1 and 3.1 (where timber harvest is allowed) would occupy some 355,000 acres of the Forest.

Long-term vegetation composition objectives in management areas 2.1 and 3.1 would be as follows:

Habitat Type	Composition objective (% of MA 2.1/3.1)
Northern Hardwood	51
Hardwood-Softwood	10
Spruce-Fir	18
Aspen-Birch	8
Permanent Opening	3
Other[1]	8

[1] Includes hemlock, oak/pine, wetlands, and non-vegetated habitats

The recreation strategy under all alternatives would concentrate use at specific sites or locations rather than dispersing use within the area or to other areas. Alternative 1 would provide a range of developed and dispersed recreation opportunities, including:

- Construction of new campgrounds or day use areas or expansion of existing areas to meet a portion of demand, accommodating approximately 25,000 additional visits annually

- Construction of new backcountry facilities or expansion of existing facilities to meet a portion of the projected demand, accommodating approximately 3,600 to 4,500 additional visits annually.
- Increased use of dispersed campsites would be allowed.
- Construction of approximately 40 miles of new non-motorized trails or expansions of existing non-motorized trails to meet a portion of projected demand, accommodating an additional 19,000 visitors annually.
- The entire Forest would be open to mountain biking unless posted closed.
- Summer motorized trails would be allowed in management areas 2.1 and 3.1, with proposals evaluated on a case-by-case basis. This alternative could result in an estimated two or three 20- to 30-mile self-contained trails.

Alternative 2

Alternative 2 proposes a total annual sale quantity of 24 million board feet in each of the first two decades of Forest Plan implementation. Approximately 67 percent of the harvest would be even-aged prescriptions, with 33 percent being uneven-aged. In the first two decades, regeneration treatments would be implemented on some 21,000 acres. Management Area 2.1 (where timber harvest is allowed) would occupy some 357,000 acres of the Forest.

Long-term vegetation composition objectives in Management Area 2.1 would be as follows:

Habitat Type	Composition objective (% of MA 2.1/3.1)
Northern Hardwood	52
Hardwood-Softwood	10
Spruce-Fir	24
Aspen-Birch	5
Permanent Opening	1
Other[1]	8

[1] Includes hemlock, oak/pine, wetlands, and non-vegetated habitats

In addition to the goals identified in Alternative 1, Alternative 2 would protect low use areas to avoid dispersing users from high use areas into low use areas. Development in the backcountry would be minimized. Alternative 2 would include the following:

- Only expansion of existing areas would be allowed to meet a portion of demand, accommodating approximately 4,500 additional visits annually. No construction of new facilities to meet demand would be allowed.

- Only expansion of existing facilities would be allowed to meet a portion of the projected demand, accommodating approximately 2,700 to 3,600 additional visits annually. No construction of new facilities to meet backcountry demands would be allowed.
- Increased use of dispersed campsites would not be allowed.
- Construction of approximately 10 miles of new non-motorized trails or expansions of existing non-motorized trails to meet a portion of projected demand, accommodating an additional 4,800 visitors annually.
- Trails on the Forest would be open to mountain biking unless posted closed. Travel corridors that are not designated trails (e.g., skid trails) would be closed unless posted open.
- Summer motorized trails would be prohibited.

Alternative 3

Alternative 3 proposes a total annual sale quantity of 18 million board feet in each of the first two decades of Forest Plan implementation. Approximately 34 percent of the harvest would be even-aged prescriptions, with 66 percent being uneven-aged. In the first two decades, regeneration treatments would be implemented on some 9,600 acres. Management Area 2.1 (where timber harvest is allowed) would occupy some 294,000 acres of the Forest.

Long-term vegetation composition objectives in Management Area 2.1 would be as follows:

Habitat Type	Composition objective (% of MA 2.1/3.1)
Northern Hardwood	52
Hardwood-Softwood	10
Spruce-Fir	24
Aspen-Birch	5
Permanent Opening	1
Other[1]	8

[1] Includes hemlock, oak/pine, wetlands, and non-vegetated habitats

The recreation strategy for Alternative 3 would be the same as in Alternative 2.

Alternative 4

Alternative 4 proposes a total annual sale quantity of 30 million board feet in each of the first two decades of Forest Plan implementation. Approximately 59 percent of the harvest would be even-aged prescriptions, with 41 percent being uneven-aged. In the first two decades, regeneration treatments would be implemented on some 23,000 acres. Management Area 2.1 (where timber harvest is allowed) would occupy some 364,000 acres of the Forest.

Long-term vegetation composition objectives in Management Area 2.1 would be as follows:

Habitat Type	Composition objective (% of MA 2.1/3.1)
Northern Hardwood	52
Hardwood-Softwood	10
Spruce-Fir	24
Aspen-Birch	5
Permanent Opening	1
Other[1]	8

[1] Includes hemlock, oak/pine, wetlands, and non-vegetated habitats

The recreation strategy under all alternatives would concentrate use at specific sites or locations rather than dispersing use within the area or to other areas. The overall strategy goals in Alternative 4 are similar to alternatives 2 and 3, but Alternative 4 allows more opportunities to meet demand. Opportunities under Alternative 4 would include:

- Construction of new campgrounds or day use areas or expansion of existing areas to meet a portion of demand, accommodating approximately 45,000 additional visits annually
- Construction of new backcountry facilities or expansion of existing facilities to meet a portion of the projected demand, accommodating approximately 5,400 to 6,300 additional visits annually.
- Increased use of dispersed campsites would be allowed.
- Construction of approximately 100 miles of new non-motorized trails or expansions of existing non-motorized trails to meet a portion of projected demand, accommodating an additional 48,000 visitors annually.
- Trails and travel corridors would be open to mountain biking unless posted closed. Mountain bike use in Wilderness would be prohibited.
- Summer motorized trails would be allowed in Management Area 2.l. One of two trial areas would be selected for construction of an approximately 20-mile long self-contained trail.

Common to All Alternatives

The following Forest Plan direction for Rare and Unique Features would be applied in all alternatives:

Program Goals and Objectives

Goals

The White Mountain National Forest will provide sufficient habitat and protection to preclude the need for species listing under the Federal Endangered Species Act due to National Forest habitat conditions or effects of activities.

For species currently listed under the Federal Endangered Species Act or designated Regional Forester's sensitive species, the Forest Service will contribute to conservation and recovery of species and their habitats.

Objectives

1. Within five years of listing, develop conservation approaches for all sensitive species. Biological diversity will be conserved by maintaining viable reproducing populations for all native plant and animal species. For species where the Forest alone cannot support a viable population, species persistence will be maintained, and the Forest Service will contribute to maintaining or improving viability where possible.

Goals

Outstanding natural communities will be conserved.

Objectives

1. Continue to develop a Forest-wide natural community inventory based on botanical, geologic and landscape considerations.

Goals

Alpine communities, including areas of alpine and subalpine habitat outside the Alpine Zone management area, will be conserved.

Maintain the successful recovery of dwarf cinquefoil (*Potentilla robbinsianna*).

Bald Eagle

Goals

Contribute to bald eagle recovery efforts.

Gray Wolf

Goals

Maintain habitat opportunities for wolf colonization on the Forest.

Indiana Bat

Goals

Maintain suitable conditions for roosting and foraging.

Objectives

1. Work with the US Fish and Wildlife Service and research partners to understand the role of the White Mountain National Forest in Indiana bat recovery.

Small Whorled Pogonia

Goals

Maintain or enhance habitat conditions around known occurrences, including consideration of vegetation management to increase light levels if needed.

Canada Lynx

Goals

In Lynx Analysis Units, provide suitable lynx habitat, with an emphasis on high quality foraging habitat in proximity to denning habitat, in sufficient amounts that neither is limiting to lynx.

Plan and manage activities and special uses to protect the integrity of lynx habitat.

Maintain the natural competitive advantage of lynx by providing a landscape with large, interconnected blocks of foraging habitat where snow-compacting activities are minimized.

Maintain sufficient habitat connectivity across forested landscapes and across highway rights-of-way to allow dispersal of lynx between Lynx Analysis Units and lynx population sources.

Objectives

1. Concentrate recreational activities within existing developed areas rather than developing new recreational areas in lynx habitat.
2. Cooperate with state and other federal agencies to identify and prioritize highway crossing sites to reduce highway impacts.

Dwarf Cinquefoil

Goals

Maintain the successful recovery of dwarf cinquefoil (*Potentilla robbinsiana*).

Bicknell's Thrush

Goals

Maintain or enhance suitable breeding habitat for Bicknell's thrush.

Objectives

1. During the planning period, determine if human activity levels result in reduced breeding success.

Program Standards and Guidelines

S-1 All project sites must be investigated for the presence of TES species and/or habitat prior to beginning any authorized ground-disturbing activity at the site. TES plant surveys must be completed for all new ground-disturbing projects, unless biologists/botanists determine TES species occurrence is unlikely (e.g., no habitat exists).

S-2 Unless conservation approaches have already been developed for a species, individual site prescriptions must be developed for each identified TES plant species occurrence to provide specific habitat conservation actions for those plant species. Individual site prescriptions must similarly be developed for all fixed TES wildlife habitat features (e.g., den sites, nest sites, or other features necessary for the reproductive success of the animal). Until conservation

approaches or specific site prescriptions are developed, new management actions that would negatively alter habitat conditions necessary to support the species must not be allowed within 100 feet of the plant(s) or within one quarter mile of the wildlife habitat feature(s).

S-3 Timber harvest is prohibited in old growth forest.

G-1 Outstanding natural communities should be conserved.

G-2 TES habitat that is important to species conservation should be retained in public ownership unless an exchange results in a net gain or higher quality habitat.

G-3 Use restrictions and other mitigative measures may be implemented to protect or improve habitat for threatened, endangered, or sensitive species. See individual management areas for additional direction.

G-4 When feasible, standards and guidelines for the Alpine Zone MA (8.1) also should apply to alpine and subalpine communities outside MA 8.1.

Bald Eagle

G-1 Winter roost habitat should be protected along major rivers and water bodies with known eagle activity.

Gray Wolf

G-1 If wolves become reestablished on or near the Forest, suitable early successional habitat should be provided, especially for deer and moose.

G-2 Known winter deeryards should be protected and deeryard conditions should be improved where possible.

Indiana Bat

S-1 Standards for *wildlife reserve trees* in the Wildlife resource section apply.

G-1 Guidelines for *wildlife reserve trees* in the Wildlife resource section apply.

Small Whorled Pogonia

S-1 Known small whorled pogonia colonies must be protected from human disturbances that may be detrimental to the colony.

S-2 Evaluate projects with ground-disturbing activities to determine the potential for small whorled pogonia habitat to occur within the influence of the project area.

G-1 Known small whorled pogonia colonies should be evaluated to determine the potential for natural colonization of surrounding habitat that becomes functionally suitable over time. Actions may be taken that would benefit existing colonies or encourage additional colonization, e.g., removing trees to reduce canopy cover allowing more sunlight to reach the forest floor.

Canada Lynx

S-1 Standards and guidelines for lynx apply only to lynx habitat within a Lynx Analysis Unit (LAU).

S-2 LAUs shall not be adjusted without agreement between the U.S. Forest Service and the U.S. Fish and Wildlife Service.

S-3 Unless a broad-scale assessment of landscape patterns that compares historical and current ecological processes and vegetation patterns is developed, disturbance must be limited in the following manner:

a. If more than 30 percent of lynx habitat within a LAU is currently in unsuitable condition, no further reduction of suitable conditions shall occur because of vegetation management activities by federal agencies unless the activity is proposed specifically to improve future snowshoe hare habitat.

b. Vegetation management projects in lynx habitat should promote increases in suitable snowshoe hare habitat and retain/enhance habitat conditions for important alternate prey (particularly red squirrel) where possible. Overstory harvest treatments that retain or enhance existing softwood understories are allowed provided denning habitat within the LAU does not fall below 10 percent.

S-4 Prior to any action that may affect lynx, lynx habitat within affected LAUs must be mapped, including potential foraging and denning habitat. Mapping should also include identification of topographic features that may be important for lynx movement (e.g. major ridge systems, prominent saddles, riparian corridors).

S-5 Within an LAU, denning habitat in patches generally larger than five acres, comprising at least 10 percent of lynx habitat must be maintained. Where less than 10 percent denning habitat is currently present within an LAU, management actions that would delay development of denning habitat structure must be deferred. Projects may still move forward if other lynx habitat areas within the LAU can be identified that will not be treated (e.g., RNAs) and which will subsequently move into denning conditions at some future time.

S-6 On-the-ground management actions must not change more than 15 percent of lynx habitat within an LAU to an unsuitable condition within a 10-year period.

S-7 Existing and potential diurnal security habitat around highly disturbed recreation developments (e.g., ski areas) must be maintained.

G-1 In lynx habitat, no net increase in groomed or designated over-the-snow routes and snowmobile play areas by LAU is allowed unless:

a. The designation serves to consolidate unregulated use and improves lynx habitat.

b. Existing snowmobile trails must be temporarily rerouted to avoid conflicts around active timber sales.

c. Preexisting trails or corridors on private land come into National Forest ownership.

Groomed or designated over-the-snow routes include the following: designated winter route, groomed winter route, and authorized winter route/use area. Groomed or designated over-the-snow routes are generally compacted during the winter season, but do not include plowed roads or roads/trails accessing private land. Winter logging and alpine ski areas are not subject to this guideline. Nordic ski areas should have a "concentrated trail area" delineated by a Forest Service biologist within which existing trails are so networked that a competitive advantage for lynx does not likely exist. These "concentrated trail areas" are not subject to this guideline.

G-2 For trails constructed primarily for summer use but which may also be used in winter (e.g., hiking trails), new construction should result in no net increase in trail mileage in lynx habitat by LAU. Designating or grooming these routes for winter use should include closures of other similar routes in lynx habitat so no net increase in routes occurs by LAU.

a. Exceptions to this guideline may be considered when an increase in over-the-snow routes would not increase the potential for competitors to gain access to an area, e.g., constructing a snowmobile trail that closely parallels an existing winter road. Exceptions may also be allowed in areas where snow depth or snow condition is insufficient to limit competing predators in winter, and consistent presence by competing predators off-trail is documented. Exceptions must be recommended by a Forest Service wildlife biologist.

G-3 Following disturbances such as blow down, fire, or insects/pathogens resulting in mortality that could contribute to lynx denning habitat, salvage harvest should not occur when the affected area is smaller than five acres. Exceptions to this include:

a. Areas such as developed recreation sites or other areas of high human concentration;

b. LAUs where denning habitat has been mapped and field-validated (not simply modeled or estimated) and comprises more than 10% of lynx habitat within a LAU. In these cases, salvage harvest may occur, if at least the minimum amount of denning habitat is maintained in a well-distributed pattern; and

c. Already active timber sales where removal of blowdown trees is necessary to ensure access, reduce safety hazards, or otherwise meet the project objectives.

G-4 In lynx habitat, pre-commercial thinning may be allowed only when stands no longer provide snowshoe hare habitat (e.g., self-pruning processes have eliminated snowshoe hare cover and forage availability during winter conditions with average snowpack). However, timber stand improvement may be used in softwoods or mixed wood stands to enhance or maintain softwood regeneration. This practice would

be acceptable in stands that have suitable stem density (greater than or equal to 7,000 stems per acre in softwoods or mixed woods) for snowshoe hare cover if that stem density is retained across most of the stand.

G-5 Key linkage areas must be maintained to allow lynx movement. Native plant communities and patterns, and habitat for potential lynx prey, should be maintained or enhanced within identified key lynx linkage areas where feasible. Habitat connectivity (e.g. along large riparian zones and across major ridges, and prominent saddles) should be retained across the landscape to support lynx movement. Creation of permanent linear routes (e.g., roads, fuel breaks, trails) that could facilitate increased over-the-snow access by competitors should not be built on ridges and saddles or in riparian zones. Clearcuts should be placed near softwood cover where possible.

G-6 Snow compaction off designated trails and roads should be minimized when authorizing and monitoring special uses in lynx habitat

G-7 New temporary roads constructed in lynx habitat should be closed to public use. The ability to implement effective closures should be provided in the initial road designs. Upon project completion these roads should be reclaimed or obliterated if not needed for other forest management objectives

G-8 Dirt and gravel roads (particularly those that could become highways) traversing lynx habitat should not be paved or otherwise upgraded (e.g., straightening of curves, widening of roadway) in a manner that is likely to lead to significant increases in traffic volumes, traffic speeds, or would contribute to development or increases in human activity in lynx habitat, unless road safety hazards exist.

Bicknell's Thrush

S-1 Projects must not result in a net decrease of suitable Bicknell's thrush habitat.

Consultation History

Consultation between the White Mountain national Forest and US Fish and Wildlife Service staff has included a number of meetings and other discussions. Following is a chronological history:

Extensive consultation regarding the Indiana bat and small whorled pogonia occurred in 1999-2001, when the 1986 Forest Plan was evaluated for these species. A Biological Opinion was issued in 2000 and Terms and Conditions for Indiana bat were amended to the Forest Plan in 2001.

April, 2000: Meeting to discuss WMNF draft lynx habitat definition. (Additional consultation at the national level is summarized for lynx under its species evaluation below)

April, 2000 – May, 2000: Informal consultation and concurrence that ongoing implementation of the current Forest Plan does not require project-level consultation pursuant to Section 7(a)(2) of the Endangered Species Act.

March, 2003 – May 2003: Request for updated species list to consider for revision; response from USFWS (USFWS 2003a).

March, 2003: Signed Consultation Agreement between WMNF and USFWS (WMNF and

USFWS 2003) that established the process to be used for consultation on the revision of the Forest Plan. Discussed issues and draft alternatives being considered.

Fall, 2004 – Summer, 2005: Informal review of the draft Biological Assessment and discussion of recent species information.

September, 2005 – Written concurrence on Biological Assessment determinations provided by USFWS.

Species Evaluated

Table G-1 lists the species that are evaluated in this Biological Assessment. Because this is a programmatic document based on proposed management actions across the entire WMNF, all species are included for evaluation.

Table G-1. Endangered, Threatened, Proposed, and Sensitive species that may occur on the White Mountain National Forest.

Common name	Scientific name	ESA[1]	RFSS[2]	NH[3]	ME[4]
Small whorled pogonia	*Isotria medeoloides*	T		E	E
Bald eagle	*Haliaeetus leucocephalus*	T		E	T
Indiana bat	*Myotis sodalis*	E			
Gray wolf	*Canis lupus*	E			
Eastern cougar	*Puma concolor couguar*	E			
Canada lynx	*Lynx canadensis*	T		E	
Arnica	*Arnica lanceolata*		Y	T	T
Dwarf white birch	*Betula minor*		Y		E
Pond reed bent-grass	*Calamagrostis lacustris*		Y	E	E
Alpine bitter cress	*Cardamine bellidifolia*		Y	E	E
Bailey's sedge	*Carex baileyi*		Y	T	
Piled-up sedge	*Carex cumulata*		Y	T	
Wiegand's sedge	*Carex wiegandii*		Y	T	
Squirrel corn	*Dicentra canadensis*		Y	T	T
Goldie's woodfern	*Dryopteris goldiana*		Y	T	
Oakes' eyebright	*Euphrasia oakesii*		Y	E	
Proliferous red fescue	*Festuca rubra ssp. arctica = var prolifera*		Y	E	
Northern comandra	*Geocaulon lividum*		Y	T	
Mountain avens	*Geum peckii*		Y	T	
Butternut	*Juglans cinerea*		Y		

Table G-1. Endangered, Threatened, Proposed, and Sensitive species that may occur on the White Mountain National Forest — continued.

Common name	Scientific name	ESA[1]	RFSS[2]	NH[3]	ME[4]
Auricled twayblade	*Listera auriculata*		Y	E	
Broad-leaved twayblade	*Listera convallarioides*		Y	T	
Heartleaf twayblade	*Listera cordata*		Y	T	
Alpine cudweed	*Omalotheca supina*		Y	E	
Canada mountain ricegrass	*Oryzopsis* (= *Piptatherum*) *canadensis*		Y	E	
Mountain sweet-cicely	*Osmorhiza berteroi*		Y	E	
American ginseng	*Panax quinquefolius*		Y	T	
Silverling	*Paronychia argyrocoma*		Y	T	
Sweet coltsfoot	*Petasites frigidus var palmatus*		Y	E	
Wavy bluegrass	*Poa fernaldiana*		Y	E	E
Robbins' cinquefoil	*Potentilla robbinsiana*		Y	E	
Boott's rattlesnake root	*Prenanthes* (= *Nabalus*) *boottii*		Y	T	E
Pink wintergreen	*Pyrola asarifolia*		Y	E	
Livelong saxifrage	*Saxifraga paniculata*		Y	E	E
Moss campion	*Silene acaulis var exscapa*		Y	T	
Nodding pogonia	*Triphora trianthophora*		Y	T	T
Boreal blueberry	*Vaccinium boreale*		Y		T
White Mountain fritillary	*Boloria montinus montina*		Y		
White Mountain butterfly	*Oeneis melissa semidea*		Y		
Wood turtle	*Clemmys insculpta*		Y		
Timber rattlesnake	*Crotalus horridus*		EX	E	
Bicknell's thrush	*Catharus bicknellii*		Y		
American peregrine falcon	*Falco peregrinus anatum*		Y	E	E
Common loon	*Gavia immer*		Y	T	
Eastern small-footed bat	*Myotis leibeii*		Y	E	
Northern bog lemming	*Synaptomys borealis sphagnicola*		Y		T

[1]Species listed as Endangered (E), Threatened (T), or Proposed (P) under the federal Endangered Species Act of 1973, as amended.

[2]Species designated by the Regional Forester (Eastern Region of the Forest Service) as Sensitive under Forest Service Manual 2670. EX indicates a species that is listed Sensitive on other Forests, but considered extirpated from the WMNF.

[3]Species listed as Endangered (E) or Threatened (T) by the State of New Hampshire.

[4]Species listed as Endangered (E) or Threatened (T) by the State of Maine

Note the migrant loggerhead shrike (*Lanius ludovicianus migrans*) is officially listed as an extirpated sensitive species for the White Mountain National Forest. Unlike the timber rattlesnake, however, it is not carried forward in this analysis because its occurrence was the result of widespread cutting and burning that resulted in large, temporary grassy or brushy openings. Like other grassland species, loggerhead shrikes likely took advantage of this additional habitat and temporarily expanded their range. It has been many years since a loggerhead shrike was seen on the Forest and they are only infrequent visitors to New Hampshire. This analysis will focus primarily on those sensitive species that are likely to be resident or persistent during the breeding season on the Forest.

Summary of Species Determinations of Effects

The following chapters discuss effects to each species in detail. Table G-2 summarizes the determinations for each species.

Table G-2. Determinations of effects to federal threatened, endangered, and sensitive species, WMNF Forest Plan revision

No Effect	**May affect, not likely to adversely affect**	**May impact individuals, but not likely to result in a trend towards federal listing or loss of viability.**	
Bald eagle	Small whorled pogonia	Arnica	American ginseng
Gray wolf	Indiana bat	Dwarf white birch	Silverling
Eastern cougar		Pond reed bent-grass	Sweet coltsfoot
Canada lynx		Alpine bitter cress	Wavy bluegrass
Timber rattlesnake		Piled-up sedge	Robbins' cinquefoil
Bailey's sedge		Wiegand's sedge	Boott's rattlesnake root
		Squirrel corn	Pink wintergreen
		Goldie's woodfern	Livelong saxifrage
		Oakes' eyebright	Moss campion
		Proliferous red fescue	Nodding pogonia
		Northern comandra	Boreal blueberry
		Mountain avens	White Mountain fritillary
		Butternut	White Mountain butterfly
		Auricled twayblade	Wood turtle
		Broad-leaved twayblade	Bicknell's thrush
		Heartleaf twayblade	American peregrine falcon
		Alpine cudweed	Common loon

Table G-2. Determinations of effects to federal threatened, endangered, and sensitive species, WMNF Forest Plan revision — continued.

No Effect	**May affect, not likely to adversely affect**	**May impact individuals, but not likely to result in a trend towards federal listing or loss of viability.**	
		Canada mountain ricegrass	Eastern small-footed bat
		Mountain sweet-cicely	Northern bog lemming

Chapter 2 - Federally Listed Species

Small whorled pogonia (*Isotria medeoloides*) — Federal Threatened

The small whorled pogonia was listed as endangered on October 12, 1982. A recovery plan was completed in 1985 and revised in 1992. In 1994, the species was downlisted to threatened status.

Distribution

Small whorled pogonia is broadly but sparsely distributed from Georgia to Maine. There are three main population centers: The Blue Ridge Mountains of North Carolina, South Carolina, Georgia, and Tennessee; the coastal plain and piedmont provinces of Virginia, Delaware, and New Jersey; and the Appalachian foothills in New England. A decade ago, the largest population center was New England, consisting of 53 sites producing about 2,200 stems. The Blue Ridge concentration consisted of 15 stems producing about 172 stems, while the Virginia coastal/piedmont center had 12 sites with 250 stems (USFWS 1992a). Today, New England remains the stronghold for the regional population, with 81 sites producing at least 1300 stems (M. Sperduto 2003).

Life History

The small whorled pogonia is a perennial orchid. It is self-compatible and self-pollinating, with occasional vegetative reproduction. The age of first reproduction is unknown, although reproductive state may be correlated with leaf whorl diameter (an estimate of total leaf area). The largest plants tend to flower the following year, while the smallest plants will usually be sterile or die. Intermediate plants usually return in an arrested condition (Mehrhoff 1988; Mehrhoff 1989). Without annual monitoring or an evaluation of the rootstock, determining whether a small vegetative plant is a seedling, a young plant, or an older plant that has already flowered, is not possible (USFWS 1992a).

Plants emerge as early as mid-May, and flower in early to mid-June. Flowering lasts approximately one week to 10 days (Rawinski 1986). Plants may not flower every year (Case and Schwab 1971). The fruit capsule does not fully ripen until fall (USFWS 1992a).

Like many orchids, *Isotria* may lay dormant for several years. Orchid seeds hold very small quantities of food reserves, if any. They will not germinate and/or establish seedlings unless they fall on a substrate containing a suitable mycorrhizal fungus. The fungus penetrates the seeds and they form a symbiotic root/fungus (mycorrhizal) association. The orchid seedling receives water and nutrients and in return, provides the fungus with a carbohydrate source at a later stage of its life cycle (USFWS 1992a).

Habitat

Small whorled pogonias occur on upland sites in mixed deciduous or mixed deciduous-coniferous forests ranging in age from 30 to 80 years. Overstory canopy species in New England are typically red maple (*Acer rubrum*),

eastern hemlock (*Tsuga canadensis*), paper birch (*Betula papyrifera*), northern red oak (*Quercus rubra*), white pine (*Pinus strobus*), or American beech (*Fagus grandifolia*). Characteristics common to most small whorled pogonia sites include sparse to moderate microhabitat ground cover, relatively open understory, and proximity to features that create long persisting breaks in the forest canopy (e.g., old logging roads, streams, or wind throw (USFWS 1992a, Mehrhoff 1989). Decaying vegetation (fallen trunks and limbs, leaf and frond litter, bark, stumps, and dead tree roots) is usually present. Soils at most sites are highly acidic and nutrient poor, with moderately high soil moisture values (summarized by USFWS 1992a).

Slopes of 11% to 17% are preferred, and some New England sites include an impervious (fragipan) soil layer near the surface, which blocks downward water percolation and provides needed moisture (Rawinski 1986, M. Sperduto 1993).

No critical habitat has been designated for this species.

Occurrences

There are 28 extant and 1 historic occurrence in Maine and 1 historical occurrence in Vermont (M. Sperduto 2003, USFWS 1992a). In New Hampshire, there were at least 30 sites in 1991 (USFWS 1992a) and at least 36 today (M. Sperduto 2003).

A protocol for survey and habitat modeling (M. Sperduto 1993) was developed to better identify potential small whorled pogonia suitable habitat. Surveys have been conducted on at least 27,000 acres in the WMNF. Although it is possible that individual plants may have been missed, the likelihood of this is small. Despite significant survey effort, only four colonies of small whorled pogonia are known from three sites on the Forest (three in Albany, NH and one in Stoneham, ME).

Threats/Limiting Factors

1. *Habitat destruction* is considered to be the primary threat to the species (USFWS 1992a). Much of the documented population decline is probably due to habitat loss at low elevations (SVE Upland Forest 2002).
2. *Collecting*
3. *Recreational use* of the habitat
4. *Deer and slug herbivory* (USFWS 1992a, SVE Upland Forest Panel 2002). Experts on the SVE Upland Forest Panel (2002) believe local populations are very subject to deer herbivory.
5. *Inadvertent damage* from research and other activities (USFWS 1992a).
6. *Forest succession* is not a concern globally, but was identified by the SVE Upland Forest Panel (2002) as a problem locally.

The most limiting factors of concern under WMNF control are:

a. Habitat destruction or alteration, e.g., loss of appropriate light conditions to support individuals. Timber harvest would be the most likely activity to cause this effect.

b. Increased recreational use.

c. Herbivory

d. Forest succession

Information Gaps

The only identified information gap is to determine the response of this species to changes in canopy closure (Rawinski 1986).

Pertinent Resource Actions

The goal for small whorled pogonia is to enhance habitat conditions around known occurrences, including consideration of vegetation management to increase light levels if needed.

Standards and guidelines specific to small whorled pogonia would include the following:

Standards

1. Known small whorled pogonia colonies must be protected from human disturbances that may be detrimental to the colony.
2. Evaluate projects with ground-disturbing activities to determine the potential for small whorled pogonia habitat to occur within the influence of the project area.

Guidelines

1. Known small whorled pogonia colonies should be evaluated to determine the potential for natural colonization of surrounding habitat that becomes functionally suitable over time. Actions may be taken that would benefit existing colonies or encourage additional colonization, e.g., removing trees to reduce canopy cover allowing more sunlight to reach the forest floor.

Affected Environment

The analysis area for effects for small whorled pogonia is the area encompassed by the ecological subsections that surround and include the WMNF (Map G-01).

Habitat Trend

The amount of suitable habitat has probably declined over time, although probably not much since 1986, when the current Forest Plan was approved. Northern hardwoods and mixed wood stands are abundant throughout the analysis area, but low elevation habitats are often the first to be affected by development (USFWS 1992a). Habitat suitability at some extant sites may have declined as a result of shading in recent years (see effects section for additional details).

Population Trend

The population trend for small whorled pogonia is considered stable. Monitoring of Forest occurrences has demonstrated an apparent increase

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Map G-01
Wildlife & Veg Analysis
Areas
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Page G-25

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in numbers in both colonies at one site and stable or slight decline at a second site. The SVE Upland Forest Panel (2002) indicated WMNF populations are stable, but vulnerable due to site quality and low numbers. Some colonies throughout New England appear to be declining, perhaps due to shading or recent drought conditions, but few known populations have been lost.

Environmental Effects

Alternative 1

Timber harvest/Herbivory/Forest succession

All alternatives would include mitigation to protect known Threatened, Endangered, or Sensitive (TES) species from management actions. However, activities could impact an unknown colony or plant either directly through trampling of individual plants or indirectly through canopy changes that alter light levels and render the habitat unsuitable. Timber harvest would be the most likely activity to cause potential adverse effects. Alternative 1 has the second greatest amount (after Alternative 4) of timber harvest in terms of total number of acres treated. It includes slightly less acres in management areas 2.1 and 3.1 that allow timber harvest compared to Alternative 4, which has the highest acreage. However, Alternative 1 proposes the highest level of regeneration harvest treatments. Regeneration harvests such as clearcutting result in a flush of young vegetative growth that can attract and support increased deer numbers in a local area. If deer were attracted to a small whorled pogonia area because harvesting created a suitable forage base near existing pogonia sites, the plants would be at higher risk of herbivory loss. It should be noted that the risk of unintentionally impacting a small whorled pogonia on the WMNF is extremely small. The Forest uses a tested model (M. Sperduto 1993) to identify areas that have the highest potential for occurrence for small whorled pogonia. Over 27,000 acres of the highest potential habitat has been searched on the Forest, with no new occurrences found. Although timber harvest can potentially impact this species, the probability of it happening here is extremely small.

On the other hand, some of the colonies on the Forest are currently declining, which appears to be caused, at least in part, by a loss of light levels as understory shrubs and overstory canopies close in and increase shade around known small whorled pogonia plants. At least three nearby colonies off-Forest seem to be thriving following timber harvest activity, with some colonies located within and immediately adjacent to skid trails (S. von Oettingen, pers. comm.). The U.S. Fish and Wildlife Service has suggested the Forest evaluate removing some trees around extant occurrences in an effort to improve the condition of remaining plants. The extant occurrences on the WMNF in New Hampshire would all be located in management areas that allow vegetation management under Alternative 1 to conserve threatened, endangered, or sensitive species.

Recreation use

Recreation use may cause trampling of plants, which over time can result in population decline. Alternative 1 allows many recreation activities to occur over much of the Forest (e.g., hiking, mountain biking), although this alternative proposes construction of fewer facilities and infrastructure than Alternative 4. Summer motorized use would be allowed under this alternative, with an estimated 40 to 60 miles of trails being designated on a case-by-case basis. It is anticipated that much of this new activity would occur on already designated trails, so trail construction would avoid known small whorled pogonia areas, but small amounts of suitable unoccupied habitat could potentially be affected. The extent to which this would affect small whorled pogonia colonization potential would be dependent on site-specific trail placement.

Non-motorized recreation use is expected to increase up to eight percent per year over the next 20 years (see Recreation effects section for more details). The risk of trampling small whorled pogonias would be greater in Alternative 1 than the current condition, although the chance of this actually occurring is very small.

Cumulative effects of Alternative 1

The WMNF supports only a small percentage (perhaps 4-6%) of the occurrences in New Hampshire and Maine. Although the exact number of occurrences within the analysis area is unknown, the proportion is likely similar. At least three populations immediately surrounding the WMNF are more robust than the Forest's occurrences, perhaps due in part to more active management to promote suitable habitat conditions. The SVE Upland Forest Plants Panel (2002) suggest that in the next 20 years, the outlook for small whorled pogonia on the Forest may decline dependent on deer herbivory and management, although rangewide they are expected to improve as more populations are discovered and protection measures implemented. Because the risk of deer herbivory would be highest in Alternative 1, and because recreation is the least restricted, this alternative would be the least likely to contribute to regional populations.

Alternative 2

Timber harvest/ Herbivory/Forest succession

In Alternative 2, the amount of land available for timber harvest (MA 2.1) is approximately the same as in Alternative 1, however, the total acres actually proposed for timber harvest is approximately 30 percent less than Alternative 1. This reduces somewhat the risk of impacting an unknown small whorled pogonia colony. It also reduces the risk of increasing local deer herbivory. However, it may reduce somewhat the amount of suitable habitat that could be created through timber harvest. If filtered light conditions are required to support this species, it is possible that some uneven-aged harvest prescriptions could improve habitat quality. Whether or not the habitat would be suitable, though, would also depend on the presence of required mycorrhizal fungi, the locations of which are unknown.

Recreation use
The recreation strategy in Alternative 2 places more emphasis on keeping users from dispersing from high use areas to low use areas. Mountain biking activities would be limited to designated trails, rather than allowed to travel cross-country. No summer motorized use would be allowed and construction of non-motorized trails would be one-third of that proposed in Alternative 1. The risk of unintentionally trampling plants would be less than in Alternative 1.

Cumulative effects of Alternative 2

Cumulative effects would be similar to those described in Alternative 1, although the Forest would have a better chance of contributing to regional populations. However, it should be noted that even a significant increase in WMNF small whorled pogonia occurrences would not likely result in a change to metapopulation viability, simply because the Forest holds such a small proportion of the larger population.

Alternative 3

Timber harvest/Herbivory/Forest succession
Alternative 3 proposes approximately ten percent more acres to be treated through timber harvest than Alternative 2. However, Alternative 3 has the least amount of acres proposed for even-aged regeneration harvest (approximately half as much as in Alternative 2). Because the amount of even-aged regeneration harvest is the lowest of the alternatives, Alternative 3 would be the least likely to directly impact small whorled pogonia. Potential impacts as a result of deer herbivory would be the lowest of the alternatives, as would the potential of harvesting equipment accidentally impacting an unknown colony. Improvement of habitat suitability may be highest in this alternative, assuming even-aged regeneration treatments cause too dramatic a change in light levels to be beneficial.

Recreation use
Effects from recreation use would be the same as those described in Alternative 2.

Cumulative effects of Alternative 3

Cumulative effects would be similar to Alternative 2.

Alternative 4

Timber harvest/Herbivory/Forest succession
Implementing Alternative 4 would result in effects similar to Alternative 1. Slightly more acres of total harvest and slightly fewer acres of even-aged regeneration harvest would be treated in Alternative 4, but the magnitude of the difference probably is not sufficient to cause a change in anticipated effects.

Recreation use
The recreation strategy for Alternative 4 strives to keep users from dispersing from high use areas to low use areas, similar to alternatives 2 and 3. Mountain bikes would be allowed on both trails and travel corridors unless posted closed, so use would be dispersed more than alternatives 2 and 3,

but less than Alternative 1. Summer motorized use would be allowed, but would be limited to one of two designated areas, neither of which contains a known occurrence. Non-motorized trail construction would be more than double that of Alternative 1. Although there is a difference between motorized and non-motorized trail construction between alternatives 1 and 4, the difference between their effects is probably negligible.

Cumulative effects of Alternative 4

Cumulative effects would be similar to Alternative 1.

Determination — Small whorled pogonia

In all alternatives, projected activities **may affect but are not likely to adversely affect** small whorled pogonia.

Rationale Summary

1. The potential for management activities that could improve habitat conditions at known sites is the same in all alternatives, since known sites would continue to occur in management areas that allow vegetation management for TES habitat improvement.
2. Use of a predictive model and past extensive survey effort in the highest probability areas of occurrence on the Forest improve the chances that other colonies will not be missed during projects.
3. Timber harvest activities may degrade habitat through unintentional impacts to unknown colonies (which is unlikely given reliability of predictive models and survey efforts) and changes in light conditions or other habitat requirements. Harvest may also improve habitat suitability provided required fungi are present.
4. The extant occurrences currently found on the WMNF are such a small proportion of the regional metapopulation that any change is unlikely to result in a shift in regional population viability.

Bald eagle (*Haliaeetus leucocephalus*) — Federal threatened

The bald eagle is listed as threatened in the coterminous United States; the U.S. Fish and Wildlife Service has proposed removing the eagle from Threatened status due to species recovery (U.S. Fish and Wildlife Service 1999a).

Distribution

The bald eagle is widely distributed throughout the United States (except Hawaii) and Canada. Breeding occurs throughout much of the range, although wintering generally occurs from southern Alaska and southern Canada southward.

Locally in New England, bald eagles breed throughout Maine, west to New Hampshire, south to western Massachusetts (Quabbin Reservoir), and to northern Connecticut in the Northwest Hills. Recent territories have also been found in Rhode Island and south-central Vermont (M. Amaral,

pers. comm). During the winter, New England hosts wintering eagles along the coastal regions, on open inland waters, and along large rivers such as the Connecticut and Merrimack (DeGraaf and Yamasaki, 2001).

Life History

Bald eagles are long-lived birds, with the record being 28 years in the wild (Buehler, 2000). Captive eagles may live 40 years or more (U.S. Fish and Wildlife Service, 1999a). They are sexually mature at approximately four to six years old (USFWS 1983), typically producing only one brood per year, with one to three eggs making up the clutch. In New England, egg laying occurs from the last two weeks of March to early April on the Maine coast, with inland pairs and inexperienced nesters lagging approximately two weeks behind (DeGraaf and Yamasaki, 2001).

Fledging occurs in late July or early August, but the young remain close to the nest well into the fall. Nests and perch sites may be used for generations (Evans, 1994).

Fledgling nest departure can occur at eight to fourteen weeks, with much variation across the range. Up to half of all nest departures are unsuccessful and young may remain on the ground for weeks before gaining the ability to fly. Although parents continue to feed them, predation becomes a more likely risk for these grounded birds. For several weeks after fledging, young birds associate with adults and other birds (Buehler, 2000).

Predation of eggs, nestlings, and fledglings can occur from gulls, ravens, crows, black bears, raccoons, bobcats, hawks, and owls (Buehler, 2000).

Bald eagles require large bodies of water that support abundant fish for prey. Competition with other raptors (osprey, golden eagle) and fish-eating birds (herons, gulls) may occur. Carrion may also be used for food, which may result in competition with coyotes, otters, bears, and other mammals (Buehler 2000).

Habitat

Bald eagles breed on large lakes, rivers, and estuaries with abundant fish resources. They commonly use large supracanopy trees adjacent to water for nesting, perching, and roosting (DeGraaf and Yamasaki 2001). In New Hampshire and Vermont, supracanopy white pine is preferentially used for nesting (SVE Bird Panel 2002). Maine nests are usually within 250 meters from shore, although they may be further back if human activity is present along the shoreline (Kozie 1999).

In forested situations, canopy closure may be a factor. In several studies (not in the northeast), eagles tended to nest in more open forest conditions relative to random plots (Anthony and Isaacs 1989, Peterson 1986, Andrew and Mosher 1982). A study in Maine showed eagles nesting on river stretches with larger basin area, less forest edge, and closer to shore than random sites. On lakeshores, nests were positively correlated with number of superdominant trees and negatively correlated with distance to water, area of human disturbance, and area of timber harvest (Livingston et al., 1990). Locally, the SVE Bird Panel (2002) felt that vegetation around the

nest site is not an important habitat selection criterion, other than it is generally undisturbed and probably mature.

Territory size varies widely based on nesting density and food supply conditions. Average size was about one square kilometer in Minnesota (Buehler 2000).

Winter foraging areas are also near water bodies supporting fish or where other food sources such as deer carcasses are present (DeGraaf and Yamasaki 2001, Kozie 1999).

Connectivity corridors are not necessary because eagles can migrate or disperse over unsuitable habitat, provided that suitable stopover habitat (food availability) is present (Buehler 2000).

Occurrences

Maine contains over 240 geographically distinct breeding areas, including Oxford County (Owen et al., 1991). In 2003, Maine supported 190 successful nests with 273 young fledged (Amaral 2003). In 2004, these numbers increased to 202 successful nesting attempts and 298 eaglets fledged (Todd 2004).

In New Hampshire, three successful pairs fledged a total of five young in 2003 (Amaral 2003). New Hampshire also increased its numbers in 2004, with 6 successful pairs fledging 11 eaglets (Martin 2004).

Breeding eagles in Vermont have historically been rare, although potential breeding activity occasionally occurs (Fichtel 1985). No breeding activity occurred in 2001, 2002, 2003, or 2004. However, in 2004, 8 eaglets were hacked out at the Dead Creek Wildlife Management Area in Addison as part of a multi-year reintroduction effort (M. Amaral, pers. comm.).

Eagles have never been documented breeding on the White Mountain National Forest and are considered transient here (U.S. Fish and Wildlife Service 2003a). During the winter, roosting eagles are not uncommon near the Forest along the Androscoggin River.

Threats/Limiting Factors

Known threats include the following:

1. *Human development.* Shoreline development and associated loss of nesting, perching, and roosting, and associated foraging habitat is the most significant threat (Buehler 2000).
2. *Direct trauma*. One 30-year study indicated that most eagle deaths were due to trauma (23%; including collisions with vehicles, power lines, and structures), gunshot (15%), electrocution (12%), and poisoning (16%) (Franson et al., 1995).
3. *Contaminants.* Low reproductive rates have been the biggest obstacle to eagle recovery in Maine. DDE (a metabolite of DDT) was responsible for past reproductive failure range-wide; eggshell thinning has improved since a ban on DDT was imposed in the 1970s. Other environmental contaminants such as PCBs, organophosphates, and heavy metals (especially mercury) continue to pose threats (Buehler,

2000). As predators/scavengers at the top of the food chain, eagles are especially susceptible to bioaccumulation of environmental contaminants (Wiemeyer et al., 1993).

4. *Human disturbance*. Minimal human disturbance may be a factor in nest success; eagles are known to abandon nests if human activity occurs near the nest (DeGraaf and Yamasaki 2001). Researchers in Washington recommend prohibiting recreational activity during the first five hours of daylight within 400 meters of eagles to minimize disturbance of feeding behavior, and restricting foot traffic and use of motorboats (Stalmaster and Kaiser 1998). Bald eagles along the Colorado River in Arizona were detected 22 more times in reaches with low human use compared to reaches with moderate to high use (Brown and Stevens, 1997).
5. *Fish declines*. Changes in fisheries, including overfishing, acid rain-related fish declines, and alterations of waterways, could negatively impact the prey base (Kozie 1999).

The most limiting factors of concern under WMNF control are:

a. Collisions with power lines, facilities, or other infrastructure within the Forest boundary (authorized through permit).

b. Activities that promote human use near potential roosting areas.

c. Activities that would significantly reduce the amount of available roost/nest trees near foraging sources.

Information Gaps

The SVE Bird Panel (2002) identified the following information gaps:

1. Minimum waterbody size to support a breeding population is unknown.
2. Maximum distance from nest to foraging habitat is unknown.
3. Additionally, knowledge of migration corridors through the Forest would be helpful in evaluating potential proposals for communication towers or wind turbines (M. Amaral, pers. comm.)

Pertinent Resource Actions and Mitigation

The goal for bald eagle is to contribute to recovery efforts by protecting winter roost habitat along major rivers and waterbodies with abundant fish resources.

No standards or guidelines specific to bald eagle are proposed. However, direction is included to protect riparian conditions and to mitigate for potential collisions with structures that exceed the tree canopy (e.g., cell towers).

Affected Environment

The area of effects analysis for bald eagle is the HUC (Hydrological Unit Code) 5 subwatersheds that encompass the WMNF (with a few changes to exclude areas unlikely to be affected by Forest activities) (Map G-01).

Habitat Trend

The number of suitable roost and nest trees is stable or increasing on the Forest as stands continue to mature. Throughout the analysis area, there has probably been a trade-off between some roost/nest trees becoming suitable as stands mature, while other opportunities have been lost to shoreline and riparian development.

Actions such as hydropower dam construction and turn-of-the-century logging probably affected fish populations, but more recent actions have been less dramatic in terms of effects. River cleanup efforts have helped improve fisheries, especially in the larger rivers in the analysis area. Compared to conditions 20 years ago, foraging opportunities are considered stable.

Population Trend

Only 1 extant and 1 historic nesting site is known from within the analysis area, so a population trend cannot be established. Given that the population elsewhere in the region is expanding, it seems likely that any population in the analysis area would be at least stable, if not increasing.

Environmental Effects

All alternatives

Environmental Effects would be the same for all alternatives. Habitat for bald eagles is very limited on the Forest and breeding has never been documented. Although eagles are routinely spotted near the Forest, the most consistent place eagles are seen is along the Androscoggin River, along which management areas would be unchanged by alternative; therefore, eagles are expected to continue roosting on the Forest nearby. As regional bald eagle populations increase, the potential for breeding on the Forest will increase, especially along larger rivers such as the Saco. In all alternatives, abundant white pine and other suitable nest trees would be available. Mitigation measures to protect riparian conditions would protect foraging and nesting opportunities in all alternatives.

The only other potential threat to eagles would be construction of facilities or infrastructure that could result in eagle collisions (e.g., cell towers). The potential for these types of facilities is the same in all alternatives. Effective mitigation is available to visually deter birds from collisions, which could be further evaluated in site-specific projects.

Cumulative effects of all alternatives

Currently, the WMNF does not contribute to reproductive success of the local eagle population. Because of the higher elevations that predominate on the WMNF, most watercourses on the Forest are primarily headwater streams that are too small, too flashy, and/or too bouldery to support an adequate forage base for eagles. Large, shallow lakes are also more limited on the Forest compared to areas off Forest. Suitable breeding habitat is more prevalent off the Forest where rivers slow and widen as they reach the valleys.

Populations are likely to continue their increasing trend since pesticide threats have been removed. In time, it is possible for the WMNF to support breeding eagles, but probably not for a few decades until more suitable habitat in lower elevations is occupied first.

Determination — Bald eagle

All alternatives would result in **no effect** to bald eagles.

Rationale Summary

Implementation of any alternative would result in effects to bald eagles that are so small as to be immeasurable. Nesting has never been documented on the Forest, and while roosting occurs, the stretch of Forest Service land along the Androscoggin River is so limited that the chance of affecting an eagle there is extremely small.

Indiana bat (*Myotis sodalis*) — Federal endangered

The Indiana bat was listed as endangered in 1967. A recovery plan was completed in 1983. Revisions were proposed and comments solicited by the USFWS in the late 1990s, but as yet, the final revision has not been completed.

The species is listed as endangered in Vermont (Vermont Department of Fish and Wildlife 1999) and it is not tracked in Maine. The State of New Hampshire considers Indiana bat records to be falsely reported (New Hampshire Natural Heritage Bureau 2003).

Distribution

As of 2001, Indiana bats were known from 311 counties in 27 states in the eastern U.S., including Vermont and New Hampshire. More than half of these records are hibernating bats in caves and abandoned mines (Gardner and Cook 2002). The WMNF is located at the extreme northern edge of the Indiana bat's range.

Life History

Reproduction

Female Indiana bats typically mate during their first year prior to entering hibernation (at 6 months or less); males may not mature until their second year. Prior to hibernation, Indiana bats "swarm" around the hibernacula, during which time mating occurs (August through October, depending on the location). Indiana bats employ delayed fertilization, in which sperm is stored in the uterus over the winter and later fertilizes the egg, typically in April or early May. A few may mate in the spring as bats leave hibernation (Hall 1962).

Females are still pregnant when they leave the hibernacula and travel to maternity roosts. Young are born in late June and early July (Hall 1962). Juveniles are able to fly and forage in their own at 25-37 days (between early July and early August depending on location) (Humphrey et al. 1977). In the northeast, colder weather may delay these events.

Indiana bats have a surprisingly long lifespan for such a small animal. In one study, female survivorship of an Indiana population was 76 percent for ages 1-6 years and 66 percent for ages 6-10 years. Survivorship for males was 70 percent for ages 1-6 years and 36 percent for ages 6-10 years; maximum ages for banded individuals were 15 years for females and 14 years for males (Humphrey and Cope 1977).

Dispersal

Females leave hibernation sites in late March and April, while males leave slightly later (USFWS 1999b). Most bats emerge by mid-May (Barbour and Davis 1969). Some Indiana bats migrate more than 500 km (300 mi) between hibernacula and summer roost areas (Hall 1962, Belwood 1998), although there may regional differences in migration distances. Female bats emerging from three hibernacula in New York traveled less than 40 miles to their summer habitat (S. von Oettingen, pers. comm.). Even in migratory populations, some males remain in the general vicinity of their hibernaculum throughout the summer (Barbour and Davis 1969). The return migration occurs during the late summer; most bats arrive at hibernacula from late August through September. The majority of bats are hibernating by late November, earlier in northern areas (USFWS 1999b). The hibernation period may last from mid-September to early June, but averages mid-October to mid-April (USFWS 1999b).

Home range size is unclear, since Indiana bats may travel great distances between hibernacula and summer habitat. The maximum known distance traveled seasonally is approximately 500 km (310 mi) (Gardner and Cook 2002), but may be much smaller (<10 km/6.2 mi) (Rommé et al. 2002). Within the summer habitat, Indiana bats moving between roosts do not appear to move greater than 10km (6.2 mi) at a time (Kurta et al. 2002). Indiana bats in Pennsylvania did not move more than 4.5 km (2.8 mi) between a roost and a foraging area (Butchkoski and Hassinger 2002). Rommé et al. (1995) cite work by Garner and Gardner (1992) showing summer foraging areas ranging from 37 ha to 213 ha (91 to 526 acres).

Foraging

Indiana bats are insectivorous. Flies, moths, beetles, and caddisflies make up the majority of their diet, but they have the ability to feed opportunistically on whatever flying insects are prevalent in their foraging habitats (Murray and Kurta 2002). Those that forage in terrestrial habitats feed more on moths (Lepidoptera) and beetles (Coleoptera), while those that forage over aquatic habitats eat more caddisflies (Trichoptera) and true flies (Diptera) (Kurta and Whitaker 1998). Kurta et al (2002) also found that Indiana bats in southern colonies ate primarily beetles and moths, while diets in northern colonies consisted of true flies and caddisflies. Mosquitoes, midges, bees, and other flying insects are also consumed (USFWS 1999b).

Butchkoski and Hassinger (2002) in Pennsylvania studied nine Indiana bats of both sexes and various reproductive condition (pregnant, lactating, post-lactating, non-reproductive) and found the median foraging time was 7.8 hours per night.

Hibernation

Indiana bats typically return to the same hibernaculum every year (Hall 1962). Hibernacula are typically in natural karst caves, but may also be located in mines (Clawson 2002). They hibernate in dense clusters, often holding 500-1,000 individuals, although they can be as large as 5,000 bats (Handley 1991). A general rule is the cooler the temperature, the larger the cluster (Belwood 1998).

Habitat

The most limited habitat feature for Indiana bats range-wide is suitable hibernacula. Limestone caves with standing water are preferred. Indiana bats prefer cold temperatures, but select hibernation sites where freezing is unlikely and where temperatures are stable (below 10°C when they arrive and 3-6º in mid-winter) (BCI 2001; USFWS 1999b). A study by Tuttle and Kennedy (2002) demonstrated that hibernacula whose roosts had average temperatures outside these parameters suffered population declines, while those with roost temperatures within these ranges showed population increases over the same time period. Less than one percent of caves and mines within the range of the species are estimated to offer suitable hibernating conditions (USFWS 1999b).

Relative humidity is also important for hibernation; it is generally above 74 percent, but below saturation (USFWS 1999b). Within an individual cave or mine, Indiana bats select roost sites that may be near entrances, but may also be deeper if airflow patterns or temperature create suitable conditions (USFWS 1999b).

Hibernacula are designated by Priority Level to designate their relative importance to species recovery. Over 50 percent of all Indiana bats currently hibernate in eight Priority One hibernacula (located in Missouri, Indiana, Kentucky, and Ohio). However, populations have continued to decline in these hibernacula, raising the significance of the 76 Priority Two and 342 Priority Three hibernacula elsewhere in the species range (Clawson 2002).

In the summer, pregnant females separate from males and non-pregnant females. Pregnant females form maternity colonies under loose bark of living or dead trees. Roost sites are often in the open or along the edge of a forest with an open canopy and open understory; they may be in upland or floodplain/riparian forests (USFWS 1999b). However, in the northeast, Indiana bats are unlikely to roost in mature, coniferous forests (SVE Mammal Panel 2002) because such forests are generally more closed, with cooler temperatures and less opportunity for solar heating of roost trees.

Maternity roosts have been documented in many species of trees. It appears the presence of loose, exfoliating bark, exposure to sunlight, and proximity to other trees are more important habitat features than the species of tree (USFWS 1999b, Rommé et al. 1995). Most roost trees are larger than other available trees, with dbh (diameter at breast height) often measuring at least 40 cm (15.75 in.), although they have known to be as small as 22 cm (8.7 in.) (Williams et al. 1993, Kurta et al. 2002, Rommé et al. 1995). By their nature, roost trees have a limited "lifespan", but bats will use the same roost tree in multiple years as long as it is usable (USFWS 1999b).

Maternity colonies typically use one or more primary roosts that receive direct sunlight for much of the day and alternate roosts in other trees that may be more shaded or in the open (Kurta et al. 2002). The amount of shading preferred for maternity roosts seems to be variable, with some completely unshaded and others with >80% canopy closure (Rommé et al. 1995). Alternate roost trees are usually within a few hundred meters from the primary roost tree, although some have been found up to several kilometers away (Kurta et al. 2002). Primary roosts are located in openings or at the edge of forest stands, while alternate roosts can be in either open or forested conditions (USFWS 1999b). Maternity colonies have occasionally been located in tree cavities and cracks, buildings, in bridge crevices, and behind shutters (BCI 2001), but only trees with exfoliating bark have been documented as summer roosting sites in New England (SVE Mammal Panel 2002).

It is unknown if there are temperature parameters that would help define habitat suitability (SVE Mammal Panel 2002). Hall (1962) indicated that body temperatures of 34-36°C (93-97°F) were thought to be fatal to Indiana bats, but Kurta et al. (1995) demonstrated they could survive body temperatures up to at least 40°C (104°F) in summer. Humphrey et al. (1977) documented roost temperatures averaging 18-23°C (64-73°F). Butchkoski and Hassinger (2002) found building roost temperatures between 21.7º and 56.1°C (71-133°F), although the temperature at actual capture sites ranged from 26.7° to 38.3°C 80-101°F). When a choice of temperature was available, the average Indiana bat capture site measured 36.5° $\pm$ 1.3°C (98$\pm$2°).

Minimum temperature thresholds are also unknown, but it is assumed that temperatures must be at least high enough to support insect activity for foraging. Also, because bats are small animals with high thermoregulatory requirements, it is assumed that nighttime temperatures must not be so cold that an excessive amount of energy is expended on maintaining body temperature. Because of this, alpine and high elevation spruce-fir on the WMNF are not considered suitable habitats. In fact, Brack et al. (2002) suggest that the probability of Indiana bats reproducing in much of the eastern and northeastern U.S. is low because summer temperatures are generally too cool, especially in higher latitudes and elevations compared to the core habitat area in the Midwest. This is supported by Kiser et al. (2002), who surveyed woodland bats in Vermont. All of the Indiana bats captured in this study were found at low elevations in the warmest, driest part of the region in the Lake Champlain Valley.

Gardner and Cook (2002) evaluated land cover types in the 132 counties known to have evidence of Indiana bat reproduction. Their analysis showed that the predominant forest types are oak-hickory (15% of total area), maple-beech-birch (3.2%), oak-pine (2.7%), and elm-ash-cottonwood (2.1%). However, more than three-fourths (75.7%) of the land area in these counties is non-forested. Gardner and Cook (2002) theorize that although non-forested habitats would not provide suitable maternity roost sites, they may produce a significant quantity of insect prey required by reproductively active females. Agricultural activity is prevalent in the Lake

Champlain Valley, limiting forest land cover where Indiana bats were found to 32 percent of the presettlement condition. This mixture of forest and agriculture is very similar to Indiana bat summer habitat in the core of its range (Kiser et al. 2002).

Males and non-reproductive females seem to spend summer alone or in small groups in variable habitats. They will use tree roosts (Ford et al. 2002), caves and mines (Handley 1991), and artificial structures (Rommé et al. 1995). Summer roosts of all types are typically within a few hundred meters of streams or rivers (Webster et al. 1985, Hoffman 1996, Menzel et al. 2001, Rommé et al. 1995, Kurta et al. 2002). However, roost trees may also be located within small openings in a forest or within 50 meters (164 ft) of the forest edge (Carter 2003). Roost trees in southern Michigan received at least 10 hours of sunlight per day (Kurta et al. 2002). High amount of solar exposure was also found in Indiana bat studies elsewhere (Carter 2003, Callahan 1997 cited in Carter 2003).

Indiana bats may move frequently between multiple roost trees in their home range, perhaps because such habitat features are ephemeral and movement may allow monitoring of additional suitable sites (Kurta et al. 2002, Carter 2003). Butchkoski and Hassinger (2002) point out that none of the Indiana bats in their study foraged on slopes of 10º or higher, although appropriate habitat appeared to be available there.

Management can provide habitat for these bats on a small scale. Indiana bats have been documented using bat boxes in some areas. Small logging roads may provide suitable travel corridors. Logging and sugar bushes can create or maintain open forest habitat that is suitable for summer roosting (SVE Mammal Panel 2002). Tree removal does not discourage Indiana bats from using nearby snags as roosts (USFWS 1999b). Management of an area for a steady supply of suitable roost trees is more important than trying to manage individual roost trees (Callahan et al. 1997, Kiser and Elliot 1996, Rommé et al. 1995 cited in WMNF 1999). It is important to recognize that roost trees are an ephemeral component of the habitat and probably are not utilized for more than 10 years. Although Indiana bats may return to the same roost tree over several years, management that only protects existing roost trees with no consideration of the need for future sites may not succeed in sustaining local populations (Carter 2003).

Foraging takes place two to thirty meters (7-98 ft) above the ground in or beneath the tree canopy. Some bats also forage over clearings and farmland and along forest edges (USFWS 1999b, Menzel et al. 2001), although others appear to avoid these areas (Humphrey et al. 1977). Openings and riparian habitat seem to be important for foraging in northern New England (SVE Mammal Panel 2002, Rommé et al. 1995), although bats elsewhere immediately seek out forested conditions when leaving a roost (Carter 2003).

Occurrences

The total number of Indiana bats is estimated at 380,000 bats, a 57 percent decrease from 1960 when the population was estimated at about 880,000 individuals. However, the decline has not been evenly distributed throughout the species' range. In the last 40 years, the Indiana bat population in the south has decreased 80 percent, but in the northern Midwest and Northeast, the population has increased by 30 percent, including a more than 100 percent increase in winter occurrences (Clawson 2002).

On the White Mountain National Forest, a woodland bat survey was conducted in 1992. Twenty-five capture sites, distributed across the Forest, were sampled. Over 350 bats were captured, one of which was identified as an Indiana bat. Some question regarding the species identification remains (New Hampshire Natural Heritage Bureau 2003), but the WMNF has assumed the identification was valid. Subsequent bat surveys (some specifically targeting Indiana bats) have not produced any additional Indiana bats on the WMNF (M. Yamasaki, pers. comm.; Bat Conservation and Management 2002, Bat Conservation and Management 2004).

Based on occupancy in nearby locations, it is assumed that Indiana bats could theoretically occupy the WMNF between May 15 and August 30. No hibernacula are known on the Forest. The closest known occupied hibernaculum is the Brandon Silver Mine in Vermont, approximately 70 miles from the Forest's boundary.

However, recent woodland bat surveys in New Hampshire during 2002 found a drastic difference in sex ratios on the WMNF compared to other parts of the state. In 2002, bat captures in the coastal region were equally divided between males and females (n=36). Likewise in the Connecticut River valley, half of all bat captures were males (n=82), but on the WMNF, 86 percent of captured bats were males (n=70) (Bat Conservation and Management 2002).

In the same study, pregnant and/or lactating females of three woodland bat species were netted, indicating reproductive activity. In the coastal region, 72 percent of 18 females showed reproductive signs. In the Connecticut River Valley, 52 percent of 58 females showed reproductive sign, but only 10 percent of 10 females (just one individual) showed signs of reproductive activity in the White Mountains (Bat Conservation and Management 2002). Low numbers of females and lower numbers of reproductive females in the White Mountains may indicate the WMNF is not suitable for Indiana bat reproduction.

In 2004, another survey was made in the WMNF. Of the 233 bats captured, none were Indiana bats. The sex ratio was also more balanced in 2004, with females accounting for 42% of all captures. However, reproductive condition was skewed more than 2002, with only 5 of 96 female bats (0.05%) identified as post-lactating, indicating very little reproductive activity occurring on the Forest.

Other recent woodland bat surveys in the Connecticut River Valley and at the Quabbin Reservoir in Massachusetts all have failed to pick up Indiana bats (Bat Conservation and Management, Inc. 2003; R. Brooks, USFS, pers. comm.). In Vermont, the Green Mountain National Forest has surveyed woodland bats for the last five years, with the express purpose of finding and tracking Indiana bats to roost locations. Neither of the two Indiana bats found traveled out of the state (D. Grove, USFS, pers. comm.).

Threats

1. *Hibernacula impacts* Impacts at hibernacula are the greatest threat to Indiana bats. Impacts may come from natural disturbance (e.g. flooding, climate changes that alter interior temperature and humidity, cave collapse) or human actions (e.g. cave disturbance by humans, mine reclamation, closing cave entrances, improper installation of bat gates) (USFWS 1999b, Richter et al. 1993).
2. *Availability of suitable hibernacula* In northern New England, the availability of suitable hibernacula may be a limiting factor. It is unlikely that bats hibernating elsewhere would travel towards the WMNF for summer roosting. In addition, the cool climate and dense forest of the WMNF and Green Mountain National Forest in Vermont may limit the ability of this species to use these areas (SVE Mammal Panel 2002).
3. *Human-caused mortality* Several instances exist where people had purposefully killed large numbers of bats in caves (USFWS 1999b).
4. *Loss of summer habitat* Destruction of summer habitat may negatively affect Indiana bats if suitable roost sites and foraging areas (including bodies of water and the insects they produce) are altered. Land clearing and development, stream channelization, and management of surface water have reduced suitable summer habitat in some locations, although the extent and impact of this loss is unknown (Humphrey et al. 1977, SVE Mammal Panel 2002).
5. *Timber harvest* Timber harvest has the potential to impact Indiana bat habitat, although some studies indicate that as long as snags and suitable roost trees are protected, habitat may still be used (USFWS 1999b, BCI 2001). However, it appears unnecessary to try to provide additional roost trees at higher elevations and other cooler sites (e.g. north-facing slopes) because these habitats are just too cool to provide optimal habitat (Brack et al. 2002).
6. *Disease* Diseases, including rabies, may impact Indiana bat populations, although the incidence of rabies is assumed to be low as it is in other bat species – probably less than 1 percent (Brass 1994 and references cited therein; Belwood 1998). The potential effect of the West Nile virus is unknown. As yet, it has not been detected in Indiana bats, but has been documented to kill big brown bats and little brown bats in New York (CDC 2002).

7. *Chemicals* Insecticides and pesticides used for agriculture and forestry, especially if applied at dusk, have been implicated in the decline of several bat species. Bats are either killed directly through exposure or through reduced forage availability (Belwood 1998). Heavy metals and other contaminants also reduce bat populations (Belwood 1998).
8. *Climate change* Widespread global warming may negatively impact Indiana bats if their insect forage base is reduced. Temperature changes could make currently usable hibernacula unsuitable (but could also improve habitat conditions at previously unusable sites).
9. *Wind turbines* Wind turbines used to generate electricity have caused bat mortality in various parts of the U.S. Migratory tree bats make up the majority of the fatalities and nearly 90% of collisions occur in mid- to late summer (Johnson 2002).
10. *Predation* Documented predators include mink, pilot black snakes, and screech owls (Thomson 1982), although there are no predators who specifically predate bats.

The most limiting factors of concern under WMNF control are:

a. Activities that could destroy a tree holding a roosting Indiana bat.
b. Activities that may significantly reduce the availability of suitable roost trees.
c. Activities that could reduce foraging habitat (openings including open wetlands)
d. Placement of wind turbines.

Information Gaps

The SVE Mammal Panel (2002) identified the following information gaps:

1) Role of temperature and elevation in defining summer habitat
2) Possible habitat differences related to temperature and elevation between sexes.

Pertinent Resource Actions and Mitigation

The goal for Indiana bat is to maintain suitable conditions for roosting and foraging. Additional direction is provided to work with partners to further understand the role of the forest in recovery and to protect suitable roost trees.

Affected Environment

The scope of effects analysis for the Indiana bat is the radius distance between the closest hibernaculum to the eastern boundary of the WMNF. This distance is approximately 90 miles and would encompass the majority of the Indiana bat population in the northeast U.S.

Habitat Trends

Five hibernacula are currently occupied within the analysis area, three in New York and three in Vermont (Hicks and Novak 2002, Kiser et al. 2002, S. von Oettingen, pers. comm.)). Most potential caves and mines in the rest of the Northeast have been searched, but no additional Indiana bat locations have been found (Hicks and Novak 2002).

Gardner and Cook (2002) modeled suitable summer habitat in the Northeast, using the following criteria:

"≥1% oak-hickory OR ≥3% oak-pine OR ≥3% maple-beech-birch OR ≥-2% elm-ash-cottonwood AND ≥38% nonforested"

Using these criteria, twelve counties (of 28) in the analysis area contain suitable summer habitat. Notable is that of the three counties that encompass the WMNF in New Hampshire, only Carroll County is included. This was a coarse level analysis, so there may still be pockets of suitable habitat in counties that don't meet the criteria, but at a landscape scale, the northeast in general shows approximately 50 percent of counties as suitable habitat, while the Indiana bat core habitat in the Midwest is almost 100 percent.

The WMNF appears to offer less suitable Indiana bat habitat than surrounding areas. Oak-hickory and elm-ash-cottonwood do not exist on the Forest, and oak-pine is considered uncommon (approximately one percent of the WMNF). Permanent openings make up only two percent. Although regenerating stands would increase that amount, it would add less than one percent to existing open habitat, a substantial difference from the 38 percent modeled by Gardner and Cook (2002).

Where Indiana bats do occur in the Champlain Valley, habitat is considered stable, but somewhat limited. With the low numbers of Indiana bats currently present, suitable habitat is still available, but woodlots are generally small in scale.

In 1999, the WMNF completed a Biological Assessment (Whisler 1999) that documented the rationale for choosing habitat evaluation factors for Indiana bat. These habitat evaluation factors were measured to determine the amount of suitable roosting and foraging habitat on the Forest. The Biological Assessment determined that both roosting and foraging habitat is found on the vast majority of the Forest. However, because much of the WMNF is dominated by mature conifer forests, solar heating on the majority of available natural roosts is limited. In addition, the steep slopes common across the Forest require higher travel and foraging energy costs and are likely to be unattractive to reproductive female bats (Bat Conservation and Management 2002, SVE Mammal Panel 2002). Approximately 13 percent of the WMNF is less than 10 percent slope.

The 1986 Forest Plan objectives emphasized even-age harvests (e.g. clearcuts, seed tree, shelterwood, etc.), with 70 percent of the acreage where timber harvest was allowed to receive even-age treatments and 30 percent to receive uneven-age treatments.

Table G-3 displays the actual results of harvest accomplished under the 1986 plan from 1987 through 2002.

Table G-3. Projected harvests vs. actual harvests on the WMNF between 1987 and 2002

Harvest Method	Total Acres Treated	Projected Forest Plan Acres*	% Accom- plished
Even-age Regeneration (clearcuts, shelterwood seed cuts, strip cuts)	11,960	24,640	48.5
Even-age Intermediate (thinnings, shelterwood prep cuts, improvement cuts)	16,300	23,460	69.5
Uneven-age	17,626**	15,080	116.9
Total	**45,886**	**63,180**	

* Projected Forest Plan acres are based on the estimates for the first decade plus 70 % of the estimate for the second decade. This accounts for 17 years of the 2-decade period.

** Uneven age acres include both single-tree and group selection treatments. Group selection figures are adjusted to account for the fact that treatment within group selection stands is usually applied on approximately 20% of the actual stand acreage.

As the table indicates, even age treatments in general and regeneration treatments in particular have not been implemented at the projected rate. Uneven age treatments, on the other hand have occurred at a rate slightly greater than the intensity envisioned in the current Forest Plan.

Currently, in all vegetative community types, the overwhelming majority of the acreage is in mature and overmature age classes. Overall, 24 percent of the land in Management Areas 2.1 and 3.1 (where timber harvest is allowed) are in an overmature age class and 58 percent are in mature age class. Conversely, only about 17 percent are in the young age class and only 1 percent is in a regeneration age class.

Since 1987, the net result is that approximately 3.5 percent of the 345,000 acres contained within MA 2.1 and 3.1 lands has been regenerated with even-age methods.

Population Trend

The northeast population of Indiana bats has grown considerably in recent years. In 1975, the northeast held an estimated 500 Indiana bats (0.001% of the species) (Humphrey 1978 cited in Hicks and Novak 2002). Six years later, the population was estimated at 2,000 individuals (0.003%) (U.S. Fish and Wildlife Service (1983) cited in Hicks and Novak 2002). However, by the mid-1990s, while the range-wide population had declined by 35 percent (USFWS 1999b), numbers in the northeast continued to increase. The Northeast currently makes up almost 10 percent of the total population (Clawson 2002). Virtually all (>99%) Indiana bats in the Northeast hibernate in New York (Hicks and Novak 2002). However, these numbers may be somewhat misleading because much of the apparent increase is, in fact, due to new hibernacula being located, rather than an increase in numbers at known sites. Because of this, the overall population in the northeast is considered stable.

Environmental Effects

Alternative 1

In 2000, the U.S. Fish and Wildlife Service concurred with a determination made by the WMNF that continued implementation of the existing Forest Plan would result in an adverse effect to Indiana bats. A Biological Opinion issued by the U.S. Fish and Wildlife Service required Terms and Conditions be implemented to avoid impacts to Indiana bats potentially in the area. However, since that time, new information has become available. Specifically, additional survey effort both on the WMNF and in surrounding areas (e.g., Vermont, Connecticut River Valley) have pointed out a noticeable lack of Indiana bats outside of the Champlain Valley and an even more striking lack of reproductive activity for any woodland bat species on the Forest (see above). Thus, implementation of the current Forest Plan is no longer considered to have the same effects as originally surmised a few years ago. There is still no lack of roost trees on the Forest under any alternative as summarized in the WMNF's Biological Assessment conducted in 1999 (Whisler 1999). Standards and guidelines for Riparian and Aquatic Habitats and Watershed would protect these foraging and potentially roosting habitats in all alternatives. Wildlife objectives include maintenance of some permanent openings which would also provide limited foraging habitat. The only negative impact that could result in measurable effect would be if an active Indiana bat roost tree was cut. However, the likelihood of an Indiana bat leaving the hibernacula of New York and Vermont and bypassing the more suitable Champlain and Connecticut River valleys to roost on the White Mountain National Forest is very unlikely. It is even more unlikely that an Indiana bat would be in a tree that was targeted for harvesting or otherwise impacted (e.g. through prescribed burning or hazard tree removal). The chance of an Indiana bat being harmed by loss of its roost tree is so small as to be discountable.

On the positive side, the mature forests in the WMNF are below the optimal threshold for canopy closure, i.e., generally they are too closed. Uneven-aged timber harvest activities could improve canopy closure conditions and even-aged regeneration treatments could provide temporary foraging habitat soon after cutting. Again, this would only be a beneficial local effect, provided an Indiana bat is nearby to take advantage.

Placement of wind turbines under special use permit would be allowed in all alternatives. It is possible that an Indiana bat would have a higher risk of colliding with such a structure, but the likelihood that an Indiana bat would be found on the Forest and in the same location as a wind turbine is remote. In any case, Wildlife guidelines to mitigate collision would be included in all alternatives.

Cumulative effects of Alternative 1

Future activities within the analysis area are likely to include increased development and loss of agricultural lands. Forested lands will also likely be reduced, although suitable roost trees appear to be abundant regardless. The vast majority of the WMNF does not resemble Indiana bat habitat

found in the Champlain Valley, which is far more open, with slow-moving streams that support more abundant aquatic insects. Woodlots are common there, but contain tree species not found on the WMNF such as shagbark hickory (*Carya ovata*) which provides much more obvious roosting sites. It is possible that the WMNF could contribute to the regional Indiana bat population during the non-hibernation season, but since summer roosting habitat is not limiting in the region, the importance of the Forest to recovery is small. If Indiana bats occur on the WMNF, they are likely transient males and not reproductive females, which would not likely cross such a vast expanse of suitable habitat to occupy more marginal habitat on the Forest. Development and loss of agricultural habitat would likely continue in the future and may have some effect on the Indiana bats that currently reside in the analysis area. The regional population will probably continue to remain stable for a period of time, assuming hibernacula space is available, with the core of the regional population continuing to center around the New York/Vermont border.

The one factor that could change this would be if multiple wind farms are placed within the analysis area in Indiana bat migration corridors. Recent studies (e.g., Johnson 2002, Arnett et al. 2004, and literature summarized by Johnson and Arnett 2004) identify the potential for high mortality rates at some turbine sites caused by bat collisions with turbine blades and towers. Several wind turbine projects have been proposed in the northeast and could contribute to mortality effects on the regional population. Impacts to the regional population would be dependent on the magnitude and locations of these projects. This would have little bearing on the WMNF, since it is so unlikely that reproductive Indiana bats would ever occupy the Forest, but could have implications for the population within the larger analysis area.

Alternatives 2, 3, and 4

Effects from the other alternatives would be similar to those described above in Alternative 1, but since less timber harvest occurs, the likelihood of impacting an Indiana bat roost tree is reduced. Fewer temporary openings would be provided; therefore, less foraging habitat would be available. However, the likelihood of an Indiana bat occurring on the Forest is so small that the actual difference between the alternatives is inconsequential.

Cumulative effects of Alternative 2, 3, and 4

Cumulative effects would be similar to Alternative 1. Regardless of alternative, the WMNF is not likely to support reproducing Indiana bats, although abundant foraging and roosting habitat would be available in all alternatives.

Determination — Indiana bat

Implementation of any alternative **may affect but would be not likely to adversely affect** Indiana bats.

Rationale Summary

1. Based on recent studies in the northeast, it seems unlikely that an Indiana bat would occur on the WMNF. The western edge of the Forest is twice the distance that Indiana bats have been known to travel from hibernacula in New York.
2. Foraging and roosting habitat exists and could be enhanced or reduced somewhat by timber harvest and other activities, but when compared to the more suitable habitat in the Champlain and Connecticut River valleys, it is extremely unlikely an Indiana bat would remain or even occur on the WMNF. Factors such as canopy closure levels and lack of optimal roosting tree species (e.g. shagbark hickory) make WMNF habitat suboptimal.
3. Since 1992, additional surveys have not documented another Indiana bat on the Forest or even east of the Green Mountain National Forest in Vermont. It is likely the one Indiana bat occurrence was a transient individual, not a member of a breeding colony. Survey data also shows a disproportionate number of male bats (of various woodland bat species), indicating a lack of breeding females. Since roosting and foraging habitat is available, it may be that the Forest's temperature and other climatic factors are not optimal for Indiana bat breeding and management direction would not influence species recovery in any alternative.
4. Forest Plan direction to reserve snags and other "wildlife" trees from timber harvest would mitigate loss of roosting habitat through harvest treatments.
5. Best Management Practices and riparian standards and guidelines would protect potential foraging sources over water.
6. Roads and other travel corridors would continue to exist, as would openings (both natural and managed) that would serve as foraging sources, so these would not be considered limiting.

Potential effects from placement of wind turbines or cell towers are worth evaluating as an emerging issue, and mitigation is in place to consider these potential effects during site specific placement and construction. However, the chance of an Indiana bat being on the Forest is already remote; the chance that an Indiana bat would be located on the Forest and would come in contact with one of these structures is so remote as to be considered discountable.

Gray wolf (*Canis lupus*) — Federal endangered

The gray wolf was first listed as endangered under the Endangered Species Act in 1974.

The Minnesota population was reclassified to threatened status in 1978 (USFWS 1992b). In 2003, the USFWS established three distinct population segments (DPS) for wolves in the United States: the Western DPS (Washington, Oregon, California, Nevada, Idaho, Montana, Wyoming, northern Utah, and northern Colorado), the Southwestern DPS (Arizona,

New Mexico, western Texas and Oklahoma, and southern Utah and Colorado), and the Eastern DPS (North Dakota, South Dakota, Nebraska, Kansas, Missouri, Iowa, Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, New York, and New England. Although there was some discussion about designating the northeast as a separate DPS, there is no firm evidence of a wolf population existing there, so it was included with the Lake States. The USFWS proposed changing the Eastern DPS classification to threatened (USFWS 2003c). However, an Oregon district court ruling in January 2005 vacated the changed classification. The gray wolf continues to be listed as endangered.

Distribution

Gray wolves were historically distributed throughout the northern hemisphere north of 20 degrees latitude in all habitats and topography except deserts and high mountain tops, but deliberate hunting has shrunk the current distribution considerably (Mech 1974). By 1900, the species was extirpated from more than 95 percent of its historic range in the conterminous U.S. At the time the wolf was listed under the Endangered Species Act, it is estimated that only several hundred wolves existed (in northeastern Minnesota; on Isle Royale, Michigan; and possibly Montana, the southwestern U.S., and the upper peninsula of Michigan (USFWS 2000b)).

Wolves that most recently inhabited the northeastern U.S. have been considered unique among North American wolves; however, it is unclear if northeastern wolves were a subspecies (*C. lupus lycaon*) or a separate species (*C. lycaon*) (Wilson et al., 2000). Hybridization with coyotes in the northeast has further complicated taxonomy issues. Also unclear is whether wolves that occurred in the northeast before European settlers arrived were the same taxon as wolves currently in or within dispersal distance of the region.

Nevertheless, wolves are considered extirpated in the northeastern U.S.; no occurrences of wolves of any taxon have been documented in New Hampshire or Vermont since they were extirpated from the region in the late 19th century. In Maine, two animals believed to be wolves were found during the mid-1990s (USFWS 2000b). In 1998, a wolf-like animal was shot in Glover, Vermont. Tissue analyses were conflicting but suggested a wolf-dog or wolf-hybrid ancestry (a hybrid). In 2001, another wolf-like animal was shot in Edinburg, New York. Examination by state experts proved inconclusive, but the animal was identified as a wolf by the U.S. Fish and Wildlife Service's Wildlife Forensic Lab in 2003 (M. Amaral, pers. comm.). Local species experts believe that regardless of the species taxonomy, if a large canid is to reoccupy the northeast, it is important that it be large enough and capable of the pack structure necessary to prey successfully on moose (SVE Mammal Panel 2002).

Life History

Life history factors are based on *C. lupus*.

Reproduction

The reproductive process in wolves drives pack dynamics, social status of individuals, movements, and some aspects of seasonal habitat use. Alpha males and females generally suppress behavior in lower ranking individuals and only mate among high ranking individuals in the pack (Carbyn 1987). Estrus may take place anytime from January in low latitudes to April in high latitudes (Mech 1974). A wolf pack generally produces only one litter per year (Packard and Mech 1980 cited in Carbyn 1987). A proportion of 15-30 percent pups indicated a stable population, while 40-50 percent pups indicated a moderately to heavily exploited population (Pimlott et al. (1969) cited in Carbyn 1987).

Wolves may be sexually mature at 22 months, but often do not breed until they are three years old (Carbyn 1987). Gestation lasts 63 days and an average of six (range = 1-11) altricial young are born in a den that may be used year after year (Mech 1974). Wolves may dig their own den or enlarge the dens of other mammals (Carbyn 1987). The female stays near the young for at least two months, while other pack members hunt and feed both the female and her young. Weaning occurs at approximately five weeks and at around eight weeks, the female moves her pups to a "rendezvous site", where they can play over a larger area. They may remain up to three weeks at one rendezvous site, but then shift as far away as eight kilometers (5 mi) to another site (Mech 1974), moving progressively further and further from the den (Carbyn 1987).

Ten years is considered old age for a wild individual (Mech 1974).

Carbyn (1987) cites a number of studies indicating the greatest mortality factor for wolves is human activity.

Dispersal

Wydeven et al. (1998) reviewed the literature on dispersal of wolves beyond their natal territories in North America outside of Alaska. Most dispersal occurs from late fall to early spring, but during one study in Quebec, all dispersals occurred during spring and summer (April-August). Wolves tend to disperse at a higher rate and at a younger age in growing populations (e.g., Minnesota/Wisconsin) than in stable ones (e.g., western U.S.). In Minnesota, 47-83 percent of yearlings dispersed depending on the growth rate of the population.

Dispersal distances vary widely, but individual wolves are capable of traveling hundreds of kilometers, provided there is a sufficiently large source population and no barriers to movement (Mech 1974, Wydeven et al., 1998). Wolves in Algonquin Provincial Park, Ontario, migrate across 2,300 km^2 (884 mi^2) during winter (generally December – March) to follow 2,000-3,000 deer that migrate to winter grounds outside the park. The wolves follow deer despite a moose density of approximately 0.5/km^2 (0.19/mi^2) (Theberge et al., 1996).

Wydeven et al. (1998) reviewed recolonization by wolves in different areas. Wolves crossed 24 km (15 mi) of frozen Lake Superior to colonize Isle Royale, Michigan, and traveled >600-1,000 km (370-620 mi) from northern

Scandinavia or Russia to southern Sweden. Mountainous terrain, scattered woodlots, and rivers bordered by forests seem to facilitate recolonization, although wolves in Wisconsin and Manitoba crossed extensive areas of farmland to colonize isolated areas.

It is believed that wolves in southeastern Canada could be physically capable of dispersing into suitable habitat in Maine and New York; however, barriers may preclude immigration of sufficient numbers to establish self-sustaining populations. Potential barriers include the St. Lawrence Seaway (whose shipping lanes are kept open from freezing during the winter), extensive areas of unforested agricultural land, and areas with high densities of humans and/or roads. Negative attitudes towards wolves may result in killing of migrating wolves, which could further impede recolonization of the northeastern U.S.; people's positive attitudes towards wolves is associated with successful natural recolonization (reviewed by Wydevan et al., 1998).

Home ranges for wolf packs range from 125-344 km^2 (48-132 mi^2 or approximately 31,000-85,000 acres) in areas with deer/moose; where moose are the primary prey, home ranges often exceed 500 km^2 (193 mi2) (Carbyn 1987).

Relationships with Other Species

Wolves predate ungulates (e.g., deer and moose) and beaver, though they may opportunistically take any animal species, including domestic livestock (Mech 1974). When prey is abundant, wolves may consume approximately 1 moose/wolf/45 days and 1 deer/wolf/18 days (reviewed by Mech 1974). Densities of moose and deer in the WMNF are likely 4-4.5/km^2 (10-12/mi^2) and <2/km^2 (<5/mi^2) respectively, which is at the low end of deer densities in areas where viable wolf populations are found (SVE Mammal Panel 2002).

Few species successfully compete with wolves, except for humans and perhaps cougars. Although wolves are able to exclude coyotes and other smaller canids through competition for limited food resources, coexistence between wolves and canids is relatively common (Peterson 1996).

Habitat

Like many large carnivores, wolf habitat is variable and depends primarily on habitat availability for prey species, prey abundance, and low human density (Carbyn 1987, DeGraaf and Yamasaki 2001). Deer habitat is characterized by forest edges, swamp borders, areas interspersed with fields and woodland openings, dense cover for winter shelter, and adequate browse. Moose occur in second-growth boreal forests interspersed with semi-open areas and swamps or lakes that have cover and aquatic plants for food. Beavers are found in slow-moving brooks, streams, and rivers that are usually bordered by young hardwoods (DeGraaf and Yamasaki 2001).

Minimal human activity also influences wolf use of an area. Harrison and Chapin (1998) defined potential dispersal habitat in the northeastern U.S. as areas in either forested or mixed forest-cropland cover types with <10

humans/km^2 (16 humans/mi^2) and <0.7 km roads/km^2 (1.1 mi/mi2) (based on Fuller et al. (1992) thresholds for wolf occupancy in Minnesota). Core habitat requirements are more rigid: forested areas with <4 humans/km^2 (6.5 humans/mi^2) (Harrison and Chapin 1998). Mladenoff and Sickley (1998) modeled potential wolf habitat in the northeast as forest and wetlands, but with even less human disturbance: <0.45 km roads/km^2 (<0.72 mi/mi^2) and <1.5 humans/km^2 (2.5 humans/mi^2).

In the Recovery Plan for the Eastern Timber Wolf (USFWS 1992b), a viable population was considered to have either: 1) 25,600 km^2 (10,000 mi^2 or approximately 6 million acres) of contiguous, suitable habitat occupied by wolves if the population was isolated; or 2) 12,800 km^2 (5,000 mi^2 or approximately 3 million acres) of such habitat if the population was within 160 km (100 mi) of a self-sustaining wolf population. In general, viable populations are associated with single large areas rather than many small habitat patches comprising a similar area (USFWS 1992b, USFWS 2000b). The Recovery Plan did not include the WMNF as a potential area for wolf reintroduction.

However, the SVE Mammal Panel (2002) believes the WMNF could play a role in providing wolf habitat. The Panel points to analyses by Mladenoff and Sickley (1998) and Harrison and Chapin (1998), who independently assessed potential wolf habitat in the Northeast using different methods, but arrived at similar results. Mladenoff and Sickley (1998) used road density to estimate that the northeastern states from upstate New York to Maine contained >77,000 km^2 (>29,000 mi^2) of suitable wolf habitat. A contiguous area from Maine to northeastern Vermont (including portions of the WMNF) was estimated to contain >53,000 km^2 (>20,373 mi^2) of suitable habitat that could support 702-1,439 (90% CI) wolves based on estimates of prey abundance.

Harrison and Chapin (1998) also estimated the area of potential wolf habitat in the northeastern states; their estimates were based on a GIS analysis of forested habitat and human density in addition to road densities. Inclusion of the three variables instead of just road density used by Mladenoff and Sickley (1998) resulted in similar, but slightly lower estimates of potential core wolf habitat: 65,710 km^2 (25,370 mi^2) in Maine, New Hampshire, Vermont, and New York combined. Their area also included portions of the WMNF. Harrison and Chapin (1998) further point out that the potential habitat in Maine and New Hampshire exceeds by 36 percent the area of habitat identified for further study in the Recovery Plan (1992). They estimated that the contiguous area comprising northern, western, and eastern Maine into northern New Hampshire (including portions of the WMNF) could support a population of 488-1,951 wolves; the prey base and proximity to wolf populations in southeastern Canada make this area the most likely to support viable wolf populations in the Northeast.

In the entire Maine Maritime complex there is 172,000 km^2 (66,410 mi^2) of suitable habitat, which could support 1200-4800 wolves (probably closer to the lower range based on prey items). If human tolerance can be increased, wolves can be supported and the habitat map could be expanded, including the WMNF.

Occurrences

The wolf is currently considered extirpated from the WMNF (USFWS 2003a) and is likely not present anywhere in New Hampshire. There have been no confirmed wolf sightings in New England since possibly 1996 (USFWS 2000b), although the difficulty in identifying an animal as a true wolf, even when a whole specimen is available, has complicated the situation. The closest extant wolf population is in southeastern Quebec (Harrison and Chapin 1998).

Threats/Limiting Factors

The following have been identified as threats to wolves:

1. *Automobile collisions* (USFWS 2000b)
2. *Accidental trapping*
3. *Disease*. Other canids (including domestic dogs) can transmit diseases (e.g., rabies, canine distemper, canine parvovirus, and heartworm) to wolves (reviewed by Brand et al., 1996). Ticks can infect wolves with Lyme disease (reviewed in USFWS 2000b). Wolves are also susceptible to blastomycosis, tuberculosis, and sarcoptic mange. Canine parvovirus, sarcoptic mange, and Lyme disease are thought to influence population growth in wolves (Brand et al., 1996; USFWS 2000b). Heartworm, canine parvovirus, and Lyme disease are relatively new to gray wolves and could potentially limit isolated or disjunct populations (USFWS 1992b)
4. *Lack of public support* (Theberge et al., 1996). Positive attitudes towards natural recolonization have been associated with viable populations (reviewed by Wydevan et al., 1998)
5. *Loss of genetic viability*. Potential interbreeding with coyotes is likely to hamper wolf reestablishment in the northeastern U.S. because individual wolves would be dispersing into a "sea" of coyotes with very limited opportunities to breed with other wolves; this could lead to genetic 'swamping' (Wydeven et al., 1998). Hybridization has been shown to occur between wolves and coyotes in Minnesota, Ontario, and Quebec – the latter two being populations from which wolves might immigrate to the northeast U.S. Introgression of coyote mitochondrial DNA into wolf populations occurs, but not vice versa, which probably indicates hybridization between male wolves and female coyotes in regions where coyotes have become recently abundant (Lehman et al., 1991; Roy et al., 1994).

The most limiting factors of concern under WMNF control are:

a. Actions that may reduce prey availability below minimum thresholds
b. Actions that increase potential for vehicle collisions
c. Actions that may increase human access into wolf habitat and that lead to persecution of wolves.

Information Gaps

The SVE Mammal Panel (2002) identified a need in the east to incorporate land ownership patterns into an analysis of optimal habitat for supporting viable wolf populations.

Pertinent Resource Actions and Mitigation

The revised Forest Plan would include a goal of providing suitable prey habitat for wolves if they become established on or near the WMNF. A guideline would also protect known deeryards and improve deeryard conditions where possible.

Affected Environment

The scope of effects analysis for wolf is the ecological sections that encompass the WMNF: M212A and M212B (McNab and Avers 1994, Keys et al., 1995). GIS analysis by Harrison and Chapin (1998) suggests that potential habitat is contiguous throughout northern, western, and eastern Maine, and extends well into northern New Hampshire (Map G-01).

Habitat Trend

A study of wolves in Algonquin Provincial Park, Ontario showed that a wolf population may persist in areas used for resource extraction and surrounded by human settlement and agriculture if three conditions are met: 1) adequate prey, 2) adequate protection, and 3) adequate public support (Theberge et al., 1996).

Prey

The New Hampshire deer herd peaked in the 1960s, then crashed to its lowest point in the mid-1980s. The herd rebounded and has held fairly steady in the last decade, although it is still lower than the 1960s peak (NHFG 2003). In Maine, population trends have been similar, peaking in the 1950s, but holding steadier and lower in recent years. Maine has analyzed deer density by state regions, concluding deer abundance approximates 1-2 deer/km^2 (2-5 deer/mi^2) in the northern part of the state and increases to 6-10 deer/km^2 (15-25 deer/mi^2) in central and southern areas. Some individual locations where hunting access is denied or limited have deer densities as high as 16-40 deer/km^2 (40-100 deer/mi^2). State goals for deer are set at 4 deer/km^2 (10 deer/mi^2) overall (Lavigne 2003).

Unrestricted hunting and increased exposure to brainworm in the 19th century caused a catastrophic decline in the moose population. Following habitat improvement and legislative action to protect moose, they have increased in numbers and are now more than ten times more abundant in Maine than at the turn of the century (Vashon 2003a). Moose experienced a similar history in New Hampshire, although in the White Mountains region, the goal is to increase the size of the future herd by 66 percent. (The northern region is considered to have met the recommended goal for population size) (NHFG 2003).

Vehicle collisions
Road densities have probably increased over the analysis area as development has increased. On the WMNF, however, road densities are very low (approximately 0.5 miles per square mile across the entire Forest).

Human use on the WMNF has increased since the Forest Plan was approved (see Recreation effects), and development around the WMNF and in northern New England has also increased road densities and human use. Forested lands are being lost outside of the WMNF, although large blocks of unfragmented forest still exist (Thorne and Sundquist 2001). Although human use density in terms of people living year round within the Forest boundaries would not meet the thresholds of the studies described above, recreation use on any given day in the summer would likely exceed them in many parts of the Forest. Unfortunately, recreation use figures are not available in any consistent format to be able to compare current use against threshold levels.

Public support
Public support for wolves is unknown but probably ranges from those wanting to see wolves return to the northeast to those who fear livestock depredation who would prefer that they remain extirpated.

Population Trend

Wolves have been considered extirpated from the WMNF for some time and are not known to occur anywhere in the analysis area.

Environmental Effects

Alternative 1

Prey
Since no wolves are currently known to exist on the Forest, there would be no effect to them as a result of implementing any of the alternatives. However, there is a possibility that in the future, wolves could recolonize the Forest or surrounding areas. Under Alternative 1, prey foraging habitat would be at the highest levels of any alternative. Clearcutting and other even-aged regeneration harvest prescriptions would disperse prey habitats across the lower elevations of the Forest. This may increase the size of the prey base and could improve the chances of locating deer and moose near areas where wolves may be found.

Vehicle collisions
Under all alternatives, temporary roads used for timber extraction would be closed upon completion of the project, so although road density in total would increase, open road density (i.e., roads actually being used) would not change much from current conditions. The risk of vehicle collisions would probably be the same in all alternatives because collisions are most likely on high-speed, high-volume highways (e.g., I-93), which would not be changed through Forest Service action (but see cumulative effects below).

Human use
Human use densities on the WMNF are somewhat unknown. Very few inholdings exist within the Forest boundary containing year-round

residences. Persecution of wolves (either killing them directly or harassment) is a significant limiting factor elsewhere in the wolf's range. Recreation use appears to not be a limiting factor in wolf recolonization, but it could be assumed that some level of harassment (likely unintended) could occur as numbers of people in an area increase. Recreation use figures are not considered reliable (see Recreation effects), although consensus exists that use on the Forest has increased and is likely to continue increasing over then next 20 years. It is assumed that in Alternative 1, increased use at developed sites (where wolves are unlikely to be found) would be minimal (up to 54 new campsites over the life of the Forest Plan) and essentially would not change the current situation in terms of habitat suitability. Dispersed activities such as hiking will likely increase, following current trends; however, studies do not seem to suggest that human presence alone causes negative effects on wolves. Fast-growing activities such as mountain biking, which can occur over more area of the Forest, would have greater potential for disturbing colonizing wolves than site-specific activities such as rock climbing. The recreation activity with the greatest potential for causing disturbance may be summer motorized (ATV) use. Alternative 1 anticipates one or two new trails likely in management areas 2.1 or 3.1. Depending on the site-specific locations of these trails, portions of the Forest could be made less suitable for wolf recolonization or use, at least during the summer.

Currently, the WMNF has some areas that would be considered suitable for wolf habitat (see Habitat discussion above), but the entire Forest would not meet minimum habitat suitability threshold levels. Habitat suitability of some areas may decline in the future under Alternative 1 due to increased recreation pressure, but should not be eliminated within the planning period.

Cumulative effects of Alternative 1

Prey

In general, development levels within the analysis area are highest to the south of the WMNF, with large tracts of forested land and low human densities further north. The prey base is also higher to the north than in the White Mountains. Throughout the analysis area, the deer herd should increase in both New Hampshire and Maine to meet management goals. Moose would be expected to increase in New Hampshire, but population goals have already been met in Maine, so should remain stable there (NHFG 2003, Vashon 2003a). Under Alternative 1, it is possible that the harvest levels proposed on the Forest could increase the prey base so that the WMNF could play a larger role in supporting wolf populations; however, habitat suitability may be better in areas further north where the prey base is higher and human activity is less.

Vehicle collisions

Road density may increase as human use increases throughout the analysis area. More likely around the WMNF, though, is that improvement projects (e.g., road widening and straightening) on existing highways will lead to a greater potential risk of vehicle collisions. State Departments of Transportation have a number of these projects proposed in the next five

years. Although the goal of these projects is improved safety conditions, a secondary result will often be increased traffic speeds. With a greater volume of cars anticipated with increasing human populations, the risk of collisions will continue to increase.

Human use
Persecution pressure may actually decline in the future. This factor is usually associated with livestock depredation. Environmental education efforts to promote wolves, as well as programs to compensate farmers for losses, may reduce the risks to wolves over the long term.

Unfortunately, the biggest limitation to wolf recovery around the WMNF is the lack of a source population close to the analysis area. Wolves have been sighted nearby, so it is likely that over time, enough wolves may disperse to the area. However, if genetic swamping from coyotes becomes a key factor, there is little that the Forest Service could do to mitigate those effects.

Alternative 2

Prey
Under Alternative 2, the amount of timber harvest proposed would keep prey levels at current levels, which is considered marginal in terms of deer numbers.

Vehicle collision
Risk of vehicle collision would be the same as Alternative 1.

Human use
Recreation use would likely increase the same as in Alternative 1, but road and trail density would remain essentially unchanged. No summer motorized trails would be constructed in this alternative, so there would be no additional effect from ATV use. This would effectively limit human disturbance to areas where it currently occurs and maintain habitat suitability for wolves at its current condition.

Cumulative effects of Alternative 2

Cumulative effects would be similar to Alternative 1, but the WMNF would play a smaller role within the analysis area. It is possible that wolves could still occur in small pockets on the Forest, but the combination of reduced prey habitat (compared to Alternative 1) and increased human use could make it more difficult for wolves to persist here beyond the first 20 years of Forest Plan implementation.

The rest of the cumulative effects in the analysis area would be the same as described in Alternative 1.

Alternative 3

Prey
Alternative 3 proposes the least amount of timber harvest and the least amount of even-aged regeneration harvest. With little foraging habitat being created, prey levels (which are already considered marginal for deer) would likely decrease to the point where they may not be abundant enough to support wolves on the Forest. The reduction in Management Area 2.1 lands

also may result in a slightly more limited distribution of foraging habitats for deer and moose.

Vehicle collisions
Risk of vehicle collision would be the same as in alternatives 1 and 2.

Human use
Effects from recreation use would be the same as described in Alternative 2.

Cumulative effects for Alternative 3

Projected actions outside the Forest would be the same as described in Alternative 1. In the larger analysis area, there is probably no measurable difference between alternatives 2 and 3.

However, because the amount of timber harvest may result in decreased prey base levels, it is more unlikely in Alternative 3 that the WMNF could serve a meaningful role in wolf recovery compared to the other alternatives.

Alternative 4

Prey
Alternative 4 would have effects similar to those described in Alternative 2, with slightly more foraging habitat being created through even-aged regeneration harvests for deer and moose.

Vehicle collisions
Road densities and risk of vehicle collision would be similar to alternatives 1, 2, and 3.

Human use
Recreation use could increase further in Alternative 4 than in the other alternatives because the Forest would respond to demand with increases in infrastructure if needed, increasing the carrying capacity of some activities and perhaps increasing disturbance levels in some areas beyond the other alternatives.

Alternative 4 also proposes a new summer motorized trail, which would likely eliminate that area from consideration as wolf habitat. Without knowing site-specific details of the trail length or location, it is difficult to predict how the habitat suitability of the area would change, but it may be assumed that in general, disturbance levels would increase considerably. However, the Moat Mountain area may not have as big an effect on wolf recolonization, since it is at the edge of the Forest near an already heavily developed area (North Conway). The Landaff area is more removed from human development, so to some extent would be more of an island of disturbance rather than an extension of one.

Cumulative effects for Alternative 4

Projected actions would be the same in Alternative 4 as those described in Alternative 1. The WMNF could still potentially serve a role in wolf recovery, but with the increased use levels projected in both motorized and non-motorized activities, it is less likely that suitable areas of large enough size could be found on the Forest to contribute effectively to the analysis area.

Determination — Gray wolf

Because wolves are not currently present on the WMNF, implementation of any alternative would result in **no effect** to the species. However, should wolves eventually relocate to the Forest, implementation of all alternatives may effect, but would not likely adversely affect wolves.

Rationale Summary

1. Deer, moose, and beaver are all present on the Forest, albeit at numbers approaching minimal levels to support wolves. The New Hampshire Fish and Game Department hope to increase the size of the deer and moose herds in the region that encompasses the WMNF.
2. Forest Plan direction would promote protection and enhancement of deeryards, probably the most limiting habitat factor for deer on the Forest.
3. Open road densities on the Forest are expected to remain low. Although road improvement projects are likely on existing roads, there are no proposals to add more than a few miles of permanent roads to the current system.
4. Environmental education efforts have worked well in the Lake States and other regions to improve attitudes towards wolves. Similar programs in the Northeast could increase levels of public support for wolf recovery, if needed.
5. Although a clear source population does not occur within the analysis area, a number of wolves have been sighted recently. Genetic swamping with coyotes will continue to be an issue outside Forest Service control.

Past studies on wolf recolonization focused primarily on prey base; no area supported the recreation levels currently present or anticipated on the WMNF. How much recreation use levels in the White Mountains would influence habitat suitability is somewhat unknown. It is assumed that the numbers of people in high use areas on the Forest would be a factor in wolf success and that potential negative effects would come from unintentional harassment.

Eastern cougar (*Puma concolor couguar*) — Federal endangered

The eastern cougar was listed as endangered in 1973. A recovery plan was completed in 1982.

Distribution

The eastern cougar (*Puma concolor couguar*) is the currently recognized subspecies that was originally known from the northeast and is now listed as Federally Endangered (U.S. Fish and Wildlife Service 1982). However, the taxonomic validity of this subspecies was recently questioned following a genetic study by Culver et al. (2000), who proposed that all cougars north of Nicaragua belong to the same subspecies (*P.c. couguar*). If any cougars are found in the Northeast, it is likely they are transients or

transplanted individuals from the west, rather than representatives of some relict local population (SVE Mammal Panel 2002). Even future genetic work on such specimens could prove cloudy because of three factors: 1) a lack of reference specimens from much of the geographic range of *P. concolor couguar*, 2) hybridization among eastern and western subspecies at the peripheries of their ranges, and 3) introgression of genes from released or escaped captive western cougars in the east (U.S. Fish and Wildlife Service 1982).

Although taxonomic confusion exists, this analysis considers *P. concolor couguar* as a separate and distinct subspecies. It is thought to have originally occurred in South Carolina, Tennessee, Kentucky, Indiana, all states to the north, Ontario, Quebec, New Brunswick, and Nova Scotia (U.S. Fish and Wildlife Service 1982). The last New England specimen of *P. concolor couguar* was taken in 1938 in Somerset County, Maine (along St. John Lake along the Quebec border) (Wright (1961) in DeGraaf and Yamasaki 2001).

Life History

Life history information presented here is for *P. concolor*, not for *P. concolor couguar* specifically.

Females are considered sexually mature at two to three years of age (Currier 1983), although some may breed earlier (Lindzey 1987 in DeGraaf and Yamasaki, 2001). They are polyestrous and may breed throughout the year at intervals of 18-24 months (Lindzey 1987 in DeGraaf and Yamasaki 2001). Gestation period is 82-96 days, with most young born between April and September in the northern hemisphere. Litter size is usually two or three, but may range from one to six (summarized by Currier 1983). Each adult female may produce four to five young over her lifetime that survive to adulthood (Kitchell 1999a).

Female cougars can remain reproductive until at least twelve years of age, males until at least twenty years, although they typically live approximately twelve years in the wild (Young and Goldman (1946) in Currier 1983). Cougars are solitary and mobile except for female-kitten groups; juveniles may disperse from 9 to 274 km (5.5-170 miles) (Logan et al., 1986 in DeGraaf and Yamasaki 2001). Young cougars stay with their mother for one and one-half to two years (Currier 1983).

Cougars are top level predators that feed on deer, fox, beaver, porcupine, raccoon, skunk, rabbit, and smaller mammals (DeGraaf and Yamasaki 2001). Competition for smaller prey may occur between cougars and coyotes, black bears, and bobcats where they coexist (Currier 1983).

Habitat

Habitat descriptions presented here are for *P. concolor* in general, not for *P. concolor couguar* specifically.

Cougars have been reported in a wide variety of habitats in the west and it would be expected that they would occupy a similar range of diverse habitats here in the east, assuming deer are seasonally abundant and some

isolation from humans exists (SVE Mammal Panel 2002). If cougars presently occur in New England, they would most likely be found in remote mountain forests, swamps, and wooded watercourses (DeGraaf and Yamasaki 2001).

Habitat required for dispersal includes corridors that provide suitable cover for crossing into disjunct patches of habitat; open areas and areas of human population are avoided (Kitchell 1999a). Watercourses are often followed in open plains or valleys because of the concealment provided by the bankside vegetation (Russell 1978). Specific dispersal barriers include roads, night lighting (Beier 1993), and recent logging activity (Van Dyke et al., 1986). Collisions with motor vehicles are the most common cause of accidental deaths for cougars (Currier 1983).

Occurrences

Today, the nearest extant population of *P. concolor* (not necessarily the subspecies *couguar*) is either Manitoba or possibly Michigan/Minnesota (SVE Mammal Panel 2002), although confirmed sign of *P. concolor* has been documented recently from three nearby sites:

1) Near Craftsbury, Vermont, in 1994 (approximately 66 km/41 miles from the White Mountain National Forest) (Bolgiano 1995). This specimen has not been confirmed, since genetic tests came back positive and negative from two independent laboratories (SVE Mammal Panel 2002);
2) Near Deersdale, New Brunswick, in 1992 (approximately 435 km/270 miles from the WMNF) (Cumberland and Dempsey 1994); and
3) In Maine near the St. John's River in 1994 (approximately 242 km/150 miles from the confirmed New Brunswick site (Bolgiano 2000).

The subspecies is considered extirpated by the U.S. Fish and Wildlife Service (2000). Remnant populations may persist in Canada and the adjacent U.S., but it is unknown whether reported sightings pertain to indigenous populations (Bolgiano 1995, Cumberland and Dempsey 1994, Stocek 1995).

Cougars were killed in the late 1800s in the White Mountains (summarized by DeGraaf and Yamasaki 2001). Winter tracking surveys in the mid-1990s and annual lynx hair snare surveys (which could also have detected cougar) since 1999 have not resulted in new occurrences. No information is available on breeding or reproduction of cougars in the White Mountain National Forest.

Threats/Limiting Factors

Loss of remote, undisturbed habitat is the greatest threat to population viability for *P. concolor*; as habitat becomes fragmented, risk of mortality increases. In Florida, half of all cougar deaths occurred due to highway collisions (Kitchell 1999a).

The most limiting factors of concern under WMNF control are:

a. Sufficient vegetation to support suitable prey base

b. Mortality from collisions on roads (SVE Mammal Panel 2002)

Information Gaps

The following information gaps were identified by the SVE Mammal Panel (2002):

1) Background information for cougars in the northeast is limited. Sightings that are confirmed are very few and far between. Information from the west cannot be extrapolated and applied to the northeast.

2) The closest extant population is unknown. Possibilities include Manitoba, Minnesota, Michigan, or even as close as Vermont, but genetic testing has been inconclusive. True eastern cougar specimens are not readily available.

3) Forage preferences in the northeast are unknown. Potential prey could include deer, moose calves, snowshoe hare, porcupine, and beaver. Deer and moose calves would seem to be a mainstay. Prey density levels on the White Mountain National Forest may not be adequate to support a sustainable population.

4) Landscape patterns associated with cougar populations in the northeast are unknown. Western subspecies show very different habitat pattern use from Florida subspecies and could reflect a difference in the eastern cougar that may exist.

Pertinent Resource Actions and Mitigation

There are no standards and guidelines specific to eastern cougar, although those for wolf and lynx would help promote suitable habitat conditions for cougar as well.

Affected Environment

The affected environment and environmental effects for the eastern cougar would be the same as for the gray wolf described above.

Determination — Eastern cougar

The determination for the eastern cougar would be the same as that for the gray wolf above. Rationale to support the determination would also be the same.

Canada lynx (*Lynx canadensis*) — Federal threatened

In 1994, the USFWS found that federal listing of the North American population of Canada lynx may be warranted and initiated a formal status review. In 1997, they determined that listing of the contiguous U.S. population was warranted but precluded by other higher priority actions. In the following year, the Canada lynx population occupying the lower 48

states in the U.S. was proposed for listing as threatened (USFWS 1998a). Following an extension to allow for additional comment, the Canada lynx was listed as threatened (in the lower 48 states) in 2000 (USFWS 2000a). This decision was litigated (Defenders of Wildlife v. Norton (Civil Action No. 00-2996 (GK)) and in December of 2002, the United States District Court for the District of Columbia issued a memorandum opinion and order, remanding the USFWS' findings and addressing the Service to consider further the lynx's status under the Endangered Species Act. In July, 2003, the USFWS issued a final rule on the remanded determination of status (USFWS 2003b), again issuing threatened status to the distinct population segment of lynx in the contiguous United States.

Throughout this time period, the Forest Service has worked cooperatively with the U.S. Fish and Wildlife Service, U.S. Park Service, and Bureau of Land Management to develop and implement a conservation strategy for lynx. In 1998, a multi-agency steering committee was convened to ensure management actions did not jeopardize lynx. This steering committee chartered several national sub-teams, including:

1) The Lynx Science Team, made up of the top lynx experts in North America, was created to compile all of the latest scientific information regarding lynx and to publish a series of findings. This task was completed in 1999, with the publication of *Ecology and Conservation of Lynx in the United States* (Ruggiero et al., 1999)
2) The Lynx Biology Team, comprised of biologists from each of the four land managing agencies, was tasked with using the information from the Lynx Science Team and drafting a strategy to conserve lynx on federal lands. This effort lead to publication of the *Canada Lynx Conservation Assessment and Strategy* (LCAS; Ruediger et al.) in 2000.

Also in 2000, the *Canada Lynx Conservation Agreement* was signed between the U.S. Forest Service and U.S. Fish and Wildlife Service. In this document, the Forest Service agrees to incorporate the intent behind the LCAS into Forest Plans through revision or amendment.

Distribution

In the contiguous United States, lynx are at the southern end of their range, with the metapopulation center located in north-central Alaska and Canada (USFWS 2003b). Historical lynx occurrence has been verified in 24 northern states (McKelvey et al., 2000), but the final rule to list the lynx delineated a distinct population segment that only included the states of Colorado, Idaho, Maine, Michigan, Minnesota, Montana, New Hampshire, New York, Oregon, Utah, Vermont, Washington, Wisconsin, and Wyoming (USFWS 2000a). Currently, resident lynx are only known to occur in Washington, Montana, Maine, possibly Minnesota, and potentially Idaho and Colorado (USFWS 2003b).

Life History

Reproduction

Lynx breed from mid-March to early April (Quinn and Parker 1987). Females generally breed for the first time as yearlings during their second winter. However, if food is abundant and lynx are in good condition, females may breed during their first winter (Nava 1970, Brand and Keith 1979; cited in Quinn and Parker 1987). Gestation averages nine weeks and young are born in late May/early June (Quinn and Parker 1987). Litter size across southern boreal forests averages three kittens, although it can be as high as five (J. Vashon, pers. comm.). Kittens are born altricial and weigh approximately seven ounces at birth; growth and development are directly related to food availability. When food is abundant, kittens' eyes open at about two weeks and weaning is completed by three months. By mid-winter, kittens weigh about ten pounds (Brand and Keith 1979 cited in Quinn and Parker 1987).

Food availability directly influences reproductive success. In northern Canada and Alaska, lynx reproduction is closely tied to hare abundance. Shortly after a cyclical hare crash, kitten survival declines to zero, few live litters are born, and in-utero litter size declines, resulting in lower litter sizes early in the population increase phase (Mowat et al., 2000).

Reproductive rates and kitten survival rates are lower in southern boreal forests compared to lynx further north (Aubry et al., 2000). In fact, most demographic parameters, including in-utero litter sizes (3.25-3.6), yearling pregnancy rates (27-44%), yearling litter sizes (1.75-3.2), and kitten mortality rate (88%) are all characteristic of northern populations during periods of low snowshoe hare abundance (Aubry et al., 2000).

In Maine, litter size over the last five years averaged 2.7 kittens (1999=2, 2000=2.3, 2001=1.5, 2002=2.5, 2003=4.3). In 2003, 66 percent of breeding females (n=6) had five-kitten litters (J. Vashon, pers. comm.).

Dispersal

Kittens remain with females during their first winter, but probably become more independent as the winter progresses. Family groups break up at the onset of breeding in late winter (Saunders 1963, Brand et al., 1976; cited in Quinn and Parker 1987).

Dispersal data in southern boreal forests is somewhat scanty. Lynx typically move distances greater than 100 km (62 mi) in both southern and northern boreal forests (Mowat et al., 2000, Aubry et al., 2000). Table G-4 summarizes data collected by Aubry et al. (2000), regarding lynx movements in the southern portion of their range.

Table G-4. Lynx dispersal distances in southern boreal forests (collected by Aubry et al., 2000).

Location	Distance	Comments	Source
Montana to British Columbia	325 km	female (late April-Nov.), trapped	Brainerd 1985, unpublished
Montana	97 km	male, trapped	Smith 1984, unpublished
Washington to British Columbia	616 km	adult male	Brittell et al., 1989
Washington to British Columbia	80 km	female	Brittell et al., 1989
Southern Canadian Rockies	44 km	juvenile male (March)	Apps et al., 2000
Southern Canadian Rockies	17 km	juvenile female (3 days in March)	Apps et al., 2000
Southern Canadian Rockies	55 km	juvenile female	Apps et al., 2000
Minnesota to Ontario	483 km	female, trapped	Mech 1977

In addition, lynx in the south occasionally make what appear to be exploratory movements in which they travel long distances beyond their normal home range but subsequently return. In Montana, one juvenile and three adult males ranged from 17 to 38 km (11 to 26 mi) in straight line distances, lasting from one week to several months. All movements were initiated in July, but the juvenile also made an exploratory movement in late March (Squires and Laurion, 2000). In a Wyoming study, an adult male left his home range in mid-June and returned in early September, and an adult female left her home range in early July and returned in early August, although the distance they traveled is unknown (Squires and Laurion, 2000). Closer to the WMNF, two sub-adult males in northern Maine traveled extensive distances in the spring before returning to the study area (A. Vashon, pers. comm.).

Aubry et al. (2000) note these exploratory movements are unique to lynx in the southern portion of the range and are not seen in the taiga. They speculate that in montane boreal forests, high-quality lynx habitat is patchy and fragmented due to high amounts of topographic relief and variation in habitat conditions. Because of this, lynx could not be certain of finding suitable habitat in any direction. Dispersal success may be enhanced by such exploratory movements in order to locate suitable habitat.

Competition

Lynx are affected by both exploitative competition (e.g., if another species exploits a shared resource with lynx so thoroughly that lynx die sooner or breed less) and interference competition (where another species acts aggressively towards lynx, denying it access to shared resources). Buskirk et al. (2000) note that while exploitative competition can occur between any species sharing similar resources, interference competition is driven by relative body size. In general, interference competition is inflicted by a

larger carnivore on a smaller one and occurs most often between two carnivores of similar body form and size. Buskirk et al. (2000) also use several studies to point out that while exploitative competition may reduce prey availability and subsequently result in fewer predators, interference competition can cause local or regional extinctions.

Several carnivores are of concern relative to interference competition with lynx. Cougars are a possibility, although their rarity in New England makes them unlikely candidates to cause competitive interactions. Bobcats (*Lynx rufus*) are more likely, being of similar form and size to lynx and sharing snowshoe hare (*Lepus americanus*) as a prey base. Buskirk et al. (2000) summarize several studies documenting snowshoe hare as a dominant part of bobcat diets. Bobcats and lynx are generally thought to be ecologically separated by deep snows, with lynx better able to take advantage with their proportionately larger paws. However, under conditions where deep snow is not a factor, interactions are not well understood.

Coyotes (*Canis latrans*) may also be potential competitors. Coyote distribution has expanded dramatically during recent decades, especially to the northeast (Hoving 2001). Virtually no coyotes were trapped in New Hampshire prior to the 1970s, and Buskirk et al. (2000) display New Hampshire Fish and Game Department data that shows an almost 20-fold increase in coyotes trapped between 1972 and 1994. Because pelt prices stayed relatively stable during the same period, the increase is attributed to abundance alone. Buskirk et al. (2000) also summarize work from O'Donoghue (1977) that concludes lynx in Canada were more abundant where coyotes were less dense, rather than where hares were more dense, suggesting coyote abundance may be a more significant factor than snowshoe hare availability, which has generally been considered the primary limiting factor for lynx. In addition, Buskirk et al. (2000) summarize instances where coyotes have predated bobcats and were implicated in bobcat declines. They note that considering bobcats can be larger and more aggressive than lynx, coyote predation of bobcat sets the stage for a potential similar relationship with lynx.

Wolves may also influence lynx populations through their interactions with coyotes. Buskirk et al. (2000) suggest wolves may reduce coyote numbers through direct interference competition between these two canids. Since wolves are marginally too large to be interference competitors with lynx and they take larger prey, lynx may be more successful coexisting with wolves rather than coyotes. In Maine, Hoving (2001) states wolves were common during the mid-1800s and still present, although rare, through the 1880s. After they were extirpated, Maine was without a wild canid for several decades, since coyotes had not yet dispersed this far east. Bobcats expanded their range in Maine coincident with the extirpation of wolves, and bobcat densities subsequently decreased following coyote establishment. Litvaitis and Harrison (1989) hypothesized that bobcat could take advantage of deer as a food source in the absence of a large canid predator. Once coyotes were established by the 1970s, bobcat switched to a diet of primarily snowshoe hare. Lynx observations declined after wolves

were extirpated and increased after coyotes arrived. Hoving (2001) argues the presence of a large canid might positively influence lynx abundance in Maine, while negatively affecting bobcat abundance. Buskirk et al. (2000) speculate that competition in the northern part of the range is less of an influence on lynx because the strongly cyclic nature of snowshoe hare populations mediates the effect of exploitation competition and the large mammal predators that would likely compete with lynx are relatively scarce.

Relationships with Other Species

Lynx populations may be affected by interspecific competition with coyote, bobcat, and cougar, although cougar is not likely a factor in the northeast. (Also see Competition section above). All three of these carnivores are more abundant and widespread throughout the southern lynx range than 50 years ago (Ruggiero et al., 2000).

Predation may occur from other felids (primarily cougars in the western United States) (Aubry et al., 2000) and fisher (*Martes pennanti*) in Maine (J. Vashon, pers. comm.). In the northern part of the range, cannibalism occurs during periods of low hare abundance (Mowat et al., 2000).

The most obvious relationship lynx have with another species is with snowshoe hare. In Canada, snowshoe hares made up 52 percent of the winter diet in one study (Apps 2000), although previous studies indicate snowshoe hares make up at least 60 percent of the winter diet and 40 percent of the summer diet (Brand and Keith 1976, cited in Quinn and Parker 1987). Other known prey include red squirrels (*Tamiasciurus hudsonicus*), northern flying squirrels (*Glaucomys* spp.), ruffed grouse (*Bonasa umbellus*), ptarmigan (*Lagopus* spp.), mice (*Peromyscus* spp.), voles (*Clethrionomys* spp. and *Microtus* spp.), and marten (*Martes americana*; probably taken opportunistically) (Apps 2000; Brand and Keith 1976, cited in Quinn and Parker 1987).

However, the numbers of alternate prey species may be misleading. When biomass is considered, snowshoe hare are clearly the dominant prey item, contributing five times as much biomass as red squirrels, the next most abundant prey item. Breeding lynx populations cannot be sustained without an adequate supply of snowshoe hare (Apps 2000).

Lynx kill about two hares every three days, although kill rates will vary based on hare abundance (Brand et al., 1976, cited in Quinn and Parker 1987).

In the northern boreal forest, there is strong evidence of a snowshoe hare population cycle (Hodges 2000), although the evidence is less clear in the southern transitional forest. Apps (2000) summarizes data from a variety of studies that show some cyclicity does occur, but with varying amplitudes and frequencies across the range. No information is available from New Hampshire, but Maine data shows peaks in 1948, 1957, 1966, 1973, and 1981 (C. McLaughlin unpublished, Keith 1963; cited in Apps 2000), which means seven to nine years between peaks and relatively small amplitude (2). Hoving (2001) suggested hare population fluctuations in the Northeast

may be more influenced by other factors such as forestry practices, weather, and other ecological conditions.

Mortality

In Maine, there have been fourteen known mortalities (eleven females; total = 93) in the Clayton Lake study area during the last five years. Of these, four were a result of starvation (at least one related to disease and some with heavy parasite loads, which may have been a contributing factor), four were adult females that were predated during the winter (at least some by fisher), and one was harvested illegally (Vashon 2003b).

Habitat

Lynx are found in a variety of ecological cover types across the northern tier of states in the U.S., although all of the types can be characterized as mesic coniferous forests with cold snowy winters (Ruggiero et al., 2000). In the Northeast, lynx habitat is associated primarily with northern spruce-fir forests and northern hardwood-spruce forest communities (generally higher elevations in mountainous areas), in areas where snow depth and condition provides a competitive advantage for lynx (Ruediger et al., 2000). Seventy percent of lynx occurrences in the Northeast evaluated by McKelvey et al. (2000) were found at elevations above 250 meters (820 feet). In the White Mountains, most trapping records from the 1960s were from elevations of at least 1,000 meters (3,280 feet) (Litvaitis et al., 1991). Hoving (2001) analyzed a number of habitat factors in the Northeast and found lynx were most likely to occur in areas with deep snow (greater than 268 cm (105 in) mean annual snowfall) and relatively little deciduous cover. Based on this model, the majority of lynx habitat in the Northeast is concentrated on the Gaspé Peninsula in Quebec, with only sixteen percent in the United States. Of that sixteen percent, Maine contains the bulk of the habitat, with 12,170 km^2 (4,700 mi^2) of suitable habitat. New Hampshire has far less (1,036 km^2/400 mi^2), as does Vermont (10 km^2/4 mi^2) and New York (73 square miles) (C. Hoving, pers. comm. cited in U.S. Fish and Wildlife Service 2003b).

Lynx have very large home ranges. The U.S. Fish and Wildlife Service (2003b) summarizes a number of studies showing home range varies based on a lynx's gender and age, prey abundance, season, and lynx population density. Aubry et al. (2000) described an average lynx home range of 151 km^2 (58 mi^2) for males and 72 km^2 (28 mi^2) for females across twelve studies in the southern boreal forest. In Maine, recent home range estimates are smaller: 91 ki^2 (35 mi^2) for males and 53 km^2 (20 mi^2) for females (Vashon 2003b).

Foraging

Snowshoe hare is indisputedly the major prey item for lynx, with as much as 97 percent of a lynx's diet coming from hare (Koehler and Aubry 1994). It is not clear what level of hare abundance would constitute a minimum level to support lynx. Apps (2000) studied hare densities in an area supporting ten resident adult lynx in the southern Canadian Rocky Mountains. Hare densities ranged from 0.16 to 0.47 hares per hectare (41-

122/mi^2) in early successional habitats, 0.06 to 0.39 hares per hectare (16-101/mi^2) in mid-successional habitats, and 0.01 to 0.32 hares per hectare (3-83/mi^2) in late-successional stands. In the Northeast, Litvaitis (pers. comm.) has suggested 0.5 hare/ha (130 hares/mi^2) is a reasonable number to identify a minimum snowshoe hare population to support lynx.

Because of the lynx's dependence on snowshoe hare, habitat suitability is often evaluated based on snowshoe hare habitat conditions. Snowshoe hare habitat use appears most correlated to the density of horizontal understory cover that is approximately one to three meters (3-10 ft) in height (Hodges 2000). In general, forested stands with dense understories support higher hare densities than stands with more sparse conditions (Litvaitis et al., 1985, Brocke et al., 1993). On the White Mountain National Forest, Brocke et al. (1993) evaluated "base cover" (young conifer stands) at high and low elevations. They determined base cover for lynx was of "high quality" (Table G-5).

Table G-5. Hare density and stem density by elevation and forest type, White Mountain National Forest (from Brocke et al., 1993).

Base cover elevation	Balsam Fir Stems/ac	Red Spruce Stems/ac	Total Stems/ac (including all other species)	Hare density (hares/mi^2)	Hare density (hares/ha)
High elevation base cover	3,050	292	3,731	136.2 (±16.3)	0.53
Low elevation base cover	9,461	929	10,533	128.4 (±18.3)	0.50
Mixed cover (hardwood/ softwood)	2,414	425	3,445	69.8 (±8.5)	0.27
Travel cover	1,233	1,144	2,645 (±3.9)	35.2	0.14

This indicates high elevation and low elevation softwood base cover would meet the minimum snowshoe hare levels needed to support lynx. However, although WMNF hare densities are above those found in the southern Rocky Mountains, they are considerably lower than those in the lynx study area in northern Maine, where hare densities were 1.2/ha (311 hares/mi^2) in 2002 and 1.6/ha (414 hares/mi^2) in 2001 (J. Vashon 2003b).

Hodges (2000) summarizes many studies which conclude that despite many variables, the most consistent finding regarding snowshoe hare habitat is that their use is correlated to understory structure; stands that are densely stocked, brushy, or somehow have more lateral cover are more heavily used by hares. Litvaitis et al. (1985) in Maine found that understories with a visual obstruction of >60% were used most intensively, especially during leaf-off seasons. They also determined that, while both hardwood and softwood understories were used by hares, an individual softwood stem provided approximately 3 times the amount of cover

compared to a hardwood stem. This additional cover may provide thermal protection in winter, as well as escape cover from predators. Litvaitis et al. (1985) point out that although hardwood and softwood stands may have the same level of visual obstruction (viewed horizontally), dense softwood stands support greater densities of hare than hardwood stands because of their greater value in providing cover from predators and extreme weather.

Next to snowshoe hare, red squirrels are considered the most important alternate prey item (Aubry et al., 2000). While hares are a necessary prey item for lynx, red squirrels may be taken opportunistically if hare levels are low.

Red squirrels are most often found in a variety of coniferous or mixed stands that are mature enough to produce cones and cavities for denning (summarized by DeGraaf and Yamasaki 2001). They are active year-round, although they are seldom found above the snow surface when temperatures fall below -32° C (-25° F) (Pruitt and Lucier 1958, Smith 1968 cited in Ruediger et al., 2000).

Denning

Few studies on lynx denning characteristics have been completed. Ruediger et al. (2000) summarize several works that point to the presence of abundant, large, woody material as a common factor at den sites. Downed logs and other overhead cover provide thermal protection for kittens, as well as escape cover from predators. Den sites may be in mature or older (>20 years) regenerating stands; stand structure is a more important component than stand age. This is comparable to findings in Maine, where den sites have been found in dense blowdown patches within young, regenerating (10-20 years old) stands (A. Vashon, pers. comm. 2002). Multiple den sites may be used as females move their kittens periodically to new sites (Ruediger et al., 2000).

However, although individual den sites may be found in a variety of stand ages, they must be located in close proximity to suitable foraging habitat to be functional. Females with kittens need an abundance of prey and have restricted home ranges until kittens are old enough to hunt (Ruediger et al., 2000).

Occurrences

In the Northeast, evidence of lynx occurrence has been found in seven states (Table G-6).

Table G-6. Number of historical lynx occurrences in the northeastern United States (McKelvey et al., 2000).

State	# verified or reliable	# unreliable or unknown reliability	Total	Time period
Connecticut	1	0	1	1839
Massachusetts	5	0	5	1855-1918
Maine	54	7	61	1862-1999
New Hampshire	194	12	206	1860-1992
New York	38	19	57	1877-1973
Pennsylvania	5	3	8	1903-1926
Vermont	8	4	12	1928-1965

Currently, lynx are found only in northern Maine, where a total of 93 lynx (including 61 kittens) were captured and marked between 1999 and 2003 (J. Vashon, pers. comm.). In addition, sightings or evidence of lynx has occurred around Moosehead Lake, near Rangely Lakes, and around the Maine/Quebec border outside of the study area (SVE Mammal Panel 2002). Lynx have also been sighted in Maine near the New Hampshire border as recently as 1995 (M. McCollough, pers. comm.)

In New Hampshire, although there is a long history of lynx occurrence in the state, no evidence of breeding has been documented. Harvest records summarized by McKelvey et al. (2000) show a total of 139 lynx collected between 1928 and 1964 (36 years). However, 114 (82%) of them were captured during the 10 years between 1928 and 1939. Subsequently, the lynx harvest declined significantly, down to just 25 lynx taken between 1940 and 1964 (a 10-fold reduction in average harvest per year). In 1964, lynx trapping was banned from the WMNF (97% of lynx bountied from 1931 to 1954 were taken from the White Mountains; Silver 1974). In 1971, lynx in New Hampshire were protected from harvest throughout the state. The most recent occurrence (in 1992) was an animal introduced to New York's Adirondack State Park as part of a reintroduction study that eventually failed.

Several recent surveys have failed to discover evidence of any lynx in New Hampshire. In 1986, Litvaitis et al. surveyed approximately 160 km^2 (99 mi) of the WMNF during the winter and found no lynx tracks, concluding a viable population of lynx did not occur in New Hampshire at that time. In 1991, Brocke et al. (1993) also failed to find lynx tracks during the winter. Track surveys performed by Forest staff during the winters of 1993-1996 and 2002-2003 did not result in any new occurrences, nor have "hair snare" surveys (McKelvey et al., 1999) conducted on the Forest in the fall of 1999-2004.

Threats/Limiting Factors

Risk factors across the contiguous U.S. were identified by Ruediger et al. (2000) and included:

1. Timber harvest levels that do not provide adequate denning and foraging habitat
2. Reduction of (or lack of retention objectives for) large diameter woody debris for denning
3. Levels of pre-commercial thinning that reduce the quality and quantity of snowshoe hare foraging habitat and escape cover
4. Fire exclusion/suppression that alters the natural mosaic of forest successional stages necessary for maintaining snowshoe hare habitat across landscapes over time
5. Livestock grazing in riparian areas, aspen stands, and high-elevation willow communities, which may reduce snowshoe hare foraging habitat
6. Human presence in lynx denning habitat between May and August
7. Human presence on forest roads and trails that results in snow compaction, which subsequently may provide lynx competitors access into lynx habitat
8. Mineral prospecting and extracting activities that may affect important lynx habitats or linkage areas
9. Incidental trapping in lynx population centers
10. Increase in groomed or packed snow trails or areas with deep snow conditions that may provide access for lynx competitors
11. Predator control activities occurring within lynx habitat on federal lands
12. Illegal or accidental shootings of lynx
13. Vehicular collisions along highways and roads

In addition, hybridization with bobcat has been confirmed in both Maine and Minnesota (J. Vashon, pers. comm.; E. Lindquist, pers. comm.). This may lead to genetic swamping similar to wolves and coyote described above.

The most limiting factors of concern under WMNF control are:

a. Potential lack of sufficient forage base or actions that reduce the amount of suitable snowshoe hare habitat.
b. Activities that could significantly reduce available denning habitat
c. Activities that increase human use in denning habitat
d. Activities that could further compact snow conditions to the point where interspecific competition is increased
e. Actions that reduce the suitability of linkages within the Forest and connecting the Forest to other suitable habitat nearby.
f. Potential for vehicular collisions or actions that increase the potential for collisions.

Information Gaps

The SVE Mammal Panel (2002) identified the need to determine if there are barriers to movement between the WMNF and the source population in Maine.

Pertinent Resource Actions and Mitigation

Forest Plan direction would include goals specific to lynx, as well as standards and guidelines adapted from the national Canada Lynx Conservation Assessment and Strategy (LCAS; Ruediger et al., 2000).

Affected Environment

In order to evaluate habitat suitability on a landscape scale, the area of effects analysis will include the two full ecological sections (described by McNab and Avers (1994) and mapped by Keys et al. (1995)) that encompass the White Mountain National Forest. This area covers approximately fourteen million acres, stretching from northwestern Massachusetts north through most of Vermont (outside the Champlain Valley), western and northern New Hampshire, and western Maine (see Map G-01). Although lynx occurrences would not be expected south of the WMNF, the Forest falls on the dividing line for these two sections; including them both in the analysis will allow an evaluation of the entire Forest in the context of an ecological boundary. Historic occurrences are known from both sections, albeit some were thought to be dispersing at the time.

As part of the national Lynx Conservation Agreement with the U.S. Fish and Wildlife Service, the Forest has mapped Lynx Analysis Units (LAU) to indicate units on the WMNF that could support lynx habitat. The Forest includes some 717,000 acres within thirteen LAUs. Not all of this acreage is lynx habitat, which may be "suitable" (currently able to support lynx) or "unsuitable" (potential to support lynx, but not at the moment or not ground-truthed). Detailed information on criteria to map lynx habitat on the WMNF can be found in the project file.

Lynx habitat may also be identified as "foraging" habitat or "denning" habitat. Foraging habitat is defined as habitat that supports snowshoe hare (dense softwood or mixed wood stands). Suitable foraging habitat makes up approximately 145,000 acres (16%) within the LAUs. Foraging habitat is underestimated because of the nature of the WMNF stands database, so this number is conservative. Suitable denning habitat (hemlock older than 150 years and other softwood and mixed wood stands older than 120 years) includes approximately 150,000 acres (21%) in LAUs.

Habitat Trends

The history of vegetation changes relative to lynx and snowshoe hare were summarized in the original listing rule (USFWS 2000a) and is presented verbatim here:

In the Northeast Region, softwoods that provided Canada lynx habitat were logged extensively during the late 1800s and early 1900s (Jackson 1961; Barbour et al., 1980; Belcher 1980; Irland 1982). Over a short time period, timber extraction during this era resulted in the replacement of late-successional conifer forest with extensive tracts of very early successional habitat, which eliminated cover for lynx and hare (Jackson 1961; Keener 1971). In the Northeast Region, slash, accumulated during logging operations, fueled wildfires that burned vast acreage of softwood forest (Belcher 1980; J. Lanier, pers. comm. 1994). This sudden alteration of habitat may have resulted in sharp declines in snowshoe hare numbers over large areas, subsequently reducing lynx numbers (Jackson 1961; Keener 1971; K. Gustafson, pers. comm. 1994; J. Lanier, pers. comm. 1994).

The impacts of the logging conducted in the Northeast Region during the late 1800s continue to affect lynx forest types. In Maine, softwood cover and dense sapling growth provided improved snowshoe hare habitat after timber harvest and fires in late successional forests (Monthey 1986). However, in the western sections of the Northeast Region, extensive tracts of predominantly softwood forests that were harvested and burned-over during the late 1800s and early 1900s were subsequently replaced with regenerating hardwoods (D. Degraff, pers. comm. 1994; J. Lanier, pers. comm. 1994). Hardwood forests do not typically supply adequate cover for snowshoe hares (Monthey 1986). For a period of time, this extensive area would have provided the early successional habitat used by snowshoe hare. However, such extensive tracts may not have provided a suitable mosaic of forest habitats and as succession progressed, these large tracts eventually became unsuitable for both snowshoe hare and lynx. Declines in snowshoe hare habitat may have occurred during the 1940s and 1950s as a result of large-scale forest maturation (Litvaitis et al., 1991).

In Maine, large tracts of forest (some as large as 36-square mile townships) were harvested in the 1960s to reduce the incidence of spruce budworm. During early successional stages, these forests may provide high quality hare habitat. However, these large tracts create a simplified, monotypic forest over large areas, not a mosaic of forest stands. Passage of the State Forestry Practices Act has required clear-cut size to be substantially reduced. The Maine Department of Conservation recently analyzed Statewide timber production on Maine's 17 million acres of forest land (Gadzik et al., 1998). The report indicated 25 percent of the forest was in seedling/sapling stages, which likely includes quality snowshoe hare habitat. However, the report concludes that increasing the number of acres under high-yield silvicultural practices, which will likely include precommercial thinning, to a cumulative total of 9 percent of Maine's forest land by the year 2015 is necessary to sustain the current timber harvest levels into the future. Such high-yield techniques may temporarily reduce snowshoe hare habitat quality, but the long-term effects on lynx on a landscape scale are not known.

> *Forested habitat in the Northeast has increased because of land-use changes during the past century (Irland 1982; Litvaitis 1993), including the abandonment of agriculture in many areas. In some areas there may be a gradual upward trend in the coniferous component as spruce and fir regenerate beneath hardwood species (D. Degraff, pers. comm. 1994). Several of the northeastern States support adequate, if not abundant, snowshoe hare populations (C. Grove, Green Mountain National Forest, pers. comm. 1994; F. Hurley, in litt. 1994; J. Lanier, pers. comm. 1994).*
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> *In 1990, the Forest Service published a report that examined the Northern Forest Lands in New York, Vermont, New Hampshire, and Maine (Harper et al.1990). Eighty-four percent of northern forest lands in the region are currently privately owned and 16 percent are in public ownership. According to another analysis, the Forest Service manages only 7 percent of lynx forest types in the Northeast, of which 23 percent is managed in nondevelopmental status (U.S. Forest Service and Bureau of Land Management 1999). Federal land management will have minimal effect on the persistence of lynx in the Northeast, due to the small amount of lynx forest types managed by the Forest Service.*
>
> *Commercial forestry continues to be the dominant land use on 60 percent of the private lands in northeastern forests. The rapid pace of subdivision for recreational home sites has been identified as a concern in maintaining the integrity of Northeast forests (Harper et al., 1990), though this is not currently posing a significant threat to lynx. At higher elevations and northern latitudes in the Northeast, red spruce and balsam fir are important components of snowshoe hare habitat. Declines in red spruce forests have been documented, and drought, acid deposition, and other human-generated pollutants have been suggested as principal causes (Scott et al., 1984). Historic declines in some forest types may have contributed to reducing the quality of lynx habitat in the Northeast. Current lynx research in Maine is contributing to our knowledge about lynx habitat use in the Northeast (J. Organ, pers. comm. 1999).*
>
> *In Northeast forests, fire return intervals are very long, due to the moist maritime influence (Agee 1999). Thus, fire did not historically play a significant role in creating early successional habitats. Insect infestations and wind were the primary disturbance events that created early successional habitats. While current fire suppression on public and private lands may have localized effects, it is not likely affecting overall lynx forest types in the Northeast. We conclude that fire suppression in the Northeast does not threaten lynx subpopulations there.*
>
> *We conclude that most lynx forest types are in private, State, or county ownership in the Northeast. Timber harvest and associated activities exert the most influence on lynx forest types in the Northeast, although the extent of influence of current forest practices on lynx is not known.*

On the WMNF, timber harvest has been a key factor in the present condition of vegetation. By the turn of the twentieth century, most of the Forest had been cut over at least once. The only remaining forest cover

was limited to patches on the northern slopes of the Presidential Range, the upper portions of the Pemigewasset River watershed, Waterville Valley, and the summits of the higher mountain peaks (WMNF 1986b). After the Forest Service acquired the land, efforts began to improve stand quality and to provide a supply of wood products. Today the majority of stands are mature or overmature. Many hardwood and mixed wood stands have softwood understories growing back.

Population Trends

Lynx have not been seen in New Hampshire since the early 1990s. In northern Maine, 32 lynx have been captured since 1999, with 12 radio-collared adult females producing 23 litters totaling 63 kittens (Vashon 2003b). The reproductive success rate has been very high in Maine and the population is increasing.

Environmental Effects

Alternative 1

Foraging Habitat

The activity with the most potential to improve habitat quality is timber harvest. Assuming there are no barriers to lynx dispersal, limited foraging habitat is probably the biggest limiting factor to lynx recovery on the WMNF. There are approximately 100,000 acres of high elevation spruce and fir habitat that would remain the same in all alternatives because they would not be subject to timber harvest. These high elevation spruce-fir stands hold the highest densities of snowshoe hare on the Forest and are of sufficient quality to support lynx (Brocke et al., 1993).

Below 2500 feet in elevation, the Forest has the opportunity to influence lynx foraging habitat through timber harvest. Harvest prescriptions that promote thick patches of regenerating softwoods or mixed woods would improve habitat suitability for snowshoe hare. As stated above, snowshoe hare may be found in a variety of habitat types, including tall, mature stands, but populations sufficient to support lynx are found in vegetation with dense horizontal understory cover (Hodges 2000). Alternative 1 proposes the greatest amount of regenerating habitats overall. It can be assumed that of the currently suitable foraging habitat, at least 6,900 acres (6%) will become unsuitable in the next 20 years as previously harvested stands mature out of optimal snowshoe hare habitat. Alternative 1 would add approximately 35,000 acres of regeneration habitat over the same time period. Exactly how these acres would be broken down by forest types is unknown, but the management objectives for MAs 2.1 and 3.1 offer some ideas. In Alternative 1, it is estimated that approximately 2,400 to 3,300 acres of softwood and mixed wood stands would be regenerated through clearcutting or other even-aged regeneration treatment and could help replace suitable lynx habitat that is growing older and moving into the unsuitable category. However, this would only replace approximately one-third to one-half of what would be growing out, so the amount of suitable foraging habitat would decrease in this alternative. Overall, though, the reduction is small, a four percent decrease in total suitable foraging habitat.

Whether or not lynx could be supported with this level of foraging habitat is unknown. Studies such as Brocke et al. (1993) identify the high elevation softwood portion of the Forest as “high quality” habitat, yet snowshoe hare numbers are only 33 to 44 percent of populations in Maine where lynx coexist. Since no evidence of breeding has ever been documented on the Forest, it is unknown whether or not historic conditions were more conducive to lynx persistence or if those animals were transients dispersing from more suitable habitats elsewhere.

Denning Habitat

Denning habitat is also influenced by timber harvest. Denning habitat is likely to be most abundant where stands are overmature (decadent). However, stands that have been previously harvested through uneven-aged prescriptions (e.g., single tree selection) would be less likely to result naturally in suitable denning habitat than stands where even-aged regeneration harvest has occurred. Although it seems counterintuitive, even-aged stands are generally entered once and then left for several decades, whereas stands on uneven-aged rotations are entered much more frequently. Although less volume may be removed at one time in uneven-aged prescriptions, often the remaining trees are stronger and may be better able to withstand natural disturbance events. Alternative 1 proposes approximately 14,000 total acres of uneven-aged harvest in the next 20 years, a portion of which would likely be in suitable lynx habitat.

However, it should be noted that if the highest snowshoe hare densities are likely to be above 2,500 feet in elevation, timber harvest in the valleys will have little effect on denning habitat regardless of alternative. More suitable juxtaposition of denning and foraging habitat is likely to occur in the higher elevations, most of which are outside management areas 2.1 and 3.1.

Human Use in Denning Habitat

The activity of most concern relative to denning habitat is ski area expansion or construction of new ski areas. These activities have the potential to bring large numbers of people into a focused area. Also, the current trend for ski areas is to provide four season recreation, rather than closing between spring and fall. On the WMNF, ski area expansion or new construction is unlikely. Since 1986, only one ski area has expanded, although management area allocation includes this option. Alternative 1 includes standards and guidelines specific to protecting lynx habitat around ski areas, as well as maintaining suitable levels of denning habitat. Therefore, there should be no measurable effect to lynx at a programmatic level related to ski area activities.

Outside of ski areas, other activities that bring additional people into previously remote, secluded areas could be detrimental to protecting suitable denning conditions. Although denning habitat may exist in terms of vegetative conditions, if construction of new trails, campgrounds, or other facilities leads people into a new area, denning suitability could be reduced. Like many wildlife species, lynx probably do not tolerate increased human disturbance during the breeding season. Alternative 1 proposes some 54 new developed campsites, construction of new backcountry

facilities to meet demand, an increase in dispersed camp sites, and up to 40 miles of new non-motorized trail construction. Approximately 40 to 60 miles of summer motorized trail construction in one or two separate sites could occur. All of these have the potential to increase human use in lynx habitat. A standard to allow no net increase in trail construction in lynx habitat would keep the bulk of these effects outside of lynx areas. However, the Forest is a mosaic of lynx habitat and non-lynx habitat and without knowing site-specific locations, there may still be some increased disturbance within lynx habitat.

Snow Compaction

In all alternatives, a guideline for no net increase in trails in lynx habitat would limit the amount of habitat that could be opened to interspecific competition. New trails could be built and new areas accessed, but other similar trails would be closed within the same LAU. However, the reason that all trails were included in this guideline is because as a trade-off it allows winter use to continue increasing on existing trails. There are many trails in place that were constructed for summer non-motorized use, but that are increasingly being used during the winter. There is little ability on the part of the WMNF to limit such use, and the result is that the number of trail miles being compacted in any given year is increasing, which may lead to increased competition. At some point in time, this will likely reach a plateau (perhaps when parking lots reach capacity), but whether or not that level will influence lynx success is unknown.

Linkages

Within the WMNF, maintaining linkages is most tied to road construction events. Road construction is proposed for timber harvest, but these would be closed at the completion of the sale. No new permanent roads are proposed in any alternative. Therefore, there should be no change to linkages as a result of Forest Service activities.

Vehicle Collisions

The activities most likely to lead to increased risk of vehicle collisions would be new road construction (of high speed roads), upgrades of existing forest roads that would lead to increased speeds, and increases in high speed road users. As stated above under Linkages, no new permanent roads are proposed in any alternative, so it is unlikely that new roads would contribute to additional risk of vehicle collisions. Some existing Forest roads may be upgraded under the Public Forest Service Roads Program, but these are generally slower than highway speed roads. Although upgrading them may increase traffic speeds to some degree, they probably won't reach the level that would constitute additional risk for collisions with lynx.

Existing roads where traffic speeds are a concern are the state highways that run through and around the Forest (e.g., Interstate 93 and highways 112, 16, 113, and 302). Recreation use would be the primary activity resulting in an increased number of cars on existing highways. Recreation use is expected to increase in all alternatives, and although the different alternatives approach recreation opportunities differently, the alternatives are not expected to demonstrate a measurable difference in road use. The expectation is that road use will continue to increase independently of any

action the Forest Service takes. Therefore, the risk of vehicle collisions in all alternatives would increase proportionally with the increase in recreation use.

Cumulative effects of Alternative 1

Foraging Habitat
Over the next 150 years, implementation of Alternative 1 would likely result in an overall increase in lynx habitat within the WMNF. Many factors outside the Forest's control would continue to exert negative influences on lynx habitat, but within the Forest itself, one goal is to promote the return of softwoods closer to the natural climax composition. As softwood understories continue to grow, stand conversion to softwoods will take place, especially on lands where vegetation management is not allowed. Most of these stands would be mature, but uneven-aged management (i.e., group cuts) could be used to promote additional snowshoe hare habitats. This will happen in all of the alternatives, although Alternative 1 would have the least change because the habitat objectives for aspen in this alternative will require more harvest on softwood ecological land types (where softwoods would be the climax community if left uncut).

Outside of the WMNF, the greatest area of suitable habitat is in northern Maine, where past harvest practices in response to budworm outbreaks around the 1960s created vast tracts of snowshoe hare habitat. Passage of the Maine Forestry Practices Act is likely to result in less clearcutting and more shelterwood harvests. This will likely change the structural character of the landscape to some degree and reduce the quality of snowshoe hare habitat. Several lynx have already died of starvation in the Clayton Lake study area, where snowshoe hare habitat is far more abundant and widespread than closer to the WMNF. If a reduction in snowshoe hare habitat quality leads to fewer hare, lynx numbers may follow suit. It is likely they will continue to persist in Maine, but may not produce sufficient young to be a source population for the WMNF.

In addition, converting forested land to smaller parcels for development is an increasing trend in the northeast. Large acreages of northern New Hampshire are being subdivided at a rapid pace. Landowners with smaller parcels, even if they wish to utilize sustainable forestry practices, are unlikely to implement the large even-aged regeneration prescriptions that would be needed to support a large snowshoe hare forage base. Despite increasing softwoods on the WMNF, within the entire analysis area, foraging habitat for lynx is likely to decrease over the next century.

Denning Habitat
Denning habitat will continue to increase on the WMNF as stands mature, especially those in management areas where timber harvest is not allowed. Over the next 150 years, the majority of the lynx habitat on the Forest would support suitable denning habitat.

Within the analysis area, denning habitat would follow trends similar to foraging habitat. As development and land divisions reduce tracts of forested lands, the amount of denning habitat will decline. If clearcutting continues to be viewed as unpopular and unnecessary, a shift to more

uneven-aged treatments may result in less potential for natural wind events to create appropriate denning habitat.

Human Use in Denning Habitat

There are no anticipated cumulative effects influencing denning habitat within the Forest beyond those already discussed above. Within the larger analysis area, increasing human disturbance would probably be less of a threat than on the Forest. As the human population in the northeast continues to grow, the risk of more human activities in lynx habitats will increase. However, the places where lynx currently exist are relatively remote and in the next 20 years will likely see a smaller increase in human activity levels compared to the WMNF.

Snow Compaction

Within the WMNF, there would be no other actions influencing snow compaction over the next 20 years, so cumulative effects would be the same as direct and indirect effects described above. Over the entire analysis area, the most likely activity that would increase snow compaction would be new snowmobile trail construction. Although there will probably be additional trail miles added in both New Hampshire and Maine, there are no known proposals that would result in a measurable change in effects to lynx habitat in the next 20 years.

Linkages

Most of the state highways within the WMNF or on its perimeter are currently undergoing work by state Departments of Transportation to widen and straighten road stretches. Much of this work is a result of greater use on roads, leading to a need to provide for safer driving conditions. Unfortunately, a secondary result is that traffic speeds often increase and roadways can become greater barriers to wildlife movements between habitats. Interstate 93 already is a fairly effective barrier over most of its length near the Forest. The only part that may be more likely to allow successful wildlife movements would be the one-lane stretches through Franconia Notch State Park, which connect to the WMNF on either side.

Road work would be the same in all alternatives. Once the current round of road improvement projects is completed, there probably won't be a need for additional work over the next 20 years. The current road work, combined with increased use, may increase the likelihood that wildlife movements would be disrupted, but wouldn't result in complete isolation of habitats.

Landscape level linkages within the larger analysis area are more likely to be disrupted by changes in land use practices. At this level, the concern is that dispersing lynx need to have connected habitat between source populations and the WMNF. If development or changes in land use result in suboptimal habitat, conditions may not be adequate to allow lynx to move to the Forest. Currently, lynx populations in Maine could feasibly travel along the Mahoosuc Range or west from northern Maine and south through northern New Hampshire to reach the Forest. Other avenues also probably exist, but these would be the primary corridors. There is some question from local experts whether or not the Mahoosucs is still a viable

corridor. If that is the case, the only large corridor would be through northern New Hampshire, which has seen increased conversion of large, forested ownerships to smaller parcels and increased development (W. Staats, pers. com). This trend is likely to continue, making it increasingly difficult for lynx to move south. In the next 50 to 150 years, if lynx do not become established on or around the WMNF, the chances for them to do so naturally will likely be lost.

Vehicle Collisions

Increased recreation use is not likely a result of Forest Service actions, as stated above in direct and indirect effects. However, as recreation use continues to increase on the WMNF, the risk of vehicle collisions would also increase. This is true beyond the WMNF boundary as well. Similar road projects are being proposed outside of the Forest. There may be some ability to mitigate collision risks through use of wildlife crossing structures, which have proven effective in other places (Federal Highway Administration 2000), but are not very well tested in the northeast. Whether or not state Departments of Transportation and adjoining landowners would be willing to consider such mitigation is unknown.

Alternative 2

Foraging Habitat

Effects to high elevation foraging habitat would be the same as in Alternative 1.

Although the amount of regeneration habitats being created overall in Alternative 2 is less than in Alternative 1, the amount in softwoods is the same. The amount of regeneration mixed wood harvest would be less than in Alternative 1. However, the magnitude of difference relative to lynx would be immeasurable. Therefore, effects to foraging habitat would be the same as those described in Alternative 1.

Denning Habitat

Effects to denning habitat would be similar to those described in Alternative 1. Although Alternative 2 proposes less overall volume to be harvested, the acres proposed for uneven-aged harvest is almost exactly the same for the first two decades of Forest Plan implementation.

Human Use in Denning Habitat

Effects would be the same as those described in Alternative 1 relative to ski areas. In other areas of the Forest, recreation goals and standards and guidelines would strive to maintain low-use recreation areas where they currently occur, rather than allowing increased human use to create additional high use areas. This would help maintain secluded areas where denning habitat could be developed. No summer motorized trails would be built, so there would be no effect from this activity.

Snow Compaction

Effects would the same as those described in Alternative 1.

Linkages

Direct and indirect effects to lynx linkages would be the same as described in Alternative 1.

Vehicle Collisions
The projected increase in recreation use is expected to be the same for road use in all alternatives. Therefore, the risk of vehicle collisions would be the same as described in Alternative 1.

Cumulative effects of Alternative 2

Foraging Habitat
Cumulative effects would be similar to those described in Alternative 1. However, Alternative 2 would promote a greater return to softwood stands than Alternative 1, so more lynx habitat would be available on the WMNF in the long term (>100 years).

Denning Habitat
The acreage where timber harvest is not allowed is similar to that of Alternative 1; therefore, cumulative effects to denning habitat would be the same in both alternatives.

Human Use in Denning Habitat
Cumulative effects would be the same as those described in Alternative 1.

Snow Compaction
Cumulative effects would be the same as those described in Alternative 1.

Linkages
Cumulative effects would be the same as those described in Alternative 1.

Vehicle Collisions
Cumulative effects would be the same as those described in Alternative 1.

Alternative 3

Foraging Habitat
High elevation foraging habitats would be the same as in Alternative 1.

Below 2500 feet in elevation, Alternative 3 proposes the least amount of regeneration habitats to be created. Alternative 3 would add approximately 1,900 to 2,600 acres of optimal snowshoe hare habitat to help replace the amount growing out of optimal condition. However, this would only cover about one-fourth to one-third of the loss, which is less than the other alternatives. However, when compared to the amount of currently suitable habitat, this still equates to a three to four percent reduction, the same as the other alternatives. Although the absolute numbers are lower than the other alternatives, the percent reduction in suitable habitat is the same because the magnitude of existing suitable habitat in high elevations is so great.

Denning Habitat
This alternative would have the least potential to develop denning habitat over the next 20 years, with about double the amount of uneven-aged harvest acres compared to alternatives 1 and 2. However, as explained in Alternative 1, the effects may be negligible if most of the lynx habitat is at higher elevations.

Human Use in Denning Habitat
Effects would be the same as those described in Alternative 2.

Snow Compaction
Effects would the same as those described in Alternative 1.

Linkages
Direct and indirect effects to lynx linkages would be the same as described in Alternative 1.

Vehicle Collisions
The projected increase in recreation use is expected to be the same for road use in all alternatives. Therefore, the risk of vehicle collisions would be the same as described in Alternative 1.

Cumulative effects of Alternative 3

Foraging Habitat
Cumulative effects would be similar to those described in Alternative 2. Although Alternative 3 proposes almost no regeneration harvests, the proportion of high elevation habitat that remains unchanged makes the differences between regeneration harvests in each alternative negligible.

Denning Habitat
Cumulative effects to denning habitat on the WMNF would be similar to those described in Alternative 1. However, since Alternative 3 proposes the least amount of acreage in Management Area 2.1, where timber harvest is allowed, a greater proportion of the WMNF would continue maturing and subsequently allow denning habitat to be created naturally over more acres than any other alternative.

Human Use in Denning Habitat
Cumulative effects would be the same as those described in Alternative 1.

Snow Compaction
Cumulative effects would be the same as those described in Alternative 1.

Linkages
Cumulative effects would be the same as those described in Alternative 1.

Vehicle Collisions
Cumulative effects would be the same as those described in Alternative 1.

Alternative 4

Foraging Habitat
Although the amount of regeneration habitats being created overall in Alternative 4 is less than in Alternative 1, the amount in softwoods is the same. The amount of mixed wood would be less. However, the magnitude of the difference relative to lynx effects would be immeasurable. Therefore, effects to foraging habitat would be the same as those described in Alternative 1.

Denning Habitat
Alternative 4 proposes some 36,700 acres of uneven-aged harvests in Management Area 2.1 over the next 20 years. This would be only slightly less than that proposed in Alternative 3, so the effects of these two alternatives relative to denning habitat would be similar.

Human Use in Denning Habitat
Effects would be the same as those described in Alternative 1 for ski areas. However, Alternative 4 proposes the greatest increase in non-motorized trail construction to meet demand. Lynx guidelines would keep most new construction outside of lynx habitat, but because the Forest is such a mosaic of lynx habitat and non-lynx habitat, new trails in non-lynx habitat could result in dispersed use into areas of more suitable habitat. Without knowing site-specific locations and without having any lynx on the Forest currently, the effects of this many new trails are somewhat unknown. However, because of the magnitude of construction being proposed, Alternative 4 would have more risk of potentially impacting lynx from human disturbance than the other alternatives.

Alternative 4 allows summer motorized trail construction in one of two areas. In terms of lynx habitat, the Moat Mountain area would result in fewer effects to lynx than the Landaff area. Moat Mountain would likely have fewer crossings through lynx habitat and would already be close to a heavily disturbed area (see gray wolf effects above).

Snow Compaction
Effects would the same as those described in Alternative 1.

Linkages
Direct and indirect effects to lynx linkages would be the same as described in Alternative 1.

Vehicle Collisions
The projected increase in recreation use is expected to be the same for road use in all alternatives. Therefore, the risk of vehicle collisions would be the same as described in Alternative 1.

Cumulative effects of Alternative 4

Foraging Habitat
Cumulative effects would be similar to those described in Alternative 2.

Denning Habitat
Cumulative effects of denning habitat would be similar to those described in Alternative 1.

Human Use in Denning Habitat
At a landscape scale, cumulative effects would be similar to those described in Alternative 1.

Snow Compaction
Cumulative effects would be the same as those described in Alternative 1.

Linkages
Cumulative effects would be the same as those described in Alternative 1.

Vehicle Collisions
Cumulative effects would be the same as those described in Alternative 1.

Determination — Canada lynx

Since there is no evidence of Canada lynx currently occurring on the Forest, implementation of any alternative would result in **no effect** to Canada lynx. If, at some time, lynx appear on the Forest, implementation of any alternative may affect, but would not likely adversely affect Canada lynx.

Rationale Summary

1. Implementation of standards and guidelines would be implemented to conserve lynx and their habitat.
2. The core foraging habitat for lynx is in the high elevation softwoods. This habitat would be conserved in all alternatives. The opportunity exists to create additional foraging habitat in lower elevations, although the magnitude of what would be created here is minimal in all alternatives.
3. Denning habitat will continue to increase in all alternatives, especially in the core high elevation zone.
4. Goals, objectives, standards, and guidelines would minimize increases in snow compaction and subsequent negative effects to lynx.

Chapter 3 — Regional Forester Sensitive Species (Plants)

Arnica (*Arnica lanceolata*)

Distribution

Arnica lanceolata subspecies *lanceolata* is found only in Maine, New Hampshire, New York, Quebec, and New Brunswick. *A. l.* subspecies *amplexicaulis* is found from California north to Alaska, to Nevada, Utah, Idaho, Montana, and Alberta (NatureServe 2001j).

Life History

The species is an asexually reproducing perennial; plants set seed without fertilization. It blooms from late June to mid-September (Gruezo and Denford 1994). Seeds are dispersed by wind, water, or animal vectors (Zika 1992).

Habitat

Arnica lanceolata ssp. *lanceolata* is restricted to areas with constant moisture. It may be found in wet, rocky or sandy situations such as rocky river banks, gravel bars, beaches, and alluvial flats of rivers and streams at low elevations. At higher elevations, it grows on hornblende schist in gullies, on cliffs near waterfalls, on ravine headwalls, and in alpine and subalpine meadows (Gruezo and Denford 1994). It occurs in most components of the alpine snowbank/wet ravine community, including broad wet meadows and wet ravines (SVE Alpine Plant Panel 2002).

The species grows in open (not forested) areas, although some occurrences in Maine contain a few shrubs (MNAP 2001).

Occurrences

There are at least 7 extant and 2 historic occurrences in New Hampshire, 13 extant and 4 historic occurrences in Maine, and 1 historic occurrence in Vermont (NHNHI 2001, MNAP 2001, VNNHP 2001, NHNHB 2005 and additional data summarized in WMNF Literature Review for *Arnica lanceolata*). New Hampshire populations are disjunct from those in Maine.

On the WMNF, there are 5 extant occurrences, all around Mt. Washington. One historic occurrence is known from the Swift River in Albany (NHNHI 2005).

Threats/Limiting Factors

Identified threats to arnica include:

1. *Severe drought*, which could alter the constant moisture regime required by this species.
2. *Erosion* could impact occurrences along riverbanks.
3. *Changes in local hydrology* could impact the species through loss of habitat

4. *Hiker trampling* (SVE Alpine Plant Panel 2002).

The limiting factors of concern under WMNF control are:

a. Recreation activities, including trail construction, hiking, and winter camping, especially in the alpine zone.

b. Recreation use in riparian areas, which is believed to have caused the extirpation of at least one occurrence along the Swift River (NHNHI 2001).

Drought and other climate conditions are outside WMNF control.

Information Gaps

The SVE Alpine Plant Panel (2002) did not identify information gaps specific to arnica, but note the following information gaps relative to the alpine snowbank/wet ravine community:

1) Effects of winter camping, especially digging of snow caves, and other recreation impacts on snowbank communities.

2) Processes that differentiate individual communities within the snowbank/wet ravine system.

3) Patterns of distribution for the communities within the snowbank/wet ravine system.

Pertinent Resource Actions and Mitigation

No standards and guidelines specific to arnica are proposed, although Forest-wide direction related to protection of alpine communities and riparian areas would be provided in all alternatives.

Affected Environment

The area of effects analysis for arnica is the WMNF proclamation boundary plus Franconia Notch, Crawford Notch, and Mt. Washington State Parks. This covers the extent of the alpine zone in the White Mountains. Other smaller patches of alpine (e.g., on Mt. Katahdin in ME or on the Green Mountain National Forest in Vermont) are too distant for individual plants to be considered part of the same population. This boundary will also encompass any potential lower elevation riparian habitats. Given that no extant populations currently exist in this habitat, it is reasonable to focus primarily on alpine habitats.

Habitat Trend

Habitat in the alpine zone has been reduced over time by hiker traffic and construction of trails and other facilities. Trail impacts are considered greater outside of the Presidential Range (SVE Alpine Panel 2002).

Riparian habitats were greatly altered by the heavy logging activity that occurred in the 19th century. More recently, they have probably become more stabilized as mature riparian vegetation has returned.

Population Trend

The population trend for arnica is unknown. There are a number of historic occurrences for this species in the northeast, but no indication in the record of how recently some of these sites have been searched.

Environmental Effects

Alternative 1

Under all alternatives, hiking would likely continue its increasing trend. More people using the area means the likelihood of off-trail use would be proportionally higher. Overall, hiker impacts in the Presidentials are reduced compared to previous decades due to education and trail marking, but are especially prevalent around Alpine Garden and in Tuckerman's Ravine. Impacts may be greater on disjunct alpine summits outside of the Presidentials where education efforts occur at lower intensity and frequency (SVE Alpine Plant Panel 2002).

The risk of harming individual plants in these communities may increase over the next planning period because recreation use is expected to increase. Digging snow caves for winter camping and hiker traffic would be a continued threat, although alpine education programs and snow depth requirements for camping would help reduce the magnitude of these effects. New direction that requires action if monitoring demonstrates declines in alpine communities would also help reduce potential negative impacts. Loss of individual plants may occur over the next 20 years, which may reduce the quality of the population somewhat, but the expected effect is not so great that species viability would be jeopardized.

Some standards and guidelines exist to protect riparian values from activities that could change hydrological patterns. There are no known extant occurrences in riparian habitats, so there would be no effect to known individuals, but habitat and undiscovered occurrences could be degraded along areas where many users wander off-trail (e.g., along the Swift River near the Kancamagus Highway).

Cumulative effects of Alternative 1

Past trail construction and human use has undoubtedly resulted in loss of patches of alpine communities over the landscape, although the SVE Alpine Plant Panel (2002) considered the current state of these communities to be viable. No future actions are known at the three state parks with alpine habitat that would cause a change to projected effects described above, although use would be expected to increase similar to projected increases on the Forest. Similar management techniques (e.g., education programs) at these locations would also help reduce trampling effects.

Over the next 50 to 100 years, use will likely continue to increase as the population in the Northeast increases and more people look to the White Mountains for outdoor recreation. The risk of hiker trampling, especially near established trails, will increase, although construction of scree walls or other barriers, increased patrols, trail closures, and other mitigation would be available if effects became considerably worse. Other factors

outside of Forest Service control, such as air pollution, acid rain, global warming and associated climate change, may become more influential than increased human use levels in determining whether rare alpine communities remain viable.

Global warming may ultimately be a greater threat than any management activity, since it has the potential to greatly alter precipitation and subsequently vegetation. Many alpine species already survive in a narrow window of habitat suitability and may not easily adapt to changes that would occur relatively rapidly. Whether or not arnica or other alpine plants could persist in the face of such change is unknown, although it is unlikely that global warming would change habitats so radically over the next planning period that this species would be extirpated.

Alternative 2

Under Alternative 2, standards and guidelines would be the same as in Alternative 1, although the alpine zone in the Presidential and Franconia ranges would be identified as a separate management area. Effects from recreation activities would be the same as those described in Alternative 1

Effects to riparian habitats would be the same as described in Alternative 1.

Cumulative effects of Alternative 2

Cumulative effects would be the same as those described in Alternative 1.

Alternative 3

Effects would be the same as those described in Alternative 2.

Cumulative effects of Alternative 3

Cumulative effects would be the same as those described in Alternative 2.

Alternative 4

In Alternative 4, recreation use would be allowed to increase to meet demand, provided other resources are not compromised. However, while this is the intent on a Forest-wide basis, Forest Plan direction for the alpine zone would limit activities here. For example, regardless of demand, standards and guidelines prohibit construction of new facilities and trails in the alpine zone, so the amount of increased use in the alpine zone is somewhat limited. Use levels would still be expected to increase, but probably not noticeably different than in the other alternatives. Therefore, effects of alternative 4 would be similar to those described above in Alternative 1.

Cumulative effects of Alternative 4

Cumulative effects would be the same as those described in Alternative 1.

Determination — Arnica

Implementation of any alternative **may impact individuals**, **but would not likely cause a trend towards federal listing or a loss of viability**.

Rationale Summary

1. Mitigation to protect alpine plants and increase public education/awareness of rare alpine communities should reduce potential impacts in all alternatives. Although recreation use is expected to increase, implementation of Forest Plan standards and guidelines would keep the majority of the use on existing trails. Not every scenario can be anticipated, but many alpine species have persisted for years with heavy hiker traffic and little or no protection, so it is unlikely that a significant decline would occur during the next 20 years.

Dwarf white birch (*Betula minor*)

Distribution

Dwarf white birch is found from Labrador south to Newfoundland, the Gaspé Peninsula and Laurentide Mountains, Quebec, and on mountain summits and passes of northern New England and northeastern New York (Furlow and Mitchell 1990).

Life History

Dwarf white birch is a tree that flowers from June to July with fruiting occurring from August to September. Based on the fruit structure, dispersal via wind is assumed (Furlow and Mitchell 1990).

Spruce grouse and ruffed grouse feed on catkins, buds, and seeds of various *Betula* species. Redpolls and pine siskins forage on the seeds. Leaves and small branches may be eaten by browsers such as moose, snowshoe hare, porcupine, and beaver (Martin et al., 1951), although these species would be virtually nonexistent in the alpine zone.

Habitat

Dwarf white birch is found on fairly exposed windy ridges in the dry/mesic heath meadow system of alpine communities in New Hampshire. This system is associated with stony areas and convex landforms that are more exposed. The community includes an array of *Carex* meadows, strong heaths, *Diapensia*, fell fields, and barren rock and occurs as a large and widespread patch matrix in the Presidential Range, as well as on disjunct summits in smaller patches. Elevation limits this community type (SVE Alpine Plant Panel 2002).

Only species adapted to wind disturbance can survive in this environment. Habitat features that are important in providing viability of the dry/mesic heath meadow system include those factors associated with exposure to the elements, especially in winter. Key factors are cold, wind, and snow and ice blast. Other characteristics include dry to mesic moisture conditions, well-drained sites, thin acidic soils, desiccation, and presence of low nutrient tolerant plants (SVE Alpine Plant Panel 2002).

Occurrences

Two extant *Betula minor* occurrences have been recorded in Maine, with 13 extant and 8 historic occurrences in New Hampshire and none in

Vermont (MNAP 2001, NHNHI 2001, VNNHP 2001, and additional data summarized in WMNF Literature Review for *Betula minor*). In New Hampshire, the species is likely more widespread than records indicate, due to difficulties in identification (SVE Alpine Plant Panel 2002).

The WMNF holds all but one of the extant occurrences found in northern New England. All of the historic occurrences are also found on the WMNF.

Threats/Limiting Factors

Identified threats for dwarf white birch include:

1. *Hiker pressure*, specifically in New England because all known occurrences in New Hampshire and one of two in Maine are located next to a trail. Threats include both trampling immediately adjacent to trails as well as on open summits, where hikers leave the trail to "view seek" (SVE Alpine Plant Panel 2002).
2. *Air pollution* (Ketchledge and Leonard 1984; Zika 1993)
3. *Climatic warming* is a potential threat

The key limiting factor for the WMNF is hiking pressure. Air pollution is outside Forest Service control.

Information Gaps

The SVE Alpine Plant Panel (2002) identified the following information gaps for dwarf white birch:

1. Additional work on taxonomic issues with *Betula minor* and other *Betula* species.
2. Information is needed on the dry/mesic heath meadow system of lower elevation peaks as they may receive heavier recreational impacts. The patches of alpine communities on the lower elevation peaks are small and isolated, and the percentage of the lower summit areas impacted by recreation is much higher than in the large alpine blocks on the higher summits.

Pertinent Resource Actions and Mitigation

No standards and guidelines specific to dwarf white birch are proposed, although Forest-wide direction related to protection of alpine communities would be provided in all alternatives.

Affected Environment

The area of effects analysis for dwarf white birch is the WMNF proclamation boundary plus Franconia Notch, Crawford Notch, and Mt. Washington State Parks. See arnica above for rationale.

Habitat Trend

Overall, the dry/mesic heath meadow system is stable (SVE Alpine Plant Panel 2002).

Population Trend

Some population loss appears evident from the number of historic occurrences in the record.

Environmental Effects

Alternative 1

Effects to dwarf white birch would be the same as those described for arnica (*Arnica* lanceolata) in alpine habitats above, although the risk from digging snow caves is not a concern for dwarf white birch, since that activity doesn't occur in heath habitats.

Cumulative effects of Alternative 1

Cumulative effects would be similar to those described for arnica above. The future outcome for *Betula minor* is that both the habitat and population will remain stable close to current levels in the Presidential Range. On the disjunct summits, threats will be higher because of less intensive educational efforts, but habitat and populations should remain relatively stable as well.

Alternatives 2, 3, and 4

Direct, indirect, and cumulative effects to dwarf white birch would be the same as those described in Alternative 1.

Determination — Dwarf white birch

Implementation of any alternative **may impact individuals**, **but would not likely cause a trend towards federal listing or a loss of viability**.

Rationale Summary

1. Mitigation to protect alpine plants and increase public education/awareness of rare alpine communities should reduce potential impacts in all alternatives. Although recreation use is expected to increase, implementation of Forest Plan standards and guidelines would keep the majority of the use on existing trails. Not every scenario can be anticipated, but many alpine species have persisted for years with heavy hiker traffic and little or no protection, so it is unlikely that a significant decline would occur during the next 20 years.

Pond reed bent-grass (*Calamagrostis lacustris*)

Calamagrostis lacustris is the synonym that has been designated as a Regional Forester's sensitive species. The current taxonomy is *Calamagrostis stricta* ssp. *inexpansa*.

Distribution

Pond reed bent-grass is a circumboreal species (Haines and Vining 1998) that is found from Alaska east to Newfoundland Island, south to New Jersey, west to California, including Maine, New Hampshire, Vermont, Connecticut, New York, Pennsylvania, West Virginia, Ohio, Michigan, Indiana, Wisconsin, Illinois, Minnesota, Iowa, Missouri, North Dakota,

South Dakota, Nebraska, Kansas, Montana, Wyoming, Colorado, new Mexico, Idaho, Utah, Nevada, Arizona, Washington, and Oregon (NatureServe 2001p).

Life History

Pond reed bent-grass is a rhizomatous, apomixis, perennial herb (Haines and Vining 1998). Little life history information on this species is found in the literature, other than that seeds are able to set without pollination (SVE Open/Nonforested Wetlands Panel 2002).

Habitat

Pond reed bent-grass is found in several habitat types, including damp woods, shaded cliffs, rocky shoreline sparsely vegetated by shrubs, open granite ledges, roadsides, streamside meadows, and within the spray zone of waterfalls (MNAP 2001). It is not found in forested wetlands unless a seep is present (SVE Open/Nonforested Wetlands Panel 2002).

NHNHI (2000) lists this species from cliffs/ledges, river and stream banks, bogs, wet alpine, fens, and seeps, while in Vermont it is found on vegetated limy cliffs with seepage from above after rainfalls and on quartzite ledges with some wet spots and seepage areas near the base, but without lime. Associated species in Vermont include *Danthonia spicata, Carex crinita,* and *Rhododendron prinophyllum* (VNNHP 2001).

The SVE Open/Nonforested Plants Panel (2002) noted the species may be found at high elevations, although that is not a preference.

Because the species prefers open conditions, natural disturbances such as regular flooding, browse pressure, beaver activity, ice-scouring, possible frost pocket influences, and ice and snow loading in alpine are likely processes that maintain habitat conditions (NHNHI 2001, SVE Open/Nonforested Wetlands Panel 2002). Engstrom (2004) also suggests fire activity may be beneficial.

Occurrences

There are 5 extant and 3 historic occurrences in Maine (MNAP 2001). New Hampshire tracks *Calamagrostis stricta* ssp. *inexpansa* and *Calamagrostis lacustris* separately. Combining these two species, there are 13 extant and 5 historic occurrences in New Hampshire (NHNHI 2001). There are 4 extant and 1 historic occurrences in Vermont (VNNHP 2001). The WMNF holds 5 extant and 4 historic occurrences, all in New Hampshire.

Threats/Limiting Factors

Identified threats for *Calamagrostis stricta* ssp. *inexpansa* include:

1. *Road maintenance* may disrupt roadside habitats, although these habitats likely did not exist prior to road construction.
2. *Succession* of wetland communities would result in a reduction in available habitat.
3. *Trampling* is a concern for inland habitats (SVE Open/Nonforested Wetland Panel 2002).

4. Sites on wet cliffs may be subjected to *rock and ice climbing* (Engstrom 2004).

The most limiting factors of concern under WMNF control are:

a. Road maintenance

b. Recreational use (that may lead to trampling or other direct impacts).

Information Gaps

The SVE Open/Nonforested Wetlands Panel (2002) identified the most significant information gap is a detailed understanding of the taxon's genetic factors.

Pertinent Resource Actions and Mitigation

There are no standards or guidelines specific to pond reed bent-grass, although some Riparian and Aquatic Habitats and Watershed standards and guidelines would help protect suitable habitat.

Affected Environment

The area of effects analysis for pond reed bent-grass is the HUC 5 subwatersheds that encompass the WMNF with some changes to exclude areas unlikely to be affected by Forest activities (Map G-01).

Habitat Trend

Habitat may have been lost to development, but some has been created through management activities such as road construction. Information is too scarce to determine a trend.

Population Trend

The taxonomy questions regarding this species makes population trends uncertain. If *Calamagrostis stricta* ssp. *inexpansa* and *Calamagrostis lacustris* are combined as one species, then the population of this larger group is probably stable.

Environmental Effects

All alternatives

Road maintenance levels would be the same in all alternatives. Although short spur roads may be constructed, there is no proposal to increase the road system beyond what is currently in place. Road maintenance operations would probably require site-specific mitigation to avoid impacting individuals.

Recreation use will undoubtedly increase over the next 20 years. This species seems to like relatively open conditions in a variety of habitats. One extant occurrence on the WMNF is from a graminoid meadow influenced by river flooding. While occasional hiker traffic may take place in such a habitat, it is unlikely that trail construction would occur there.

Standards and guidelines to protect riparian features and TES habitats would help mitigate such activity. Occasional hiker traffic should not impact this occurrence.

Cliff occurrences would be threatened by unrestricted climbing activity, since climbing is allowed unless posted closed. However, it is assumed that if potential climbing impacts are identified, closure of the cliff or other mitigation measures would be implemented to reduce the likelihood of negative effects occurring.

Elsewhere, suitable habitat exists in a variety of locations across the Forest. The SVE Open/Forested Wetlands Panel (2002) indicated this species, although naturally uncommon, appears to have persisted over time over its historic range. Therefore, it seems unlikely that increased recreation activity (including varying levels of new trail construction) would lead to trampling effects of such magnitude that suitable habitats would be lost and persistence would be jeopardized.

Cumulative effects of all alternatives

Development around the Forest will likely result in some habitat loss, although wetland and riparian habitats are protected under state law to some extent. Over the next 50 to 100 years, recreation pressure will probably continue increasing, but at some point, the Forest will likely reach a capacity that will limit the number of users that can be accommodated. Because this species may be found in so many types of habitats, it is likely that enough suitable habitats would be available and the species would continue to persist, albeit in low numbers, over time.

Determination — Pond reed bent-grass

Implementation of any alternative **may impact individuals, but would not likely cause a trend towards federal listing or loss of viability**.

Rationale Summary

1. Pond reed bent-grass occupies a variety of wet habitat types, including many which rely on disturbance to be perpetuated. Some kinds of manual disturbance, such as prescribed fire, may be beneficial in promoting suitable habitat conditions.
2. Although hiker use will continue increasing in the future, new trail construction probably would not occur in suitable habitat and off-trail use through these habitats is not expected to be so great that effects would be seen at the programmatic level.
3. Rock climbing poses a threat, but it is assumed that Rare and Unique Features standards and guidelines would be implemented to mitigate impacts at site-specific locations.

Alpine bitter cress (Cardamine bellidifolia)

Distribution

Alpine bitter cress has a circumboreal distribution, being found south to higher mountains of Maine and New Hampshire (Gleason and Cronquist 1991) and west to Oregon (Haines and Vining 1998). The SVE Alpine Plant Panel (2002) considers alpine bitter cress to be at the edge of its range in northern New England, which is typical of many alpine occurrences.

Life History

Little information is available on the reproduction of this species. Reproduction is assumed to be spotty, based on small, local populations with few numbers of individual plants (SVE Alpine Plant Panel 2002).

Habitat

Alpine bitter cress is found along alpine brooksides and in ravines (Haines and Vining 1998). It is a characteristic species of the alpine streamside community, a palustrine alpine community with high percent (approximately 90%) of vegetative cover (D. Sperduto 1993, Bliss 1963). Bliss (1963) describes the environment as along streams that are minor in total area, as represented by Alpine Garden with its several springs that flow across the area. Associated plant species at Alpine Garden include *Salix planifolia, Salix uva-ursi, Alnus crispa, Salix argyrocarpa, Vaccinium cespitosum, V. vitis-idaea*, and *V. uliginosum*. Herbaceous species found along alpine streamsides include *Saxifraga rivularis, Carex scirpoidea, Geum peckii, Houstonia caerulea, Polygonum viviparum, Potentilla tridentate, Prenanthes nana, Scirpus caespitosus, Agropyron trachycaulon, Trisetum spicatum, Veronica alpine, Achillea borealis*, and locally in moist sites *Euphrasia oakesii, Epilobium alpinum, Viola palustris*, and *Carex capillaris* (Bliss 1963, D. Sperduto 1993).

The species is also known from the alpine cliff seep community, which contrasts with the alpine streamside community in that it has sparse vegetation. Rather, it contains wet, dripping cliffs, rocky stream channels, and gullies. Associated species in this community include *Saxifraga rivularis, Houstonia caerulea, Oxyria digyna, Geum peckii, Epilobium species, Veronica alpina*, and *Pinguicula vulgaris* (D. Sperduto 1993).

The SVE Alpine Plant Panel (2002) indicated alpine bitter cress would only be found in the wet rock areas of the snowbank/wet meadow/streamside/wet shrub system, and that it would not be found in snowbanks or streamsides, which seems to counter some of the above habitat descriptions. Overall, this community has a patchy linear distribution, which may make it more vulnerable to disturbance (SVE Alpine Plant Panel 2002).

Being an alpine species, it is assumed to occur only at elevations above approximately 3,000 feet.

Occurrences

There are 2 extant and 7 historic occurrences in New Hampshire and 2 occurrences (status unknown) in Maine (NHNHI 2001, MNAP 2001).

All of the New Hampshire occurrences are on the WMNF.

Threats/Limiting Factors

The following threats have been identified for alpine bitter cress:

1. *Trampling* of habitat adjacent to existing trails is a likely threat. The SVE Alpine Plant Panel (2002) believes this species was much more common on the major summits prior to the construction of the AMC huts.
2. *Climate change* may alter snowfall amounts, but since this can be either an increase or a decrease, the consequences of this threat are unknown.
3. *Air pollution* may threaten alpine species (Ketchledge and Leonard 1984, Zika 1993).

The only threat that the WMNF could influence would be hiking pressure and winter camping.

Information Gaps

The following information gaps were identified by the SVE Alpine Plant Panel (2002):

1) Determine the effects of winter camping and other recreational sites.
2) Determine processes that distinguish the different community types within this snowbank/wet meadow/streamside/wet shrub ravine system. There is also a need for information on the patterns of distribution of communities within the snowbank/wet meadow/streamside/wet shrub ravine system.

Pertinent Resource Actions and Mitigation

No standards and guidelines specific to alpine bitter cress are proposed, although Forest-wide direction related to protection of alpine communities would be provided in all alternatives.

Affected Environment

The area of effects analysis for alpine bitter cress is the WMNF proclamation boundary plus Franconia Notch, Crawford Notch, and Mt. Washington State Parks, which encompasses almost the entire alpine zone in New Hampshire.

Habitat Trend

Habitat in the alpine zone has been reduced over time by hiker traffic, although this threat is considered greater outside of the Presidential Range. Alpine bitter cress is only known from the major ranges in the WMNF; it has not been found on any of the disjunct summits.

Population Trend

The SVE Alpine Plant Panel (2002) indicates alpine bitter cress has been extirpated from several locations. In addition, the extant occurrences aren't recent discoveries, but are from the same relative timeframe as the historic occurrences. Therefore, the population doesn't appear to be increasing, but may be stable or decreasing.

Environmental Effects

Effects of all alternatives would be the same as those described for arnica (*Arnica lanceolata*) above, except there would be no risk from digging snow caves.

Determination - Alpine bitter cress

Implementation of any alternative **may impact individuals, but would not likely cause a trend towards federal listing or loss of viability**.

Rationale Summary

1. Mitigation to protect alpine plants and increase public education/awareness of rare alpine communities should reduce potential impacts in all alternatives. Although recreation use is expected to increase, implementation of Forest Plan standards and guidelines would keep the majority of the use on existing trails. Not every scenario can be anticipated, but many alpine species have persisted for years with heavy hiker traffic and little or no protection, so it is unlikely that a significant decline would occur during the next 20 years.

Bailey's sedge (*Carex baileyi*)

Distribution

Bailey's sedge is found from Maine to Quebec, west to Michigan and south to Alabama and Florida (NatureServe 2001o).

Life History

Bailey's sedge is a perennial species that grows in bunches and is assumed to sexually reproduce. It blooms in late spring (USDA, NRCS 2001) and fruits from June through August (ME DOC 1998). Seed abundance is considered low (USDA, NRCS 2001).

Because of its similarity to the very common *Carex lurida, Carex baileyi* may often be overlooked (ME DOC 1998).

USDA and NRCS (2001) report Bailey's sedge is not fire resistant, but is fire tolerant, as well as being shade tolerant.

Habitat

Bailey's sedge is found in several habitat types, including wet meadows, fens, wet swamp woods, mixed woods, along roadsides and ditches, and in swales (MNAP 2001, ME DOC 1998, Flora of North America 2003),

and in a marsh/shrub-swamp/swamp complex (Heineke and Woods 1987). It is most often found on somewhat open sites with previous disturbance, such as along roads and in forest openings (D. Cameron, pers. comm.; E. Thompson, pers. comm.).

NHNHI (2000) indicates a preference for nutrient-rich sites, while Flora of North America (2003) states a preference for acidic soils. Local experts indicated no known pH preference.

Occurrences

There are 4 historic occurrences in Maine, 2 extant and 4 historic occurrences in New Hampshire, and 12 occurrences of unknown status in Vermont (MNAP 2001, NHNHI 2001, VNNHP 2001). Only 1 historic Maine occurrence is found on the WMNF.

Threats/Limiting Factors

Local experts identified no threats for this species; however, because of its occurrences in disturbed areas (along roads and possibly in openings created through management), activities that relate to road maintenance, opening maintenance, and possibly timber harvest could impact this species.

Information Gaps

This species was not evaluated with an expert panel format; however, local experts consulted noted there are many questions concerning preferred habitat and limiting factors for this species.

Pertinent Resource Actions and Mitigation

There are no mitigation measures designed specifically for this species, although Riparian and Aquatic Habitats standards and guidelines may help protect some habitats.

Affected Environment

The area of effects analysis for Bailey's sedge is the ecological subsections that encompass the WMNF (Map G-01). Although records are scanty, the species does occur across all three northern New England states.

Habitat Trend

Because of the variety of habitats in which this species is found, habitat is assumed to be stable. Road maintenance, opening maintenance, and timber harvest have all occurred at various levels during the past 20 years. Wetlands have been reasonably well protected, at least on the WMNF in recent decades.

Population Trend

With so few occurrences in the analysis area, a population trend cannot be determined.

Environmental Effects

All alternatives

So little is known regarding this species that evaluating differences of effects between alternatives is pointless. All alternatives would include some amount of disturbance through timber harvest, road maintenance, wildlife habitat enhancement activities, prescribed burning, trail maintenance, etc. Wetland habitats would continue to be protected in all alternatives. With no known extant populations, there would be no impact from any alternative and it is assumed suitable habitat would continue to be maintained. Experts believe the species probably occurs on the Forest, but hasn't been documented. However, if Bailey's sedge does occur, it would seem that continued management would not cause negative impacts at the programmatic level. With so few occurrences, it would appear that some unknown habitat factor may be limiting the species occurrence on the Forest.

Determination — Bailey's sedge

Implementation of any alternative would have **no impact** on Bailey's sedge.

Rationale Summary

1. There are currently no extant occurrences on the Forest. Habitat would continue to be maintained through management activities in all alternatives.

Piled-up sedge (*Carex cumulata*)

Distribution

Piled-up sedge occurs from New Brunswick Island to British Columbia, south to Indiana and New Jersey (NatureServe 2001i).

Life History

Piled-up sedge is a perennial sedge that reproduces sexually and that is unisexual and monoecious. Its major pollination agent is wind (Iverson et al., 1999).

Its lifespan is unknown.

Habitat

Piled-up sedge occurs in dry heath barrens and on acidic sand (VNNHP 2001, Iverson et al., 1999). On the WMNF, it is reported in a burned oak-pine rocky summit woodland at 1,000 feet (NHNHI 2001), and Iverson et al. (1999) reports it along the peaty margins of oak woods. It uses non-calcareous dry oak forests and hardwood talus that is open or in early successional condition (SVE Oak-Pine Panel 2002). Oak-pine forests are common throughout southern New Hampshire, but oak as a major forest component reaches its northern limit on the WMNF, which may explain why the species doesn't occur north of the Forest.

Associated species include *Carex pensylvanica* (Pennsylvania sedge), *Lysimachia quadrifolia* (whorled loosestrife), *Aralia hispida* (bristly sarsaparilla), *Quercus rubra* (red oak), and *Corydalis sempervirens* (pale corydalis) (NHNHI 2001).

Occurrences

In New England, piled-up sedge has 2 extant populations in Vermont, 3 extant and 4 historic populations in New Hampshire, and an unknown number of populations in nine counties in Maine (VNNHP 2001, NHNHI 2001, USDA 2002).

The WMNF is at the center of the species' New Hampshire range, but only one reported extant occurrence (in Rumney) (NHNHI 2001).

Threats/Limiting Factors

Threats to this species include:

1. *Genetic isolation* due to small population size could wipe out populations (SVE Oak-Pine Panel 2002).
2. *Invasive species*; this species occupies disturbed habitats that can easily be colonized by some non-native invasive plants.
3. *Trampling* can occur, especially on rocky summits.
4. *Succession* due to fire suppression has reduced habitat (SVE Oak-Pine Panel 2002). The one extant occurrence on the WMNF likely increased substantially following fire events (Engstrom 2004).

The most limiting factors of concern under WMNF control are:

a. Fire suppression

b. Spread of invasive species

c. Recreation pressure

Information Gaps

The SVE Oak-Pine Panel (2002) identified the following as information gaps:

1) More life history information is needed

2) Species searches need to occur in sandy places, e.g., the Conway area, Plymouth office, Owl's Head, and in the Saco Valley.

Pertinent Resource Actions and Mitigation

There are no standards or guidelines specific to piled-up sedge, although standards and guidelines to manage invasive species would help conserve habitat.

Affected Environment

The scope of effects analysis for piled-up sedge is the ecological subsections that surround the Forest, but only those portions that include the Forest south (see Map G-01). Because this species appears tied to oak and oak reaches its northern limit on the Forest, there is no reason to evaluate areas north of the Forest.

Habitat Trend

Habitat would seem to be readily abundant compared to the number of extant populations, although perhaps young, open oak stands were more abundant following logging and fires that occurred during the 19th and early 20th century.

Population Trend

Piled-up sedge is seemingly stable on the WMNF based on its one vigorous population, although population trends can hardly be based on just one occurrence. The species is suspected to be declining in New Hampshire based on 4 historic of 7 total occurrences.

Environmental Effects

Alternative 1

Invasive plants

The risk of invasive plants spreading on the WMNF is the highest in Alternative 1 compared to other alternatives. The Forest currently contains over 1700 occurrences of non-native invasive plants either within the proclamation boundary or nearby. Many of these are garden shrubs that were intentionally planted, but some such as purple loosestrife and common reed (*Phragmites*) are found along roads that traverse the Forest. Direction for prevention and eradication of invasive species would be included in the Forest Plan under all alternatives, but because the level of timber harvest and summer motorized trail use (which causes ground disturbance and creates suitable colonizing conditions for invasives) is highest in this alternative, the risk for spread of invasives is consequently high as well. Piled-up sedge is found in somewhat open conditions similar to those favored by invasives. Generally, invasive species have a more difficult time competing with native plants in stands with closed canopies or where light is more filtered. Activities such as prescribed burning remove standing native vegetation and can result in habitat conditions where invasives colonize an area more quickly than revegetating native communities. As yet, it does not appear that prescribed burning programs on the WMNF have resulted in spread of invasive plants, but if more source populations are available, it will be easier for spread to be facilitated into suitable habitat.

Recreation

Hiking traffic at rocky summits is likely to have more impacts than climbing because outside of the Presidential and Franconia ranges, hikers

tend to leave marked trail locations and wander over the entire summit. Summits are generally small and easily degraded by repeated traffic. Site-specific mitigation measures such as signs can help focus traffic on marked trails, although it is likely that some people will continue to ignore or forget these instructions in favor of seeking summit views. Loss of individuals and habitat is likely, and unlike other species, when soils is removed from cracks or in shallow summit depressions, it may be hundreds of years before suitable habitat is created again. Also, in Alternative 1, additional trail construction may be built to meet demand. Locations of these trails are unknown at this time, but any additional trail to a summit could potentially increase habitat losses through hiker trampling. Not all habitat occurs on summits, but because these areas are difficult to keep intact, populations may grow less robust over time.

Fire management

Oak-pine forests would remain in management areas that allow prescribed fire, with less than two percent differences in acreage between the alternatives. The Forest has recently begun evaluating the use of prescribed fire and wildland (lightning-started) fires to promote ecological processes in fire-maintained systems. If fire suppression is the reason for population decreases or reductions in habitat suitability, fire management practices should improve these conditions in the future, assuming that prescribed fire can mimic the conditions that result following wildland fire. In addition, in all alternatives, standards and guidelines would promote oak and pine should be promoted where they currently occur in management areas 2.1 and 3.1. Timber harvest would also be expected to contribute to habitat improvements as canopies are opened and oak forests regenerated. Since the WMNF only holds a single occurrence, viability may still be compromised, but over the next 10 to 20 years, it seems likely that Forest activities would be available to promote this population and other unoccupied habitats, so loss of viability would not be the result of Forest management. .

Cumulative effects of Alternative 1

It is assumed that funding levels for invasive species management would be the same in all alternatives, therefore eradication effort would also be the same. As invasive species continue to spread into areas surrounding areas the WMNF, the risk of negatively affecting rare species would increase. Prescribed fire may be effective in eradicating some invasive plants, which may benefit species such as piled-up sedge that can tolerate fire better than others. However, over time, if other activities on the WMNF increase the risk of invasives spreading, this alternative may result in higher risk to rare plants than other alternatives.

The WMNF has relatively little habitat potential compared to other areas within the analysis area. Sandy, outwash areas that support larger expanses of oak tend to occur south and east of the Forest. Over the next 50 years, increasing populations in the northeast may lead to more development on these lands. With only one occurrence on the Forest, maintaining population viability will continue to be a concern, regardless of alternative.

Alternative 2

Effects of invasive plants spreading would be similar to those described in Alternative 1. However, Alternative 2 proposes fewer acres harvested and fewer acres of even-aged regeneration harvest (which results in more open canopies and greater likelihood for invasive plant spread). Alternative 2 would prohibit summer motorized trail use, so the risk for invasives impacting piled-up sedge would be less than in Alternative 1.

Projected impacts from hiker traffic and climbing activity would be similar to Alternative 1, although no additional trails would be constructed to meet demand. Therefore, impacts are anticipated to remain primarily at existing trail locations. Although visitors may bushwhack to new locations, it is expected that these activities would be addressed through management to limit impacts.

Prescribed and wildland fire effects would be the same as those described for Alternative 1.

Cumulative effects of Alternative 2

Cumulative effects would be similar to those described in Alternative 1; however, since the amount of proposed timber harvest is reduced and summer motorized use is prohibited, the overall risk of spreading invasives on and around the Forest would be less than in Alternative 1.

Alternative 3

Alternative 3 proposes the least amount of timber harvest and even-aged regeneration harvest of all alternatives. Like Alternative 2, summer motorized trail use would be prohibited. Therefore, it has the least risk of spreading invasives. Invasives would likely still be found on the Forest, but eradication efforts would have the most proportional effect.

Effects of hiking and potential trampling would be the same as those described for Alternative 2.

Prescribed and wildland fire effects would be the same as those described for Alternative 1.

Cumulative effects of Alternative 3

Alternative effects would be similar to those described in Alternative 2, but with less potential for invasives spread from the Forest.

Alternative 4

Alternative 4 proposes less timber harvest than Alternative 1, but more than alternatives 2 and 3. Therefore, the risk of invasive plants spreading as a result of timber harvest would be intermediate between these alternatives. Alternative 4 also includes proposed summer motorized use, but the extent of this activity would be approximately one-third of that proposed in Alternative 1. While the effects would be the same as those described in Alternative 1, the magnitude would be less because fewer trail miles would be designated in this alternative.

Direct and indirect effects would be similar to those described for Alternative 1. However, in Alternative 4, there would be more emphasis

on non-motorized trail construction to meet demand, therefore, it is expected that even more hiking trails could be constructed in the next 10 to 20 years. If more of these trails were placed in rocky or sandy oak habitats, piled-up sedge would be at more risk. As in Alternative 1, though, standards and guidelines allow management responses that should prohibit loss of population viability on the Forest.

Prescribed and wildland fire effects would be the same as those described for Alternative 1.

Cumulative effects of Alternative 4

Cumulative effects would be similar to those described in Alternative 1.

Determination - Piled-up sedge

Implementation of any alternative **may impact individuals, but would not likely cause a trend towards federal listing or loss of viability**.

Rationale Summary

1. Forest Plan direction to maintain oak should result in activities to perpetuate suitable habitat.
2. Invasive plants are a risk, but new Forest Plan direction would help focus attention on the subject and further more effective eradication treatments.
3. Hiker traffic will continue to increase in all alternatives, but site-specific mitigation is available to protect occurrences.

The extant occurrence on the Forest appears to have persisted during, or perhaps benefited from, fire and other disturbance, so continuation of similar activities should not result in loss of the occurrence.

Wiegand's sedge (*Carex wiegandii*)

Distribution

The distribution of Wiegand's sedge covers much of northeastern North America, from Labrador south to New Jersey, west to Michigan and north to Quebec. It includes Maine, New Hampshire, possibly Vermont, Massachusetts, New York and Pennsylvania (NatureServe 2001e).

Life History

Wiegand's sedge is a perennial species that typically occurs in small populations that are often hard to relocate (SVE Open/Nonforested Wetland Panel 2002). Seedlings flower in their second year (A. Reznicek, pers. comm. cited in Nichols 2002).

The sedge is wind-pollinated (Nichols 2002); it flowers from June to August and fruits from July to August in Maine (MNAP 1999). Seed dispersal may be through wind, water, and/or gravity, as fruiting stems elongate 3-4 feet in length, then fall flat to the ground (A. Reznicek, pers. comm. cited in Nichols 2002).

Habitat

Nichols (2002) summarizes the New England habitat for *C. wiegandii* as occurring in "both stable natural communities with infrequent disturbance (e.g., bogs and poor fens) and dynamic habitats such as successional areas (e.g., openings in forested peatlands and graminoid swales) or sites where the soils have been disturbed (e.g., acidic sandy soils, lakeshores, borrow pits, log landings, ditches, trails, power line corridors, and wet circumneutral pastures)." Frequent natural disturbance such as beaver activity, windthrow, storms, drought, animal trails, herbivory, and fire can also create habitat patches in otherwise wooded areas (A. Reznicek, pers. comm. cited in Nichols 2002). Since seeds are wind-borne, habitat patches will be related to how far pollen can be carried. Also, although the species will tolerate disturbance, it is not required (SVE Open/Nonforested Wetland Panel 2002).

The SVE Open/Nonforested Wetlands Panel (2002) noted Wiegand's sedge is usually associated with organic soils and likes coniferous swamps.

Across its range, associated woody species include *Thuja occidentalis* (northern white cedar), *Picea mariana* (black spruce), *Larix laricina* (eastern larch), *Acer rubrum* (red maple), *Pinus banksiana* (jack pine), *Betula papyrifera* (paper birch), *Alnus incana* ssp. *rugosa* (speckled alder), *Kalmia angustifolia* (sheep laurel), and *Lyonia ligustrina* (male-berry). Associated forbs include *Solidago uliginosa* (bog goldenrod), *Aster nemoralis* (bog aster), *Iris* sp., *Drosera rotundifolia* (round-leaved sundew), and *D. intermedia* (spatulate-leaved sundew). Associated graminoids, ferns and fern allies include *Carex echinata* (prickly sedge), *C. sterilis* (sterile sedge), *C. canescens* (silvery sedge), *C. debilis* (Rudge's sedge), *Glyceria canadensis* (rattlesnake manna-grass), *Lycopodiella inundata* (slender bog clubmoss), *Osmunda cinnamomea* (cinnamon fern), and *O. regalis* var. *spectabilis* (royal fern). Several species of *Sphagnum* (peat mosses) are also common associates (Ostlie 1990 cited in Nichols 2002).

In nutrient-poor peatlands in New England, other woody species that may occur with *C. wiegandii* include *Abies balsamea* (balsam fir), *Betula populifolia* (gray birch), *Kalmia polifolia* (bog laurel), *Vaccinium corymbosum* (highbush blueberry), *V. macrocarpon* (large cranberry), *V. myrtilloides* (velvet-leaf blueberry), *Rhododendron candense* (rhodora), *Gaylussacia baccata* (black huckleberry), *Ledum groenlandicum* (Labrador-tea), *Nemopanthus mucronatus* (mountain holly), *Viburnum nudum* var. *cassinoides* (withered), *Ilex verticillata* (winterberry), *Myrica gale* (sweet gale), *Rubus hispidus* (bristly dewberry), *Aronia melanocarpa* (black chokeberry), *Spiraea alba* var. *latifolia* (eastern meadow-sweet), *S. tomentosa* (steeple-bush), and *Lonicera caerulea* var. *villosa* (mountain fly honeysuckle). Additional associated forbs include *Aster radula* (rough-leaved aster), *Sarracenia purpurea* (pitcher-plant), *Cornus canadensis* (bunchberry), *Gaultheria hispidula* (creeping snowberry), *Smilacina trifolia* (three-leaved false Solomon's seal), *Lysimachia terrestris* (swamp candles), *Lycopus uniflorus* (common water horehound), and *Platanthera* spp. (orchids). Additional associated graminoids and ferns include *Carex pauciflora* (few-flowered

sedge), *C. leptalea* (delicate sedge), *C. atlantica* (undiscovered sedge), *C. oligosperma* (few seeded sedge), *C. stricta* var. *strictior* (tussock sedge), *Eriophorum virginicum* (tawny cotton-grass), *Rhynchospora alba* (white beak-rush), *Scirpus cyperinus* (woolly bulrush), and *Calamagrostis canadensis* (blue-joint). Common associated *Sphagnum* species include *S. rubellum, S. papillosum, S. magellanicum, S. cuspidatum, S. palustre,* and *S. girgensohnii* (Nichols 2002).

Wiegand's sedge occupies a range of elevations, occurring in low coastal non-tidal wetlands (MNAP 2001) and as high as 2980 feet in New Hampshire (NHNHI 2000).

Occurrences

The WMNF has 5 extant and no historic occurrences. Currently the WMNF contains one hundred percent of the extant occurrences in New Hampshire. Maine has 27 extant and 11 historic occurrences, but none are on the Forest. (MNAP 2001, NHNHB 2005).

Threats/Limiting Factors

The following are considered threats to Wiegand's sedge:

1. *Loss and degradation of suitable wetland habitat*; factors contributing to this may include wetland filling, nutrient runoff, and changes to hydrology (Nichols 2002)
2. *Natural events that change suitable habitat conditions*, including beaver activity, herbivory, and encroachment of other vegetation may also threaten populations (Nichols 2002).
3. *Peat mining* (in New England, primarily for fuel and horticultural/ agricultural purposes) (Nichols 2002).
4. *Road construction/maintenance* (MNAP 2001).
5. *Logging* (MNAP 2001)
6. *Invasive wetland plants*, such as *Phragmites australis* (SVE Open/ Nonforested Wetlands Panel 2002)
7. Where *C. wiegandii* occurs in travel corridors (e.g., along powerline rights-of-way), *herbicide use* and *recreational use* (e.g., ATVs) can harm existing populations.

The most limiting factors of concern under WMNF control are:

a. Road construction/maintenance, and logging in suitable habitat.
b. Invasive plants and herbicide use
c. Recreational use in travel corridors

Information Gaps

The SVE Open/Nonforested Wetlands Panel (2002) identified the following information gap:

1) Need for more information on population persistence and whether a viable population can be maintained.

Pertinent Resource Actions and Mitigation

There are no proposed standards or guidelines specific to Wiegand's sedge, although standards and guidelines for Riparian and Aquatic Habitats, Watershed, and Invasive Species would help protect and conserve habitat.

Affected Environment

The area of effects analysis for Wiegand's sedge is the HUC 5 subwatersheds that encompass the WMNF with some changes to exclude areas unlikely to be affected by Forest activities (Map G-01).

Habitat Trend

Development has undoubtedly reduced the amount of available habitat for this species, as has indirect changes caused by activities such as road or trail construction that alters local hydrological patterns into appropriate habitat. On the other hand, this species is also known to occupy disturbed habitats such as ditches, log landings, etc. that may have created habitat. Some extant populations occur in beaver flooded ponds and at least one historic occurrence disappeared following beaver activity (Nichols 2002).

Population Trend

With so few occurrences in the analysis area, a population trend cannot be established.

Environmental Effects

Alternative 1

Road construction/maintenance/logging
Road construction/maintenance or logging operations are unlikely to cause negative impacts in any alternative because Watershed standards and guidelines restrict activities in wetlands.

Invasive species
Effects of invasive species would be the same as those discussed for piled-up sedge (*Carex cumulata*) above. Herbicide use is considered a threat for this species, and herbicides could be used to eradicate invasive plants, but not before TES plant surveys were completed. The nature of herbicide use for eradication of invasive plants is expected to be primarily "cut and paint", i.e., direct application on the target species, so the chance of unintentionally harming a rare plant through herbicide use is unlikely.

Recreational use
Recreational use, especially ATVs, could potentially impact individual colonies. Alternative 1 allows summer motorized trail use over approximately 60 to 90 miles. This would not impact extant populations because trails would not be routed through existing TES populations when so few exist. It is possible that ATV use could impact areas of suitable

habitat, but this is unlikely because standards and guidelines would likely keep such trails out of wetland features and protect hydrologic conditions.

Overall, the SVE Open/Nonforested Wetland Plants Panel (2002) did not feel habitats on the WMNF were threatened by any management activity.

Cumulative effects of Alternative 1

Development has probably resulted in some loss of habitat (Nichols 2002). As the population in the northeast continues to grow, additional suitable habitat will probably continue to be lost or altered indirectly, although wetland habitats should remain largely protected. Non-native invasive plants will also likely continue to increase, although prevention and eradication efforts on the Forest and other region-wide efforts (e.g., banning the sale of invasives) would help mitigate the rate of spread. Aquatic invasives such as common reed and purple loosestrife can multiply very quickly and fill in wetlands rapidly. Where Wiegand's sedge occurs on the Forest or other conservation lands, it may be relatively easy to implement eradication methods, such as hand pulling around the occurrences. However, if control methods are ineffective, it is likely that these wind-dispersed invasives will continue to spread and occupy every wet area in the analysis area. Biocontrol agents such as the loosestrife beetle (*Galerucella pusilla* Coleoptera: Chrysomelidae) have recently been released in various locations in New Hampshire, with apparently positive results. While complete eradication of these invasives is unlikely, it is expected that eradication and control efforts would help keep populations in check so native plants (such as Wiegand's sedge) can persist.

ATV use is expected to continue growing in popularity. Although individual wetlands may be impacted, it is unlikely that future ATV use would impact so much habitat that overall population viability would be jeopardized.

Alternative 2

Road construction/maintenance/logging
Road work and logging would be unlikely to result in negative effects for the same reasons as in Alternative 1.

Invasive species
Effects of invasive species would be the same as those described for piled-up sedge (*Carex cumulata*) above.

Recreational use
ATV use would be prohibited in Alternative 2, so no impacts would be expected from this activity.

Cumulative effects of Alternative 2

Cumulative effects would be similar to those described in Alternative 1. Unlike other more terrestrial species, aquatic invasives are more or less unaffected by logging activity. Therefore, they should be expected to respond in the same manner across alternatives as described in Alternative 1.

Effects from ATV use off-Forest would be the same as those described in Alternative 1. However, since they would be prohibited in Alternative 2,

the Forest would not contribute any negative effects to the regional population from this activity.

Alternative 3

Road construction/maintenance/logging
Road work and logging would be unlikely to result in negative effects for the same reasons as in Alternative 1.

Invasive species
Effects of invasive species would be the same as those described for piled-up sedge (*Carex cumulata*) above.

Recreational use
ATV use would be prohibited in Alternative 3, so no impacts would be expected from this activity.

Cumulative effects of Alternative 3

Cumulative effects would be the same as those described in Alternative 2.

Alternative 4

Road construction/maintenance/logging
Road work and logging would be unlikely to result in negative effects for the same reasons as in Alternative 1.

Invasive species
Effects of invasive species would be the same as those described for piled-up sedge (*Carex cumulata*) above.

Recreational use
Effects from ATV use would be similar to those described in Alternative 1, but since approximately two-thirds fewer trail miles would be designated in Alternative 4, the magnitude of effects across the Forest would be smaller.

Cumulative effects of Alternative 4

Cumulative effects would be similar to those described in Alternative 1, although the Forest's contribution to regional effects from ATV use might be somewhat smaller in this alternative because fewer miles of summer motorized trail would be designated.

Determination — Wiegand's sedge

Implementation of any alternative **may impact individuals, but would not likely cause a trend towards federal listing or loss of viability**.

Rationale Summary

1. Although road construction/maintenance and logging have the potential to impact individuals, mitigation to protect wetlands and protect TES species would be in place to conserve habitat and reduce those impacts.
2. Invasive species may be a threat, but new Forest Plan direction would help focus attention on the subject and further more effective eradication treatments.

3. It would appear that suitable unoccupied habitat exists, although not all habitat requirements are known.
4. Designating a summer motorized trail in an area that could impact this species is unlikely given standards and guidelines to protect threatened, endangered, and sensitive species.

Portions of some populations occur in disturbed wet areas near natural habitat, such as edges of hiking trails and ski roads. This may indicate that this species may tolerate or respond to these kinds of disturbance, although it is uncertain how well these stations can be maintained over time.

Squirrel corn *(Dicentra canadensis)*

Distribution

Squirrel corn ranges from Ontario, Quebec, and Nova Scotia south to Georgia and west to Missouri and Minnesota (NatureServe 2004).

Life History

Squirrel corn is a perennial with sexual and vegetative reproduction (USDA, NRCS 2001, IPIN 1999). It flowers early, from late April to mid-May, prior to full leaf-out (SVE Upland Forest Plants 2002, NHNHI 2002, CT BS 2002). After fruiting, it usually withers, spending the remainder of the year underground (NHNHI 2002).

Seeds may be dispersed by ants (ME DOC 1999, SVE Upland Forest Plants 2002).

Habitat

This species occurs in multi-aged, enriched northern hardwood forests. Its preferred habitat typically has a closed canopy, but not homogeneous cover. Vernal deciduous openings are important for spring ephemerals such as squirrel corn; they receive light in the spring and then stay moist in the summer when the canopy closes (SVE Upland Forest Plants Panel 2002). Because they seem to prefer these shady or partial shade conditions, it would not be expected in openings or young forests. However, at least one occurrence is known from a 4-year-old regenerating site adjacent to the primary colony (J. Williams, pers. comm.).

New Hampshire occurrences have ranged from 640-2500 feet in elevation (NHNHI 2001, S. Bailey pers. comm.).

Occurrences

In northern New England, squirrel corn occurs in 5 extant populations in Maine, 23 extant populations in New Hampshire, and an unknown number of populations in 12 Vermont counties. There are 2 historic occurrences in Maine and 10 in New Hampshire. A total of 15 populations currently occur on the WMNF (MNAP 2001, NHNHI 2001, USDA 2001, J. Williams 2004).

Threats/Limiting Factors

Identified threats for squirrel corn include:

1. *Timber harvest*; partial harvest prescriptions may be less likely to adversely affect plants than complete canopy removal (ME DOC 1999). Multiple entries and short rotation prescriptions also would be more likely to impact populations.
2. *Development* has resulted in the loss of suitable habitat.
3. *Invasive species* may increase competition in this habitat and impact rare species.
4. *Deer, moose, and turkey herbivory* are potential concerns (SVE Upland Forest Plants Panel 2002).
5. *Lack of suitable habitat* is probably the biggest limitation. New Hampshire's predominantly granitic bedrock limits the amount of naturally enriched hardwood habitats that can occur on the Forest.

The most limiting factors of concern under WMNF control are:

a. *Timber harvest*

b. *Invasive species* spread

c. *Herbivory*

Information Gaps

No information gaps were identified by the SVE Upland Forest Plants Panel (2002).

Pertinent Resource Actions and Mitigation

There are no standards or guidelines specific to squirrel corn.

Affected Environment

The area of effects analysis for squirrel corn is the ecological subsections that encompass the WMNF, along with the subsection that covers the Connecticut River Valley, where most patches of rich hardwoods habitat in New Hampshire occurs (Map G-01).

Habitat Trend

Mature, rich, northern hardwoods are relatively stable in the analysis area, although this habitat typically occurs in small patches or even tiny pockets (SVE Upland Forest Plants Panel 2002). In addition, across the Connecticut River in Vermont, abundant habitat exists where this species is considered relatively common (D. Burbank, pers. comm.). Some habitat has undoubtedly been lost to development and land clearing, but this trend would have been less since 1986 than in earlier centuries.

Population Trend

Within the analysis area, there are 28 extant and 6 historic occurrences in New Hampshire (NHNHI 2001 and additional data summarized in WMNF Literature Review for *Dicentra canadensis*), in addition to occurrences in Vermont, where the species is much more common. The species is considered relatively stable on the Forest with no evidence of decline (SVE Upland Forest Plants Panel 2002). Outside of the Forest, approximately one-third of all New Hampshire and Maine occurrences are historic (NHNHI 2001, MNAP 2001), which may indicate either a decline or a lack of monitoring. Existing populations are also probably stable within the entire analysis area, except where development or other land use changes are likely.

Environmental Effects

Alternative 1

Timber harvest

The biggest threat to this species is timber harvest, although other ground disturbing activities also have the potential to negatively impact individuals or habitat. Timber harvesting vehicles can unintentionally run over unknown individuals and cutting prescriptions can change the amount of canopy closure. If too much sunlight reaches the forest floor, microhabitats may become too dry to support this species. Effects would be most severe under even-aged regeneration treatments such as clearcutting and would be less impactive or even result in no effect with partial cuts such as single tree selection. Under all alternatives, TES plant surveys would be required prior to ground disturbance, so chances are good that known and new occurrences would be identified and mitigated prior to timber harvest or other activity. However, it is possible that an unknown occurrence could be overlooked or not have emerged at the time of survey. Alternative 1 proposes the greatest number of acres harvested through even-aged regeneration prescriptions and the second-greatest amount of total acres harvested (just behind Alternative 4). Therefore, the risk of impacting squirrel corn, albeit small, is higher in this alternative than in alternatives 2 and 3. Even-aged regeneration treatments may be more detrimental to rich hardwood species because suitable unoccupied habitat could be made unsuitable for a time as light levels increase.

Development

In a similar manner, other activities such as trail and road construction could impact known occurrences and/or impact suitable habitat. Although the risk of this is relatively small because of required plant surveys prior to ground disturbance, there is still a chance that unknown individuals or suitable habitat could be impacted. Alternative 1 would include 1900 to 3480 miles of new road/trail construction (including skid trails) compared to the other alternatives. Not all of these miles would fall in enriched hardwoods, but the more miles proposed, the greater the chance of inadvertently impacting an occurrence or suitable habitat. Up to 54 new

developed campsites could be constructed, which could impact suitable habitat, but would be dependent on site-specific location.

Invasive species
Effects from invasive species would be similar to those described for piled-up sedge (*Carex cumulata*) above. However, squirrel corn prefers less open habitats than piled-up sedge. Non-native invasive plants are less likely to colonize closed canopy stands, so squirrel corn may be better able to persist in the face of encroaching invasives.

Herbivory
The risk of deer, moose, and/or turkey herbivory increases as the amount of even-aged regeneration harvests increases. Prescriptions such as clearcutting create a flush of new growth that can attract these species to a local area. If prescriptions were located close to existing squirrel corn occurrences, the risk of herbivory would be higher.

Cumulative effects of Alternative 1

Timber harvest
Timber harvest activities outside the WMNF would contribute additional effects similar to those occurring on the Forest. There are a number of occurrences outside the Forest that could potentially be impacted. If these are reduced through harvest or other activities, the WMNF's role in maintaining populations of this species would increase.

Development
Outside of the Forest, the biggest threat to this species is loss of habitat caused by development. Chances are high that development trends (especially around the southern part of the WMNF) will continue. Much of the habitat where squirrel corn is found is at lower elevations, which is also where development is most likely. Because so many occurrences both on and off the Forest are considered stable, loss of some habitat over the next 20 to 50 years is not expected to change viability outcomes within the analysis area.

Invasive species
Cumulative effects of invasives would be similar to those of piled-up sedge above, but as explained in direct/indirect effects, invasives may be less likely to persist in squirrel corn habitat because canopy conditions would be more closed.

Herbivory
Herbivory concerns over the entire analysis area may increase locally. Deer and moose herds are below target numbers around the WMNF. Timber harvest in Alternative 1, combined with hunting policies implemented by the states, may increase populations. This could increase the potential herbivory risk, although it may not be of such magnitude that differences could be easily identified.

Alternative 2

Timber harvest
Effects of timber harvest and road/trail construction would be similar to Alternative 1, but there would be less chance of impacting an occurrence

in Alternative 2 because the amount of proposed timber harvest activity would be reduced. Alternative 2 proposes 25 percent less of the total acres treated and approximately 60 percent of the even-aged regeneration treatments compared to Alternative 1, even though the land base on which timber harvest could occur would remain essentially the same.

Development
The risk of impacts caused by road/trail construction would be reduced in Alternative 2. Total roadwork, skid trails, and new non-motorized trail construction would be approximately 69 to 85 percent of Alternative 1. No summer motorized trails would be allowed, therefore, no additional trail construction would be needed to support that activity, with a corresponding reduction in overall risk of impact. Similarly, fewer developed campsites would be developed in this alternative, so risk of impact would be lower.

Invasive species
Effects from invasive species would be similar to those described for piled-up sedge (*Carex cumulata*) above.

Herbivory

Herbivory concerns would be less than in Alternative 1. With less even-aged regeneration harvests proposed, the risk of altering herd dynamics is reduced.

Cumulative effects of Alternative 2

Cumulative effects would be similar to Alternative 1, but the Forest may contribute less to impacts within the entire analysis area.

Alternative 3

Timber harvest
Alternative 3 proposes the least amount of timber harvest, although the amount of acres proposed for treatment is approximately the same as in Alternative 2. The risk of direct mortality would be the same as in Alternative 2, since approximately the same amount of acres would be treated. However, even-aged regeneration treatments would be less than half of Alternative 2, resulting in the least risk of indirect effects caused by habitat alteration.

Development
Proposed road, trail, and developed campsite construction is about the same as Alternative 2, so effects would be the same.

Invasive species
Effects from invasive species would be similar to those described for piled-up sedge (*Carex cumulata*) above.

Herbivory
Alternative 3 would contribute the least amount of habitat to increased herbivory risks.

Cumulative effects of Alternative 3

Cumulative effects would be similar to those described in Alternative 2.

Alternative 4

Timber harvest

Alternative 4 proposes the greatest amount of acres treated by timber harvest of any alternative, although the number of acres harvested through even-aged regeneration prescriptions is less than in Alternative 1. The overall risk of impacting an unknown individual or habitat is greater than Alternative 1 because more acres would be treated. However, indirect effects of habitat loss through even-aged regeneration harvests would be less in this alternative compared to Alternative 1.

Development

The amount of road construction to support the timber program would be the highest of all alternatives, although the difference in effects compared to Alternative 1 would be virtually immeasurable. Trail construction miles would be the highest of all alternatives in order to respond to use demands, including construction of a summer motorized trail. In addition, Alternative 4 proposes more developed campsites than alternatives 1, 2, or 3. The risk of impacting squirrel corn is probably greater in Alternative 4 than in any other alternative because of the combined effects of timber harvest and recreation construction.

Invasive species

Effects from invasive species would be similar to those described for piled-up sedge (*Carex cumulata*) above.

Herbivory

Herbivory effects would be more or less comparable to Alternative 2, since the levels of even-aged regeneration harvest would be similar.

Cumulative effects of Alternative 4

Cumulative effects would be similar to Alternative 1.

Determination — Squirrel corn

Implementation of any alternative **may impact individuals, but would not likely cause a trend towards federal listing or loss of viability**.

Rationale Summary

1. Although timber harvest and road/trail construction have the potential to directly and indirectly impact individuals, mitigation to protect TES species would be in place to reduce those impacts.

This species has a number of extant occurrences that are considered stable, including some in active timber sale areas and some that have been discovered after timber sale operations were completed. While timber harvesting obviously has the potential to negatively impact this species and its habitat, it would appear that the species has sometimes been able to persist and even increase numbers within active units.

Goldie's woodfern (*Dryopteris goldiana*)

Distribution

Goldie's woodfern is distributed from southeastern Canada to the Carolinas, including Tennessee, Iowa, and Minnesota (Flora of North America 1993).

Life History

Goldie's woodfern is a perennial herb that reproduces vegetatively through rhizomes and sexually by dispensing spores (Lellinger 1985). Sori appear from July through August (MNAP 1999).

Goldie's woodfern hybridizes with a number of other species in its genera, including *D. intermedia, D. marginalis, D. carthusiana, D. clintoniana,* and *D. ludoviciana* (Werth 1991, Haines and Vining 1998).

Habitat

The primary habitat for Goldie's woodfern is rich dense wooded ravines (Werth 1991). Forest composition can be hardwood or mixed woods with calcareous soils (MNAP 1999, SVE Pteridophyte Panel 2002). This species may be found in limey seeps or along swamp edges (Flora of North America 1993, SVE Pteridophyte Species Panel 2002). Moisture is important, especially if the canopy is more open (SVE Pteridophyte Species Panel 2002).

Jenkins (1981) describes habitat in Vermont as deep fertile moist humus soils, usually in full shade, often in wooded ravines near streams or at the base of mountain slopes. New Hampshire sites are likely to be rich, circumneutral mesic forests below 2500 feet elevation, but may also occur at the edge of floodplain forests, rich hardwood swamps, and rich river terrace slopes, and at the base of cliffs (NHNHI 1998). At one New Hampshire site the overstory was dominated by white ash, northern red oak and sugar maple with occasional butternut (S. Bailey, pers. comm.).

Mature hardwood sites typically have multilayered structure, although NHNHI (1998) indicates that the species usually occurs where there is not much undergrowth. The SVE Pteridophyte Panel (2002) notes that Goldie's woodfern is associated with deep leaf litter.

Occurrences

There are 5 extant and 7 historic occurrences in Maine and 19 extant and 11 historic occurrences in New Hampshire (MNAP 2001, NHNHI 2001, and data summarized in WMNF Literature Review for *Dryopteris goldiana*). This species is not uncommon in Vermont.

The WMNF holds 7 extant occurrences and 1 historic occurrence.

Threats/Limiting Factors

Identified threats for Goldie's woodfern include:

1. *Fire* or *excessive flooding*, which would destroy the species.

2. *Wind or other activities that open the canopy* could increase exposure (Jenkins 1981). This species can tolerate some disturbance (e.g., logging), although it would be more likely to do better without it. The critical component appears to be stable moisture regimes (SVE Pteridophyte Species Panel 2002).
3. *Collection* (SVE Pteridophyte Panel 2002).
4. *Lack of circumneutral calcareous habitat* naturally limits habitat opportunities.

The most limiting factors of concern under WMNF control are:

a. Activities that affect the amount of canopy closure (primarily timber harvest)

b. Activities that affect hydrologic patterns or amount of moisture present (primarily road, trail, and skid trail construction)

c. Fire activities near known sites

Information Gaps

The SVE Pteridophyte Panel (2002) did not identify any known information gaps for this species.

Pertinent Resource Actions and Mitigation

There are no standards or guidelines specific to Goldie's woodfern. However, standards and guidelines to protect Riparian and Aquatic Habitats could help conserve this species.

Affected Environment

The area of analysis for this Goldie's woodfern is the ecological subsections in which the WMNF exists and the subsection that includes the Connecticut River Valley, where most patches of enriched forest habitat in New Hampshire occur (Map G-01).

Habitat Trend

Some habitat has undoubtedly been lost to development and other activities. Large swamps and seepy areas are usually avoided by construction and development, but smaller areas have likely been impacted.

Population Trend

Within the analysis area, there are 17 extant and 10 historic occurrences. The SVE Pteridophyte Panel (2002) ranked Goldie's woodfern at the highest level for maintaining viability now and in the next 20 years, i.e., the population is considered at least stable.

Environmental Effects

Alternative 1

Timber harvest

Timber harvest would be the most likely activity to cause changes in canopy closure. Effects from timber harvest would be similar to those described for squirrel corn (*Dicentra canadensis*) above. Goldie's fern seems somewhat more dependent on moisture than squirrel corn, so changes to hydrology in a local area could also impact the species. As with canopy closure, logging is the most likely activity to cause an effect. Equipment can cause soil compaction and divert water movement. This is generally avoided through winter harvest restrictions and is probably not a concern for obviously wet habitats, but may be for seeps. In some cases, timber harvest may not be detrimental, as Goldie's fern has been found in second growth stands, regenerating clearcuts, and at ski areas (SVE Pteridophyte Panel 2002).

Road, trail, and skid trail construction

Road, trail, and skid trail construction can also divert water movement away from occupied habitat. Depending on the magnitude of the diversion, habitats at some distance from the road or trail could be altered and made unsuitable. At a programmatic level, alternatives with more proposed road, trail, and skid trail construction would be more likely to encounter this situation. Alternative 1 proposes 1900 to 3480 miles of this work over the first two decades of Forest Plan implementation. In total, this is the second-highest amount proposed. Standards and guidelines for threatened, endangered, and sensitive species would protect known sites, but there is a risk that suitable unoccupied habitat could be indirectly impacted.

Fire activity

Fire activity could occur through lightning strikes, escaped campfires, or prescribed burning. All of these are unlikely to result in impacts given the moisture regime this species requires.

Cumulative effects of Alternative 1

Within the entire analysis area, habitat is probably fairly stable. Swamps and large, seepy habitats are often avoided and probably have a lower risk of impacts from timber harvest, development, or other human use. Enriched hardwood forest habitats would have impacts as discussed for squirrel corn (*Dicentra canadensis*) above. The Forest could contribute areas of suitable habitat, but compared to the rest of the analysis area, there are few extant occurrences, probably due to the Forest's naturally acidic soil substrates. Other threats such as flooding may impact occurrences outside of the Forest, especially in watershed valleys where flooding tends to occur more frequently, but this is outside of Forest Service control.

Alternative 2

Timber harvest

Effects from timber harvest would be similar to those described for squirrel corn (*Dicentra canadensis*) above, with additional considerations given for hydrology as described in Alternative 1 above.

Road, trail, and skid trail construction
Road and skid trail construction would be slightly less than in Alternative 1 and only 10 miles of non-motorized trail would be anticipated. No summer motorized trails would be allowed. With so few roads and trails, it is likely that placement could avoid Goldie's fern habitats, so effects may be negligible.

Fire activity
Effects from fire activity would be the same as in Alternative 1.

Cumulative effects of Alternative 2

Across the entire analysis area, cumulative effects would be similar to Alternative 1. Regardless of alternative, habitat will always be somewhat limited on the Forest.

Alternative 3

Timber harvest
Effects from timber harvest would be similar to those described for squirrel corn (*Dicentra canadensis*) above, with additional considerations made for hydrology as described in Alternative 1 above.

Road, trail, and skid trail construction

Effects of road/trail/skid trail construction would be slightly less than those described in Alternative 2.

Fire activity
Effects from fire activity would be the same as in alternatives 1 and 2.

Cumulative effects of Alternative 3

Cumulative effects would be the same as those described in Alternative 1.

Alternative 4

Timber harvest
Effects of timber harvest would be the same as for squirrel corn (*Dicentra canadensis*) above, with additional considerations given for hydrology as described in Alternative 1 above.

Road, trail, and skid trail construction
In Alternative 4, the total amount of road/trail/skid trail construction would approximate Alternative 1. Effects would be similar to those described for Alternative 1.

Fire activity
Effects from fire activity would be the same as in alternatives 1, 2, and 3.

Cumulative effects of Alternative 4

Cumulative effects would be the same as those described for Alternative 1.

Determination — Goldie's woodfern

Implementation of any alternative **may impact individuals, but would not likely cause a trend towards federal listing or loss of viability**.

Rationale Summary

1. Although timber harvest and road/trail construction have the potential to directly and indirectly impact individuals, mitigation to protect TES species would be in place to reduce those impacts.
2. This species has a number of extant occurrences that are considered stable, including some in active timber sale areas and some that have been discovered after timber sale operations were completed. While timber harvesting obviously has the potential to negatively impact this species and its habitat, it appears in at least some cases, the species is able to persist within active sale areas. Further study could help determine if this species can tolerate harvest in the long term.

The SVE Pteridophyte Panel (2002) considers the habitat of this species to be broadly distributed and of sufficient quality now and in the future to support population interaction. It was given the highest ranking available for the viability exercise.

Oakes' eyebright (*Euphrasia oakesii*)

Distribution

Oakes' eyebright is found in alpine areas in Labrador and Newfoundland south to Maine and New Hampshire (Gleason and Cronquist 1991; Haines and Vining 1998; Slack and Bell 1995). Fernald and Wiegand (1915) identified it from exposed crests and bleak mountain summits in Labrador, Maine, and New Hampshire.

Life History

Information on reproduction is sparse. Flowering occurs from July to August (Slack and Bell 1995), often later than most alpine species. Vegetative parts appear in mid-July and may be missed in early season surveys (SVE Alpine Plant Panel 2002).

The species is hemiparasitic, potentially on *Salix uva-ursi* (SVE Alpine Plant Panel 2002).

Habitat

Habitat includes gravelly plains on the summits of the White Mountains (C.G. Pringle in Fernald and Wiegand 1915); on open shaly ground at the head of Oakes Gulf (Williams and Robinson in Fernald and Wiegand 1915); on wet shelves and crevices in Maine, 4,000-4,500 feet in elevation (Williams and Fernald in Fernald and Wiegand 1915); and on rocks on the north shore of Battle Harbor in Labrador (Williamson in Fernald and Wiegand 1915).

The SVE Alpine Plant Panel (2002) identified the species as occurring in the snowbank/wet ravine system of alpine communities, which includes streamside, wet mesic meadow, herb snowbank, heath snowbank, wet shrub ravine, and Alpine Garden communities. It also occurs in the dry/mesic heath meadow system, which can include a variety of *Carex* meadows, strong heath, *Diapensia*, fell field, and windswept places. Cogbill

(1993) pointed out Oakes' eyebright grew in fell-field habitat with *Potentilla robbinsiana,* not in the streamside/moist alpine herb-heath meadow.

Snow cover may be beneficial for this species, as it is for other species in snowbank communities. Snow loading is important for providing moisture and shelter in this system. Avalanche disturbance may also be important. During the summer, hydrological patterns must be kept from becoming stagnant for these species. Other key habitat factors include cold, wind, and snow and ice blast (SVE Alpine Plant Panel 2002).

Occurrences

Oakes' eyebright is known from 2 extant and 2 historic occurrences in New Hampshire, and 1 extant occurrence in Maine (NHNHI 2001, MNAP 2001, and data summarized in WMNF Literature Review for *Euphrasia oakesii*). All but the one extant occurrence from Maine are known from the WMNF.

Threats/Limiting Factors

The following threats have been identified for Oakes' eyebright:

1. *Hiking pressure, winter camping* (i.e., digging of snow caves), and other late winter/spring uses is the most important threat.
2. *Trampling* of habitat adjacent to existing trails is also a threat.
3. *Climate change* may alter snowfall amounts, but since this can be either an increase or a decrease, the consequences of this threat are unknown.
4. *Air pollution* may threaten alpine species (Ketchledge and Leonard 1984, Zika 1993) and acid deposition (SVE Alpine Plant Panel 2002).

The limiting factors of most concern on the WMNF are hiking and winter camping activities. Climate change and air pollution are outside Forest Service control.

Information Gaps

The SVE Alpine Plant Panel (2002) identified the following information gaps for Oakes' eyebright:

1) Verify literature records that suggest some populations have been extirpated.
2) Determine the effects of winter camping and other recreational uses.
3) Information is needed regarding the processes that distinguish the different community types within this snowbank/wet meadow/streamside/wet shrub ravine system. There is also a need for information on the patterns of distribution of communities within this system.
4) Determine disturbance dynamics of the dry/mesic heath meadow system.

5) Information is needed on the dry/mesic heath meadow system of lower elevation peaks as they may receive heavier recreational impacts.

Pertinent Resource Actions and Mitigation

No standards and guidelines specific to Oakes' eyebright are proposed, although Forest-wide direction related to protection of alpine communities would be provided in all alternatives.

Affected Environment

The area of effects analysis for Oakes' eyebright is the WMNF proclamation boundary plus Franconia Notch, Crawford Notch, and Mt. Washington State Parks, which encompasses almost the entire alpine zone in New Hampshire. No alpine habitat exists in western Maine.

Habitat Trend

Habitat in the alpine zone has been reduced over time by hiker traffic, although this threat is considered greater outside of the Presidential Range.

Population Trend

With so few occurrences, a population trend cannot be determined, although recent discoveries have increased the number of extant occurrences in New Hampshire.

Environmental Effects

Effects on Oakes' eyebright would be the same as those described above for arnica (*Arnica lanceolata*).

Determination — Oakes' eyebright

Implementation of any alternative **may impact individuals**, **but would not likely cause a trend towards federal listing or a loss of viability**.

Rationale Summary

1. Mitigation to protect alpine plants and increase public education/awareness of rare alpine communities should reduce potential impacts in all alternatives. Although recreation use is expected to increase, implementation of Forest Plan standards and guidelines would keep the majority of the use on existing trails. Not every scenario can be anticipated, but many alpine species have persisted for years with heavy hiker traffic and little or no protection, so it is unlikely that a significant decline would occur during the next 15 years.

Proliferous red fescue (*Festuca rubra* ssp *arctica* = var. *prolifera*)

This species' taxonomy is somewhat confusing, also being known as *Festuca prolifera* (Piper) Fernald, 1933a and *Festuca rubra* L. (MOBOT 2001). Because it is currently listed on the Regional Forester's sensitive species list as *Festuca rubra* ssp. *arctica*, that is the synonymy used for this analysis.

Distribution

The species is at the very edge of its southern range (SVE Alpine Plant Panel 2002).

Life History

Reproduction occurs via facultative and obligate vegetative proliferation (Aiken et al., 1988). Plant growth is often limited by soil nutrient deficiencies, such as nitrogen and phosphorus. In the arctic, lichens contribute to nitrogen fixation in nutrient-poor, acidic soils (Sonesson and Callaghan 1991).

Frost heaving of soil polygons may contribute to high seedling mortality rates (Wager 1938 in Jonasson and Callaghan 1992).

Habitat

In New Hampshire, *Festuca rubra* ssp *arctica* occurs in cool, wet ravines and along alpine brooks (Crow and Storks 1980). The subspecies is not listed as a representative of any alpine community described by Sperduto and Cogbill (1999) and available information is insufficient to categorize it with any confidence.

It is assumed that water movement is an important habitat feature, since it is found in wet places.

Occurrences

Festuca rubra ssp *arctica* is known from 1 extant and 1 historic occurrence in New Hampshire and 1 extant occurrence in Maine (NHNHI 2001, MNAP 2001). The 2 New Hampshire occurrences occur on the WMNF.

Threats/Limiting Factors

Identified threats for *Festuca rubra* ssp *arctica* include:

1. *Alteration of hydrologic patterns* is probably the biggest threat.
2. *Hiking traffic, winter camping* (i.e. digging snow caves), and late spring/winter use would be threats.
3. *Global warming* and *acid deposition* are threats to the snowbank/wet meadow/streamside community system. Because of the wet nature of this subspecies' habitat, these may also be threats.
4. Because this species reproduces vegetatively (i.e. without seeds), it cannot reestablish itself at a later time if the parent plant is destroyed (SVE Alpine Plant Panel 2002).

5. *Air pollution* may threaten alpine plant species (Ketchledge and Leonard 1984, Zika 1993).

The factor of most concern on the WMNF is hiking traffic and other recreation use, especially uses that may change hydrologic patterns. Global warming, acid deposition, and air pollution are outside Forest Service control.

Information Gaps

The SVE Alpine Plant Panel (2002) identified the following information gaps for this species:

1) Taxonomic interpretation is needed. Problems with abundance are probably related to taxonomy and not threats and the species may disappear as the taxon is refined.
2) Determine effects of winter camping and other recreational uses.
3) Determine processes that distinguish the different alpine community types, especially the wetter ones.

Pertinent Resource Actions and Mitigation

No standards or guidelines specific to proliferous red fescue are proposed, although Forest-wide direction related to protection of alpine communities would be provided in all alternatives.

Affected Environment

The area of effects analysis for *Festuca rubra* spp *arctica* is the WMNF proclamation boundary plus Franconia Notch, Crawford Notch, and Mt. Washington State Parks, which encompasses almost the entire alpine zone in New Hampshire. No alpine habitat exists in western Maine.

Habitat Trend

Habitat in the alpine zone has been reduced over time by hiker traffic, although this threat is considered greater outside of the Presidential Range.

Population Trend

With so few occurrences, a population trend cannot be determined.

Environmental Effects

Effects for this species would be the similar to those described above for arnica (*Arnica lanceolata*). However, with only one extant occurrence on the Forest, the species may not persist despite actions to protect it.

Determination - Proliferous red fescue

Implementation of any alternative **may impact individuals but would not likely cause a trend towards federal listing or loss of viability.**

Rationale Summary

1. The SVE Alpine Plants Panel (2002) indicated that the rarity of this subspecies may be a reflection of its confusing taxonomy rather than a result of threats. It may be that in time, the species as it's currently known (*Festuca prolifera*) may actually disappear as taxonomic issues are cleaned up.
2. Mitigation to protect alpine plants and increase public education/awareness of rare alpine communities should reduce potential impacts in all alternatives. Although recreation use is expected to increase, implementation of Forest Plan standards and guidelines would keep the majority of the use on existing trails. Not every scenario can be anticipated, but many alpine species have persisted for years with heavy hiker traffic and little or no protection, so it is unlikely that a significant decline would occur during the next 15 years.

Northern comandra (*Geocaulon lividum*)

Distribution

Northern comandra is found from Labrador and Newfoundland to Alaska, south to Maine and west to Washington (NatureServe 2001f). It is at the edge of its range in northern New England.

Life History

Northern comandra is a perennial herb that reproduces by seed and sprouting from rhizomes. The species flowers from June to August, forming flowers in groups of three, but since only two of the flowers will produce pollen, only one flower of each cluster will bear fruit (ME DOC 1999). Reproductive success rates and life span are unknown.

Northern comandra is a root parasite that forms lateral outgrowths of the root (haustoria) that connect it to a host's roots or rhizomes, where presumably water and nutrients are received. The haustoria are white when young but become brown with age. Some host genera include spruce (*Picea* spp.), pine (*Pinus* spp.), birch (*Betula* spp.), willow (*Salix* spp.), alder (*Alnus* spp.), twinflower (*Linnaea* sp.), and blueberry/bilberry (*Vaccinium* spp.) (Warrington 1970, SVE Upland Forest Plants Panel 2002).

Habitat

Northern comandra is found primarily in bogs and moist coniferous woods, often occurring in nutrient poor areas, such as peatlands and krummholz (ME DOC 1999, USDA 2002). It often occupies acid or sterile soils and damp sands (USDA 2002) and can occur either in the open or in shaded conditions (SVE Upland Forest Plants Panel 2002).

In New England, occurrences have been located from sea level to 4,100 feet (1,200 m) elevation (USDA 2002). On the WMNF, its primary habitat is high elevation peatlands (2200-4310') (SVE Upland Forest Plants Panel 2002, NHNHI 2001).

Northern comandra in Alaska often occupies bottomland spruce-hardwood forests on taiga floodplains. It is found in balsam poplar (*Populus*

balsamifera) and black cottonwood (*P. trichocarpa*) stands with thick shrub understories that follow the initial alder and willow shrub stage after flooding. These stands are usually present for 20 to 100 years and are then replaced by white spruce if subsequent flooding does not occur. Northern comandra persists through the spruce stage and can be found in closed white spruce stands with a thick feathermoss mat. The greatest coverage of northern comandra is found in older, later successional forests (e.g., an open white spruce stand (250+ years old) or in black spruce stands on older terraces above an active floodplain. However, it has also been found among some of the first species following fire activity and has been found in communities with a fire return interval as short as 50 years (USDA 2002).

Occurrences

Northern comandra is known from a total of 16 extant and 1 historic occurrences in Maine, and 2 extant and 6 historic occurrences in New Hampshire. It is presumed extirpated from Vermont. On the WMNF, there are 2 extant populations (both in Coos County) and 4 historic populations (MNAP 2001, NHNHI 2001 and data summarized in WMNF Literature Review for *Geocaulon lividum*).

Threats/Limiting Factors

Identified threats for northern comandra include:

1. *Trails through peat bogs* can remove habitat and alter hydrology. This is considered the primary threat to the species (SVE Upland Forest Plants Panel 2002).
2. *Conifer logging* may also impact suitable habitat
3. *Identification* of this species is difficult, which may result in underreporting of occurrences.

Information Gaps

No information gaps were identified by the SVE Upland Forest Plants Panel (2002).

Pertinent Resource Actions and Mitigation

There are no standards or guidelines specific to northern comandra, but Riparian and Aquatic Habitats and Watershed direction would help protect habitats.

Affected Environment

The area of effects analysis for northern comandra is the ecological subsections that encompass the WMNF (Map G-01). The occurrences are in the northern part of the analysis area.

Habitat Trend

Within the analysis area, the WMNF holds a large portion of mature spruce and bog habitats. Although these habitats were greatly impacted in past history, since 1986, they have remained relatively stable. Many of these habitats are in higher elevations, which have been better protected from development. Trail construction and human use has probably contributed to some habitat loss, but overall the habitat is in good condition.

Population Trend

Within the analysis area, there are 12 extant and 5 historic occurrences. Although some historic occurrences may still persist and have just not been surveyed recently, a population decline has presumably occurred. This is primarily because of the number of historic occurrences in relatively protected areas (alpine) and the number of extant occurrences currently threatened by their proximity to hiking trails.

Environmental Effects

Alternative 1

Even-aged regeneration harvests would have the most drastic effect on habitat condition. Alternative 1 proposes approximately 900 to 1800 acres of softwood regeneration harvests over the first two decades of Forest Plan implementation. Considering the amount of softwood habitats in management areas 2.1 and 3.1 alone is almost 45,000 acres, it is unlikely that measurable impacts to northern comandra would occur.

Recreation use is expected to increase, regardless of alternative. The populations that currently occur on the WMNF are located immediately adjacent to trails. Additional hiking traffic would likely increase the risk of further trampling over the next 20 years. Site-specific mitigation may slow the decline, although it is difficult to shift traffic patterns once they are established. Approximately 30 miles of new hiking trails may be constructed in Alternative 1. It is unlikely that any would be approved through sensitive bog habitats, so this activity would have no effect to this habitat type. Trails through moist conifer forests could potentially impact unknown individuals, but required surveys prior to construction would make this unlikely.

Cumulative effects of Alternative 1

The SVE Upland Forest Plants Panel (2002) gave northern comandra the highest viability outcome range-wide, but projected viability was more jeopardized on the WMNF. Timber harvest has the potential to impact occurrences and habitats, although drastic changes to habitat are unlikely. Human pressure will likely increase throughout the analysis area, but recreation traffic would probably be higher on the WMNF than in other areas. Increasing development may eliminate some unoccupied suitable habitat in the analysis area, but high elevation bog habitats would be more protected on the Forest. The risk of additional viability loss is likely over the next 20 years because of the increased hiking pressure that will occur near extant occurrences, however, site-specific mitigation and keeping

additional trails out of suitable habitat should help reduce this risk and allow populations to persist.

Alternative 2

The amount of proposed even-aged regeneration harvests in conifer habitats is approximately the same as in Alternative 1. Therefore, effects would be the same as those described for Alternative 1.

Only 10 miles of new hiking trails would be constructed in Alternative 2, so effects from recreation use would be less than in Alternative 1.

Cumulative effects of Alternative 2

In the larger analysis area, cumulative effects are probably close enough to Alternative 1 as to be considered the same.

Alternative 3

The amount of even-aged regeneration harvests and non-motorized trail construction are effectively the same as Alternative 2. Therefore, effects would be the same as in Alternative 2.

Cumulative effects of Alternative 3

Cumulative effects would be the same as those described for Alternative 3.

Alternative 4

Alternative 4 would create approximately the same acres of even-aged regeneration habitat as Alternative 1 and 2. Therefore, effects of timber harvest would be the same as the other alternatives.

Approximately 100 miles of new non-motorized trail could be constructed in Alternative 4. As in Alternative 1, it is unlikely that any of these would be intentionally located through peat bogs, so there would be no effects to that habitat type. If trails passed through moist conifer forest, impacts could occur to unknown individuals, but surveys and the amount of available habitat make this unlikely.

Cumulative effects of Alternative 4

Over the entire analysis area, cumulative effects would be similar to Alternative 1.

Determination – Northern comandra

Implementation of any alternative **may impact individuals but would not likely cause a trend towards federal listing or a loss of viability**.

Rationale Summary

1. It is unlikely that additional trails would be constructed in bog habitats.

Population viability for this species is expected to be maintained, although some individuals or occurrences could be lost.

Mountain avens (*Geum peckii*)

Distribution

This species is found only in New Hampshire and Nova Scotia. Gleason and Cronquist (1991) list it in Maine as well, but Maine Natural Areas Program has no record for it, and it is not included in the *Flora Maine* by Haines and Vining (1998).

Life History

Mountain avens reproduces sexually via achenes and asexually through rhizomes (Paterson and Snyder 1999). Pollination occurs by insects (Godt et al., 1996 and Zinck 1996, both in Paterson and Snyder 1999). Flies have frequently been observed on *Geum peckii* flowers in Alpine Garden (Bliss 1966), although pollination by flies has not been confirmed.

Flowering occurs in June (Slack and Bell 1995) to July-August (Bliss 1966, Gleason and Cronquist 1991). Seeds likely ripen in late August to early September (Bliss 1966). In general, the species produces good seeds and seems very viable where it is currently found (SVE Alpine Plant Panel 2002).

Research by Bliss (1966) shows mountain avens had increased photosynthetic efficiency at higher light and temperature, which helps explain its distribution in sunnier, lower alpine zones. Also, because the species has a relatively high respiration rate at all temperatures, it may be better adapted to warmer (i.e., sunnier) alpine habitats.

Habitat

Gleason and Cronquist (1991) report this species from damp slopes and alpine meadows, while Slack and Bell (1995) consider habitat to be alpine and subalpine streamsides, alpine snowbanks, and bogs. The SVE Alpine Plant Panel (2002) categorizes this species in the snowbank/wet meadow/streamside community system (being mostly a species of streamsides), but indicates it may also be found in the dry/mesic heath meadow system of alpine communities (usually on the edges). Mountain avens has a wider and more general habitat preference than other alpine species (SVE Alpine Plant Panel 2002).

Although most occurrences are alpine above 3,000 feet elevation, one occurrence has been found at 1,100 feet (J. Williams, pers. comm.).

Occurrences

There are 28 extant and 6 historic occurrences in New Hampshire. Of these, 24 extant and all of the historic occurrences are from the WMNF, where it is widespread (NHNHI 2005).

Threats/Limiting Factors

Identified threats to mountain avens include:

1. *Hiking, winter camping* (i.e. digging snow caves), and late winter/spring use are probably the most important factors affecting the

snowbank/wet meadow/streamside community system. *Trampling* and "view seeking" also affects the dry/mesic heath meadow system.

2. *Disturbance*, especially related to hydrology, may be a potential threat. Because *Geum peckii* is mostly found in the snowbank/wet meadow/ streamside/wet shrub ravine system, which has a patchy, linear distribution, it may be more susceptible to disturbance (especially hydrological) than the larger, more widespread dry/mesic heath meadow system.
3. *Air pollution* may threaten alpine plant species (Ketchledge and Leonard 1984, Zika 1993).

The most limiting factor of concern under WMNF control is hiking and other recreation use. Air pollution is outside Forest Service control.

Information Gaps

The SVE Alpine Plant Panel (2002) identified the following information gaps for mountain avens:

1) Determine the exact number of occurrences in Nova Scotia.
2) Determine effects of winter camping and other recreational uses.
3) Determine processes that distinguish the different community types within this snowbank/wet meadow/streamside/wet shrub ravine system.
4) Determine disturbance dynamics of the dry/mesic heath meadow system
5) Information is needed on the dry/mesic heath meadow system of lower elevation peaks, since they may receive heavier recreational impacts.

Pertinent Resource Actions and Mitigation

No standards and guidelines specific to mountain avens are proposed, although Forest-wide direction related to protection of alpine communities would be provided in all alternatives.

Affected Environment

The area of effects analysis for mountain avens is the WMNF proclamation boundary plus Franconia Notch, Crawford Notch, and Mt. Washington State Parks, which encompasses almost the entire alpine zone in New Hampshire. No alpine habitat exists in western Maine.

Habitat Trend

Habitat in the alpine zone has been reduced over time by hiker traffic, although this threat is considered greater outside of the Presidential Range.

Population Trend

A number of occurrences were discovered in the 1990s and some extant occurrences date back to the 19th century, so the population is at least stable, if not increasing.

Environmental Effects

Effects for all alternatives would be the same as those described for arnica (*Arnica lanceolata)* above.

Determination — Mountain avens

Implementation of any alternative **may impact individuals but would not likely cause a trend towards federal listing or a loss of viability.**

Rationale Summary

Mitigation to protect alpine plants and increase public education/awareness of rare alpine communities should reduce potential impacts in all alternatives. Although recreation use is expected to increase, implementation of Forest Plan standards and guidelines would keep the majority of the use on existing trails. Not every scenario can be anticipated, but many alpine species have persisted for years with heavy hiker traffic and little or no protection, so it is unlikely that a significant decline would occur during the next 15 years.

Butternut *(Juglans cinerea)*

Distribution

Butternut grows throughout the central and eastern United States from the Lakes states east to northern New England. Scattered populations occur in northern Georgia, northern Alabama, South Carolina, and northern Mississippi. In the north, butternut ranges from St. John River Valley in New Brunswick to the lower St. Lawrence Valley and west through southwestern Quebec. It also occurs east and south of the Georgian Bay in Ontario (USFS 2001).

Life History

Reproduction

Butternut is monoecious. Flowers are produced from April to June. Fruit matures in September or October, remaining on the tree until after leaf fall. It bears seed at age 20 with optimum seed production occurring between age 30 to 60. Good seed crops occur every 2 to 3 years with light crops in intervening years (Rink 1990).

Seeds remain dormant until exposed to temperatures of 68º to 86º F for 90 to 120 days. Butternut can also reproduce vegetatively (Rink 1990).

Butternut is extremely susceptible to a canker fungus of unknown origin, *Sirococcus clavigignenti-juglandacearum*, which has spread throughout butternut's range in a short time and kills mature, immature, and seedling

trees (Prey and Kuntz 1981). Seedlings show symptoms within two weeks of infection. The highest rates of infection occur during the late summer rainy period when dispersal of *Sirococcus* spores is optimal and fresh leaf scars provide a pathway for infection (Tisserat and Kuntz 1981). Although infected trees do produce seeds, they rarely germinate, further lessening survival rates (Anderson 1988).

Butternut is a relatively short-lived tree among hardwoods, averaging 75 years for a healthy tree (Rink 1990).

Dispersal

Butternut seeds are dispersed through gravity or by squirrels or rodents. Mammals don't typically transport seeds very far, although seeds also were dispersed by Native Americans and early settlers (SVE Upland Forest Plants Panel 2002). Floodplain habitat indicates a likelihood that some seed dispersal occurs through flood events (J. Williams, pers. comm.)

Habitat

Butternut prefers well-drained soils of mesic forests, bottomlands, and floodplains (NatureServe 2001h), but can also grow in the talus of rock ledges and in dry, rocky soils of limestone origin (Strode 1978). The SVE Upland Forest Plants Panel (2002) suggests it occurs in rich, mesic hardwood forests and can be abundant in low gradient, but not really inundated, riparian habitat. It is associated with basswood, black cherry, beech, black walnut, elm, hemlock, hickory, oak, maple, birch, ash, poplar and occasionally white pine. It occurs as individuals or small clumps, rather than large pure stands. Climatic conditions vary widely over butternut's range, with mean annual temperatures from 60º F in the south to 40º F in the north (Rink 1990).

Butternut requires sufficient sunlight to germinate and grow to maturity. Seedlings are shade intolerant and require openings at least two to three times the height of the dominant overstory to establish. Once established, butternut requires room to grow to occupy the overstory. These conditions may occur in openings, near edges, in both young forests and large gaps of older forests, as well as in riparian areas (USFS 2001).

Occurrences

In New Hampshire, butternut ranges over most of Grafton and Carroll counties and in a small portion of Coos County. The WMNF portion of Oxford County, Maine is also within the range map boundaries at the northeast edge of the species range. Occurrence east of Lake Champlain and the Connecticut River is very patchy (Little 1971, SVE Upland Forest Plants Panel 2002). On the WMNF, 30-50 butternut trees occur in scattered locations mostly on the Pemigewassett and Saco Ranger Districts at old homesteads and in floodplains. Butternut canker is prevalent (J. Williams, pers. comm.).

Threats/Limiting Factors

The biggest threat to butternut is the butternut canker, although succession may also limit success (SVE Upland Forest Plants Panel 2002).

Information Gaps

No information gaps were identified by the SVE Upland Forest Plants Panel (2002).

Pertinent Resource Actions and Mitigation

No standards or guidelines specific to butternut are proposed.

Affected Environment

The area of effects analysis for butternut is the WMNF (see Figure 4). In New Hampshire/Maine, butternut is found primarily in Grafton, Carroll, and a small part of Coos County, the bulk of which is taken up by the WMNF.

Habitat Trends

Habitat is not considered a limiting factor for butternut at a landscape scale. However, since butternut was planted in old homesteads and as old farmlands decrease, butternut is succeeded by more vigorous, longer-lived, shade-tolerant species.

Population Trends

Since its identification in 1967, the canker fungus *Sirococcus clavigignenti-juglandacearum* has greatly reduced populations of butternut throughout the tree's range (NatureServe 2001h).

Environmental Effects

All alternatives

Because the biggest threat to this species is the butternut canker, there is no measurable difference in effects between the alternatives. Most, if not all, of the known butternut occurrences are within management areas that would allow habitat manipulation for timber harvest or to improve TES species habitat. Butternut is relatively easy to identify, being a tree rather than an ephemeral herbaceous plant. Seedlings generally occur nearby the parent tree, either falling directly to the ground or perhaps carried a short distance by squirrels (J. Williams, pers. comm.). Therefore, there is little chance that management actions would overlook individuals and negatively impact this species. Over the next 20 years, individual butternut trees will likely succumb to the butternut canker or old age, but there is nothing that can be done to mitigate that.

Cumulative effects of all alternatives

Efforts are underway to identify individual butternut trees that are naturally resistant to the canker, in the hopes that progeny of these individuals can be restocked into areas where butternut has been extirpated. However, it will likely take decades to produce enough resistant seed to initiate such action.

Determination — Butternut

Implementation of any alternative is **may impact individuals, but would not likely cause a trend towards federal listing or loss of viability**.

Rationale Summary

1. The determination is based on the effects of Forest Service management, not actions outside Forest Service control. Butternut is declining because of the butternut canker, not because of any management activities. If a treatment is not devised to mitigate the effects of this disease, it is unlikely the species will recover on its own.
2. The majority of WMNF butternut are planted or are likely progeny of planted trees. There is some question whether these trees would be considered native.

Auricled twayblade (*Listera auriculata*)

Distribution

Auricled twayblade ranges from Newfoundland Island south to New York, west to Minnesota, and north to Manitoba; including Maine, Michigan, New Hampshire, Vermont, and Wisconsin (NatureServe 2001k).

Life History

Auricled twayblade is a terrestrial orchid. It will not reproduce vegetatively (Reddoch and Reddoch 1997), although pieces of root can produce shoots (Rasmussen 1995). Twayblades as a group use non-specific small, flying insects for pollination.

Auricled twayblade doesn't flower until 7-15 years of age (Rasmussen 1995 in Hoy 2001a). Flowering occurs from late June to August, finishing by mid-July in northern New England (Coleman and Magrath 2000). Tiny, dust-sized seeds are produced early in the summer and are likely dispersed by wind or water. Hoy (2001a) speculates that given this species' association with disturbed habitats, it may mature more quickly than other related species.

Listera convallarioides hybridizes with *Listera auriculata*. Each species has unique floral anatomy and habitat preferences. The rare hybrid *Listera* x *veltmanii* has been found growing with one or the other of its parents. It is taller than either parent and is found in different, more disturbed habitat than its nearby parent (Catling 1976 in Hoy 2001a).

Herbivory has been noted on virtually all recent field notes regarding this species, as well as from historic records (Hoy 2001a).

Habitat

In New England, auricled twayblade is associated with temporarily flooded and seasonally ice-scoured riverbanks in northern forests, usually in the floodplain. In those situations it is associated with sandy alluvial or outwash deposits that may be bare or mossy. In some locations, it appears to tolerate some shade, e.g., from alder, but on other sites, it is clearly intolerant of shade or competition resulting from other dense riparian graminoids and ferns or low shrubs such as *Cornus stolonifera* and *Spiraea latifolia*. Hoy (2001a) suggests that perhaps auricled twayblade derives benefit from an association with alder through the alder's ability to anchor soil during flooding and serve as bumpers during ice scouring. Hoy (2001a) also speculates that an association with moss may benefit by providing a nursery base for seeds, as well as conserving moisture and potentially harboring beneficial fungi.

In Maine, this species has been documented from stream banks, mossy woods, alder thickets, boggy alluvial woods, cedar swamps, springs in spruce woods, river shore seep, riverside alder thicket, gravel riverbank, and lake and pond shores. It has been reported from both sandy and sandy loam substrates (MNAP 2001).

This species is strongly associated with rivers that deposit sediments and are routinely scoured. It also clearly has a strong association with moss and alder in these riparian zones. Consequently, annual flooding might be acceptable if it were of sufficient duration to deposit sediments that would sustain the population. However, for existing populations, routine flooding and heavy sand deposition could lead to population losses. Catastrophic flooding, like that of the Wild River in 1995, will eliminate populations and could have a dramatic effect on the integrity of the banks and the alder. There is likely a preferred return interval, but it is unknown. Given the associations with certain Rosgen channel types (classes C and E), perhaps river morphology studies could provide more concrete information (D. Burbank, pers. comm.).

Known sites do not appear to occur much above 1,500 feet in elevation.

Associated plants at the one WMNF extant site include *Alnus incana, Oclemena acuminate, Aralia nudicaulis,* and *Maianthemum canadense,* within a mixed hardwood landscape.

Occurrences

There are 11 extant and 22 presumed historic occurrences in Maine, 2 extant and 1 historical occurrences in New Hampshire, and 2 extant and 5 historic occurrences in Vermont (MNAP 2001, NHNHI 2001, VNNHP 2001, Hoy 2001, NHNHB 2005). Only 2 extant occurrences are from within the WMNF. However, 2 historical populations in Oxford County, Maine, are within approximately 15 miles of the Forest boundary.

Threats/Limiting Factors

Identified threats for auricled twayblade include:

1. *Global climate* change may increase the amplitude and frequency for catastrophic events, such as flooding.
2. *Logging* or other activities in riparian areas may threaten habitat.
3. *Invasive species* are a potential threat, especially in disturbed sites.
4. *Trampling*
5. *ATV use*

The most limiting factors of concern for the WMNF are activities in riparian zones, which could include activities that promote the establishment or spread of invasive species. Global climate change is outside Forest Service control.

Information Gaps

No information gaps were identified for auricled twayblade.

Pertinent Resource Actions and Mitigation

No standards or guidelines specific to auricled twayblade are proposed, but the Riparian and Aquatic Habitats and Watersheds sections include direction to protect these resources.

Affected Environment

The area of effects analysis for auricled twayblade is the HUC 5 subwatersheds that encompass the WMNF with some changes to exclude areas unlikely to be affected by Forest activities (Map G-01).

Habitat Trend

Large-scale logging likely reduced habitat availability in the past, but is less of a concern if best management practices are implemented. Off the Forest, cedar swamps, bogs, and other wetland habitats have been lost to development, although they have probably been more protected in recent years.

Population Trend

The one extant site and one historic site from within the WMNF are the only occurrences within the analysis area. They were originally described in the early 1900s and surveyed for several times in the 1980s and 1990s. Hoy (2001a) notes habitat at the historic site looks suitable, but no evidence of the plants could be found. The extant population was last described in 1992, consisting of 35 plants, growing in moss on damp sand, next to an intermittent stream. The population was still present in 1994, but a fall flood event the following year appeared to scour the site and subsequent visits nearly every year since have not located the plants.

Environmental Effects

Alternative 1

Timber harvest

Logging would be restricted within 25 feet of the bank of a perennial stream channel and crossings would only be allowed at designated locations. Other standards and guidelines would protect riparian habitats from timber harvest and road/trail construction within 100 feet of perennial streams (except for crossings). This would limit the amount of sediment transport into the streams, as well as limit canopy changes and consequent light level increases. In general, this should help maintain riparian conditions and processes. There is a possibility that logging within the Riparian Management Zone could impact unknown individuals or unoccupied suitable habitat. If the species occupies habitat similar to the one extant occurrence on the Forest, this is unlikely given the close proximity to the stream.

Trampling/ATV use

Relative to the one extant occurrence on the Forest, ATV trail construction would not be allowed in that management area, so there would be no effect at that site. Alternative 1 does propose an increase in hiking and summer motorized trails, which could impact habitat elsewhere. However, Riparian and Aquatic Habitats standards and guidelines would help conserve potential habitat similar to timber harvest effects.

Invasive species

The risk of non-native invasive species spreading on the Forest is greatest in Alternative 1. Effects related to invasives would be the same as those discussed for piled-up sedge (*Carex cumulata*) above.

Cumulative effects of Alternative 1

During the next 20 years, it is likely that some development, harvest operations, and other activities outside the Forest would eliminate suitable habitat, regardless of alternative. The magnitude of this effect is unknown, although state regulations and Best Management Practices should help limit this effect. The Forest only holds one extant population (which may have been destroyed by flooding), so maintaining population viability would be dependent on outside influences regardless of alternative. Orchids are notoriously difficult to locate from year to year, and they are dependent on mycorrhizal fungal associations that cannot be surveyed, which makes population and habitat trends difficult to determine. It would seem that through Forest Plan standards and guidelines and state regulations, suitable habitat should continue to be available, but recolonization on the Forest may be dependent on outside source populations.

Alternative 2

Timber harvest

The type of effects resulting from Alternative 2 would be the same as those described in Alternative 1, but the magnitude would be smaller because

fewer acres of timber would be harvested and fewer acres of even-aged regeneration harvests would be proposed.

Trampling/ATV use
Fewer non-motorized recreation trails and no ATV trails would be constructed compared to Alternative 1. Therefore, the risk of impacting unknown individuals or suitable unoccupied habitat would be less in Alternative 2.

Invasive species
Effects related to invasives would be the same as those discussed for piled-up sedge (*Carex cumulata*) above.

Cumulative effects of Alternative 2

Cumulative effects would be similar to those described for Alternative 1. Alternative 2 would result in less risk of impacting this species or its habitat on the Forest, but over the entire analysis area, the cumulative effects are probably not measurably different than Alternative 1.

Alternative 3

Timber harvest
The risk of logging operations unintentionally impacting individuals or suitable habitat would be similar to Alternative 2. Alternative 3 proposes more acres of total harvest, but fewer areas of even-aged regeneration harvest; the difference between alternatives 2 and 3 for this species is indistinguishable at a programmatic level.

Trampling/ATV use
Recreation use would be the same as in Alternative 2.

Invasive species
Effects related to invasives would be the same as those discussed for piled-up sedge (*Carex cumulata*) above.

Cumulative effects of Alternative 3

Cumulative effects would be the same as those described in Alternative 2.

Alternative 4

Timber harvest
Alternative 4 would have effects similar to those described for Alternative 1. Alternative 4 proposes more acres of total harvest, but fewer acres of even-aged regeneration harvest. There would be a slightly greater risk of habitat being trampled by equipment because of the total acres treated, but less chance that canopy changes would cause negative habitat impacts.

Trampling/ATV use
Recreation use would be higher than Alternative 1, with more non-motorized and motorized trail construction. However, because of Riparian and Aquatic Habitats standards and guidelines, the magnitude of the difference in effects between the two alternatives is probably not measurable.

Invasive species

Effects related to invasives would be the same as those discussed for piled-up sedge (*Carex cumulata*) above.

Cumulative effects of Alternative 4

Cumulative effects would be similar to those described for Alternative 1. Alternative 4 and Alternative 1 have very similar direct and indirect effects, so their cumulative effects would be correspondingly similar.

Determination — Auricled twayblade

Implementation of any alternative **may impact individuals, but would not likely cause a trend towards federal listing or loss of viability.**

Rationale Summary

1. Standards and guidelines would be implemented to protect riparian habitats and address invasive species prevention and eradication in all alternatives. Although all suitable habitat may not be covered by this direction, it should address the vast majority of situations.

Flooding may play a large role in determining persistence of this species on the Forest, but natural flood events are outside Forest Service control.

Broad-leaved twayblade (*Listera convallarioides*)

Distribution

Broad-leaved twayblade is found from Newfoundland and Nova Scotia west across Canada through Southern British Columbia. In the northeast, it is found through most of Maine, northern New Hampshire, and Vermont, and northeastern New York (Chapman 1997).

Life History

Broad-leaved twayblade is pollinated by small, flying insects similar to other *Listera* species (Ackerman and Mesler (1979). Flowering season is from the third week in June to the end of July, with a few flowering into August (Chapman 1997). Rasmussen (1995 in Hoy 2001a) estimates *Listera auriculata* doesn't flower until 7-15 years of age and it is assumed that *Listera convallarioides* is similar. *Listera convallarioides* is also assumed to produce tiny, dust-sized seeds similar to *L. auriculata* (Hoy 2001a).

Listera convallarioides hybridizes with *Listera auriculata*. Each species has unique floral anatomy and habitat preferences. The rare hybrid *Listera* x *veltmanii* has been found growing with one or the other of its parents. It is taller than either parent and is found in different, more disturbed habitat than its nearby parent (Catling 1976 in Hoy 2001a).

Habitat

NHNHI (2000) lists the habitat for this species as nutrient poor (acidic to intermediate), forested swamps, bogs, fens, and seeps. Gleason and Cronquist (1991) note the taxon from wet woods, usually in deep shade.

Haines (1999) includes wet thickets, banks, and cedar swamps. It has been found along borders of streams and bogs (Royal Botanic Garden of Canada 2001) and in an open seep (SVE Upland Forest Panel 2002).

Element occurrence information and field survey forms indicate a preference for forested seeps on the WMNF. Extant populations range from 1400 to 2700 feet.

Occurrences

There are 9 extant and 9 historic occurrences in New Hampshire (NHNHI 2001). Five extant and 2 historic occurrences are found in the WMNF (NHNHB 2005). An unknown number of occurrences are known from 7 Maine and 7 Vermont counties (summarized in WMNF Literature Review for *Listera convallarioides*).

Threats/Limiting Factors

Identified threats for this species include:

1. *Recreational use/trampling*, which has affected at least one population on the WMNF (SVE Upland Forest Panel 2002).
2. *Disturbance of hydrologic patterns* could alter required habitat conditions.
3. *Deer herbivory* is a suspected threat (SVE Upland Forest Panel 2002).

The most limiting factors of concern under WMNF control are:

a. Trampling
b. Timber harvest (which can alter hydrological patterns and/or promote habitat for deer)
c. Road/trail construction (which can alter hydrological patterns)

Information Gaps

No information gaps were identified by the SVE Upland Forest Panel (2002).

Pertinent Resource Actions and Mitigation

There are no standards or guidelines specific to broad-leaved twayblade, but Watershed and Riparian and Aquatic Habitats standards and guidelines may help conserve suitable habitats for this species.

Affected Environment

The area of effects analysis for broad-leaved twayblade is the HUC 5 subwatersheds that encompass the WMNF with a few changes to delete areas that would be unaffected by Forest activities (Map G-01).

Habitat Trend

Some habitat loss has likely occurred in the analysis area through development and other activities that alter hydrologic conditions (e.g., road

and trail construction). However, seepy areas are not uncommon and wetland habitats are generally protected through state Best Management Practices; therefore, habitat is considered stable.

Population Trend

There are 5 extant and 4 historic occurrences within the analysis area in New Hampshire, plus an unknown amount in Maine and Vermont. Although the extant occurrences on the Forest are associated with some threats (herbivory, potential trampling from adjacent hiking trail), these occurrences appear relatively stable based on their persistence in recent years.

Environmental Effects

Alternative 1

Hiking use/Trampling

Over the next 20 years, hiking pressure is likely to increase steadily throughout the Forest. The potential for trampling from increased recreation use along existing trails or trailheads would be the same in all alternatives because hiking use would be expected to increase at the same rate regardless of alternative. Construction of 40 miles of new hiking trail probably will not keep up with increased demand, so the proportion of hikers per trail mile would increase, so that the potential for trampling along trails would subsequently increase. This is primarily a concern for those individuals located immediately adjacent to an existing trail.

Road/trail construction

The most obvious factors in altering hydrologic patterns on the WMNF would be road or trail construction. Alternative 1 proposes approximately 220 miles of new road construction and 1180-2360 miles of skid trails to support timber harvest operations in the next 20 years. Much of this would be winter construction that shouldn't alter hydrology, but at least a portion would be summer construction. The proportion of winter vs. summer construction would be the same in all alternatives. Alternative 1 also would allow summer motorized trail designation that is estimated at approximately 60 to 90 miles. Whether or not these trail miles would occur on already existing trails or would be entirely new construction is unknown, although it is likely that a least a portion would occur on old roads or trails already in existence. Finally, some 40 miles of new non-motorized trails would also be proposed in Alternative 1. New roads or trails can change hydrologic patterns by damming or diverting water movement, which could change habitat conditions for broad-leaved twayblade. Range-wide, this species occupies a variety of wet conditions such as bogs, swamps, and streamsides that are generally protected from timber harvest or road construction by standards and guidelines or State Best Management Practices. However, on the WMNF, broad-leaved twayblade appears to favor forested seeps. These features may be protected during site-specific project layout, but there are no standards and guidelines specific to their protection unless they qualify as a spring. Seeps generally would not make the best locations for new trails or roads, but adjacent locations could still impact these

habitats by altering water movement. It is likely that at least some portion of the new roads or trails proposed in this alternative would alter the hydrology enough to change habitat conditions. However, being an orchid, broad-leaved twayblade also relies on the presence of specific fungi in order to persist at a site. There is no way of knowing just how many forested seeps on the Forest would actually contain the appropriate fungi to provide suitable habitat. It is likely that some forested seeps would be negatively affected under this alternative, but whether or not they would actually affect the habitat for broad-leaved twayblade is unknown.

Timber harvest

Timber harvest also has the potential to change the condition of wet features such as seeps. Roads and skid trails can alter water movement as described above, but opening the tree canopy can increase light levels to the ground, causing microclimate changes that dry out the area and render the site unsuitable. Even-aged regeneration treatments would be the most likely for this to happen, so alternatives with more even-aged regeneration management would result in a greater potential risk than alternatives with more acres of uneven-aged prescriptions. Alternative 1 proposes the most acres of even-aged regeneration harvest, therefore, the risk would be highest in this alternative. Standards and guidelines would protect known occurrences and required plant surveys would improve the likelihood that individuals would be protected, but orchids do not always bloom every year and individuals may get missed in plant surveys. Thus, there is some chance, albeit small, that harvest operations may impact this species or its habitat.

Deer herds can increase in size if early successional habitats (which provide a forage base) are provided. Alternative 1 would provide the greatest acreage of even-aged harvests (which tend to provide more forage than other treatments) compared to the other alternatives. Compared to current conditions, Alternative 1 would average close to four times the amount of early successional habitat. This would help to support a higher deer herd population, especially in local areas. If herbivory is already considered a threat to broad-leaved twayblade and other orchids, increasing the size of the herd would proportionally increase that risk. However, this risk is somewhat dependent on how close the cutting units would be to the twayblade locations. Some locations are closer to recreation facilities or far from timber harvest areas, so the risk in these areas is probably less.

Cumulative effects of Alternative 1

There are no other temporal factors beyond those already discussed above affecting this species on the WMNF. Over the entire analysis area, it is likely that development would result in additional habitat losses. There is only one other extant occurrence in the analysis area, so cumulative effects on individuals can equate to direct and indirect effects already described. In terms of habitat, additional roads are likely, although whether they would occur in suitable habitat is unknown. Deer densities were historically much greater than they are today and even increased cutting in Alternative 1 would not lead to deer numbers as high as in the early 20th century. Deer densities off the Forest will probably remain stable or decline as agricultural

land and other suitable habitat is converted to development. Over the next 20 years, this probably would not result in a measurable difference in terms of herbivory effects. Given the past size of the deer herd, it seems unlikely that broad-leaved twayblade could not continue to persist.

Alternative 2

Hiking use/Trampling

Effects of hiking pressure on existing trails would be the same as described in Alternative 1.

Road/trail construction

The types of effects caused by road/trail construction would be the same as those described in Alternative 1. However, in Alternative 2, road, trail, and skid trail construction and would be less (1310-2970 total miles). Summer motorized trail use would not be allowed in this alternative, so there would be no effects from ATV use. The risk of impacting a broad-leaved twayblade occurrence or its habitat through changes in hydrologic patterns would thus be reduced in this alternative compared to Alternative 1.

Timber harvest

Alternative 2 proposes less even-aged regeneration harvests and fewer total acres of harvest than Alternative 1, therefore, the risk of harvest operations impacting rare plants or their habitats is less than in Alternative 1. Deer numbers would be expected to remain approximately at current conditions. If herbivory is currently considered a threat, then it would remain a threat, but deer densities are relatively small compared to other areas in New England. It would seem that the risk of a rare plant occurrence being destroyed through deer herbivory would be low given the size of the herd and the isolated nature of these occurrences.

Cumulative effects of Alternative 2

Cumulative effects would be similar to those described in Alternative 1. With only one other known extant occurrence in the analysis area, cumulative effects are essentially the same as direct and indirect effects already described.

Alternative 3

Hiking use/Trampling

Effects of hiking pressure would be the same as described in Alternative 1.

Road/trail construction

The types of effects caused by road/trail construction would be the same as those described in Alternative 1. Alternative 3 would have approximately 1350-2490 total miles of new road, trail, and skid trail construction. Summer motorized trails would not be allowed in this alternative, so there would be no effects from this activity. At a programmatic level, effects would be similar to those described in Alternative 2.

Timber harvest

Alternative 3 proposes the least amount of even-aged harvest, although operations would cover approximately the same number of acres as in Alternative 2. The risk of directly impacting a plant would be the same as

in Alternative 2, but the risk of indirect effects would be less. Deer densities would probably decrease under Alternative 3 because this alternative would provide the least amount of early successional habitat for forage. The risk of herbivory losses would be even less than in Alternative 2.

Cumulative effects of Alternative 3

With only one other occurrence in the analysis area, cumulative effects are essentially the same as direct and indirect effects already described.

Alternative 4

Hiking use/Trampling
Effects of hiking pressure would be the same as described in Alternative 1.

Road/trail construction
The types of effects caused by road/trail construction would be the same as those described in Alternative 1. The range of all road, trail, and skid trail construction is only slightly higher than Alternative 1, so the effects for these two alternatives are essentially the same.

Timber harvest
The risk of harvest impacts and deer herbivory losses would be similar to Alternative 2, based on the amount of even-aged regeneration treatments proposed.

Cumulative effects of Alternative 4

Cumulative effects would be similar to those described in Alternative 1. With only one other occurrence in the analysis area, cumulative effects are essentially the same as direct and indirect effects already described.

Determination — Broad-leaved twayblade

Implementation of any alternative **may impact individuals, but would not likely cause a trend towards federal listing or loss of viability.**

Rationale Summary

1. Standards and guidelines for TES species would protect extant occurrences from timber harvest and road, trail, and skid trail construction effects.
2. Some potential habitat for this species (seeps) may be overlooked during timber sale activities, but it is assumed that pre-project surveys would make a reasonable effort in identifying new occurrences.
3. Hiker traffic may result in the trampling of some individuals, but occurrences away from trails should remain protected and site-specific mitigation (e.g., trail reroutes, educational signs) can help mitigate effects.
4. Deer herbivory may be a threat, but the chance that deer would destroy entire colonies and result in viability losses seems unlikely given that historically deer populations were much higher than today.

Heart-leaved twayblade (*Listera cordata*)

Distribution

Heart-leaved twayblade is found in Europe, Asia, all of the Canadian provinces, and in two potentially disjunct populations in the U.S.: (1) Washington to California, New Mexico to Montana, and (2) Minnesota, Wisconsin, Michigan, Ohio, potentially south to Virginia, and north throughout New England and surrounding states (NatureServe 2001g).

Life History

Heart-leaved twayblade occurs in colonies that can include hundreds of plants, but is more often found as small groups. Established colonies in Minnesota fluctuate considerably and unpredictably from year to year (Smith 1993 cited in Hoy 2001b). Hoy (2001b) notes that in New Hampshire, it is unclear whether populations are in the same site or shift from place to place within an area.

Heart-leaved twayblade flowers from late June through July in Vermont (Jenkins 1981). Pollination is accomplished by non-specific insects (Ackerman and Mesler 1979 cited in Hoy 2001b). Seeds are produced in early summer and most likely are dispersed by wind vectors, but whether or not they germinate in the same year is unknown (Hoy 2001b).

The species takes considerable time to develop. Vinogradova (1996 cited in Hoy 2001b) states that the first green leaf does not appear until 2-3 years of development have occurred.

Heart-leaved twayblade produces long roots that act as runners that can produce shoots (Rasmussen 1986 cited in Hoy 2001b). Orchids are well-known for their relationship with mycorrhizal fungi, which provides a more effective means of germination and growth.

Habitat

Heart-leaved twayblade is found in wet cold woods, conifer/shrub swamps, outcrops/cliffs, bogs, and spruce woods on lime (Jenkins 1981). Angelo and Boufford (2001) note it on mossy knolls in wet woods. In New Hampshire, it has been found in subalpine dwarf fir/birch forest and high elevation spruce fir forest communities, specifically near seeps or riverine habitats and usually on mossy ground or moss-covered rocks (NHNHI 2001).

In New Hampshire, the species has been reported between 1,800 and 5,300 feet elevation (NHNHI 2001).

Typical *Listera cordata* associates in the Northeast include northern white cedar (*Thuja occidentalis*), balsam fir (*Abies balsamea*), peat mosses (*Sphagnum* spp.), goldthread (*Coptis trifolia*), Labrador-tea (*Ledum groenlandicum*), twinflower (*Linnaea borealis*), speckled alder (*Alnus incana*), wood-fern (*Dryopteris* spp.), bunchberry (*Cornus canadensis*), dwarf enchanter's nightshade (*Circaea alpina*), bedstraw (*Galium* spp.), northern wood-sorrel (*Oxalis montana*), moss (*Polytrichum* spp.), blue-bead lily

(*Clintonia borealis*), rein-orchid (*Platanthera* spp.), and sedges (*Carex* spp.) (Hoy 2001b).

Occurrences

In northern New England, there are 68 known occurrences of this species. There are 11 extant and 12 historic occurrences in New Hampshire. This species is not considered uncommon in Vermont or Maine. The WMNF contains 7 extant populations and 6 historic records (Hoy 2001b, NHNHI 2001, and data summarized in WMNF Literature Review for *Listera cordata*).

Threats/Limiting Factors

The following threats have been identified for heart-leaved twayblade:

1. *Trail/road work* or other effects from human activities (e.g., hikers, mountain biking, ATVs) where populations occur near trails can trample plants or change water conditions (e.g., water bar construction, road salting, attracting beaver) (Hoy 2001b).
2. *Herbivory/insect infestation* was noted from several extant populations in the WMNF (Hoy 2001b, NHNHI 2001).
3. *Harvesting* the canopy over seepy depressions or in a forested swamp could affect *Listera cordata* either by influencing light levels or altering water movement (Thompson and Sorenson 2000; Prenger and Crisman 2001 cited in Hoy 2001b).
4. *Global climate change* may affect temperature, precipitation, and storm severity and frequency (Dale et al., 2001; Hansen et al., 2001 cited in Hoy 2001b).

The most limiting threat under WMNF control would be:

a. Road/trail work
b. Timber harvest in seeps or forested wetlands.
c. Herbivory

Global climate change is outside Forest Service control.

Information Gaps

No information gaps were cited.

Pertinent Resource Actions and Mitigation

There are no standards or guidelines specific to heart-leaved twayblade, although Watershed and Riparian and Aquatic Habitats standards and guidelines would help protect some habitats.

Affected Environment

The area of effects analysis for heart-leaved twayblade is the HUC 5 subwatersheds that encompass the WMNF with a few changes to delete areas that would be unaffected by Forest activities (Map G-01).

Habitat Trends

Development at lower elevations has probably reduced some habitat and in specific locations, activities such as trails and roads may have reduced suitable habitat. However, seepy areas are not uncommon and wetland habitats are generally protected through state Best Management Practices. Therefore, habitat is considered stable.

Population Trends

The population trend in the analysis area appears stable based on recent monitoring.

Environmental Effects

All alternatives

Direct, indirect, and cumulative effects would be the same for heart-leaved twayblade as those described for broad-leaved twayblade (*Listera convallarioides*) above.

Determination — Heart-leaved twayblade

Implementation of any alternative **may impact individuals, but would not likely cause a trend towards federal listing or loss of viability.**

Rationale Summary

See broad-leaved twayblade (*Listera convallarioides*) above.

Alpine cudweed (*Omalotheca supina*)

Distribution

Alpine cudweed is circumboreal. In North America, it is found in Labrador, Quebec, and on Mt. Washington and Mt. Katahdin (Fernald 1950).

Life History

Alpine cudweed is a sexually reproducing perennial (Gleason and Cronquist 1991). It is classified as having a ruderal or exploitative strategy, meaning that it produces a large number of small seeds, forms a large seed bank, and responds well to disturbance (Onipchenko et al., 1998).

Being a perennial, it must be at least one year old to reproduce. Flowering occurs from July to September (Fernald 1950). Although germination rates are unknown, it is believed that germination rates are higher after disturbance (Onipchenko et al., 1998).

Habitat

Alpine cudweed grows in exposed alpine areas, in alpine meadows or in alpine plant communities that do not have shrubs or dwarfed trees and are not dominated by graminoids. In the WMNF, it occurs in open patches that have been disturbed by rockfall and spring runoff (W. Brumback, pers. comm.; D. Weihrauch, pers. comm.). Brumback (2002) notes the species may relocate slightly based on disturbance and resulting habitat availability. The one extant WMNF occurrences is associated with a calcareous cliff community (NHNHI 2001).

Occurrences

There are 2 extant occurrences in Maine and 1 extant and 3 historic occurrences in New Hampshire (MNAP 2001, NHNHI 2001). All of the New Hampshire occurrences are from the WMNF.

Threats/Limiting Factors

Identified threats for alpine cudweed include:

1. *Trampling* by hikers and ice climbers (W. Brumback, pers. comm.; D. Weihrauch, pers. comm.), although some hiker activity could help keep the habitat open and reduce competition (D. Weihrauch, pers. comm.).
2. *Loss of habitat to succession* is a potential limiting factor (D. Weihrauch, pers. comm.)
3. *Lack of disturbance-created habitat* is a potential limiting factor (W. Brumback, pers. comm.).

The primary threat under WMNF control is trampling.

Information Gaps

This species was not addressed by a convened panel of experts; however, individual experts identified the following information gaps for alpine cudweed:

1) Further information is needed on habitat requirements.
2) Determine if hiking or ice climbing are really concerns.
3) Determine if there are actions that can be taken to increase success in available habitat.

Pertinent Resource Actions and Mitigation

No standards and guidelines specific to alpine cudweed are proposed, although Forest-wide direction related to protection of alpine communities would be provided in all alternatives.

Affected Environment

The area of effects analysis for alpine cudweed is the WMNF proclamation

boundary plus Franconia Notch, Crawford Notch, and Mt. Washington State Parks, which encompasses almost the entire alpine zone in New Hampshire. No alpine habitat exists in western Maine.

Habitat Trend

Habitat in the alpine zone has been reduced over time by hiker traffic, although this threat is considered greater outside of the Presidential Range.

Population Trend

The population is considered declining based on the number of historic occurrences that have not been relocated. The one extant occurrence in New Hampshire was discovered in 1969 and grows in an area approximately 3 square yards in size. Population size over time is as follows: 1970 = 100 plants, 1978 = 60 plants, 1987 = approx. 50 plants, 1993 = 65 plants (26 were seedlings), 1996 = 59 plants (NHNHI 2001). In 2002, 150 plants were found in an area slightly moved from previously years (Brumback 2002).

Environmental Effects

All alternatives

Direct, indirect, and cumulative effects for alpine cudweed would be the same as those described for arnica above.

Determination — Alpine cudweed

Implementation of any alternative **may impact individuals**, **but would not likely cause a trend towards federal listing or a loss of viability**.

Rationale Summary

1. Mitigation to protect alpine plants and increase public education/awareness of rare alpine communities should reduce potential impacts in all alternatives. Although recreation use is expected to increase, implementation of Forest Plan standards and guidelines would keep the majority of the use on existing trails. Not every scenario can be anticipated, but many alpine species have persisted for years with heavy hiker traffic and little or no protection, so it is unlikely that a significant decline would occur during the next 15 years.

Canada mountain ricegrass (*Oryzopsis canadensis*)

This species has undergone a name change and is now called *Piptatherum canadensis*, but has not yet been updated on the Regional Forester's sensitive species list.

Distribution

Canada mountain ricegrass is found from Nova Scotia to Newfoundland west to Saskatchewan south to Minnesota and east to Maine. There are disjunct populations occurring in Wyoming, West Virginia, and South Carolina (NatureServe 2001l).

Life History

Little is known regarding the species' life history other than it is a perennial species that reproduces sexually.

Habitat

Canada mountain ricegrass occurs in dry, rocky, or sandy deciduous woodlands, on open ledges, in early successional plant communities, along sandy roadsides, and on open, sparsely brushy ground (MNAP 2001).

Associated species include *Kalmia angustifolia, Vaccinium pallida, Comptonia peregrine, Vaccinium augustifolium,* and *Danthonia spicata* (MNAP 2001).

Occurrences

There are 4 extant and 9 historic occurrences in Maine, 1 extant and 3 historic occurrences in New Hampshire (MNAP 2001, NHNHI 2001). Only 1 extant population occurs on the WMNF. No historic populations are located on the Forest.

Threats/Limiting Factors

The following threats were identified for this species:

1. *Trampling* of the existing occurrence (currently located adjacent to a trail) or new trail construction in suitable habitat could cause an impact based on its habitat on the WMNF.
2. *Succession* is considered the primary threat (SVE Open and Rock Panel 2002)

Information Gaps

This species was not put before an expert panel; therefore, no gaps were identified by a paneled group or through literature review.

Pertinent Resource Actions and Mitigation

There are no standards or guidelines specific to Canada mountain ricegrass.

Affected Environment

The area of effects analysis for Canada mountain ricegrass is the WMNF proclamation boundary plus adjacent State Parks and the Appalachian Trail corridor that is managed by the Forest (Map G-01).

Habitat Trend

It is assumed that some habitat has been lost given the number of historic occurrences; however, the magnitude of this habitat loss is unknown.

Population Trend

The population trend for this species is assumed to be declining based on the number of historic occurrences.

Environmental Effects

Alternative 1

Hiking use/Trampling

Hiking is expected to increase regardless of alternative. Hiking traffic at rocky summits is likely to have more impacts than rock climbing because outside of the Presidential and Franconia ranges, hikers tend to leave marked trail locations and wander over the entire summit. Summits are generally small and easily degraded by repeated traffic. Site-specific mitigation measures such as signs can help focus traffic on marked trails, although it is likely that some people will continue to ignore or forget these instructions in favor of seeking summit views. Plant communities in these habitats usually rest on shallow soils that are easily dislodged. Loss of habitat is likely, and unlike other species, when soil is removed from cracks or in shallow summit depressions, it may be hundreds of years before suitable habitat is created again. Also, in Alternative 1, additional trail construction may be built to meet demand. Locations of these trails are unknown at this time, but any additional trail to a summit could potentially increase habitat losses through hiker trampling. Although environmental education efforts, trail closures/relocations, or other mitigation measures could be implemented to protect individual colonies, summit habitat will likely be reduced.

Succession

Canada mountain rice-grass seems to occupy a variety of habitat types, as long as they are open and soil is somewhat dry. Some activities such as prescribed fire could benefit the species if habitats are opened, especially wildlife openings or blueberry patches. It would seem the WMNF holds more suitable habitat than would be evident from one occurrence, but there must be some unknown habitat factor limiting further colonization. Without knowing more specifics, the only other activity that would perhaps cause impacts would be recreational use in openings, especially high elevation subalpine areas, where the known occurrence is located.

Cumulative effects of Alternative 1

In the next 20 years, recreational use in adjacent state parks is expected to increase similar to that on the Forest. Effects to Canada mountain rice-grass in the state parks would be the same as that described above for the WMNF. Over the next 50 years, recreation use will probably continue to increase as the population in the Northeast increases. Habitat will not improve unless fire occurs where succession is a concern, but can only remain stable or get worse. In addition to recreation pressures, succession may result in loss of suitable habitat as shading increases at certain sites, although would not be a threat for the Forest's occurrence. Protecting ecosystem sustainability is a Forest Plan goal for all alternatives and maintaining population viability is a mandate under the National Forest Management Act. At some point, it may be necessary to close trails or create physical barriers (e.g., scree walls) to restrict users to identified hiking trails. These strategies have worked before, so it is anticipated that the

population would be maintained over the long term, albeit at smaller numbers with less suitable habitat.

Alternative 2

Hiking use/Trampling

Projected impacts from hiker traffic would be similar to Alternative 1, although no additional trails would be constructed to meet demand. Therefore, impacts are anticipated to remain primarily at existing trail locations, including near known sites. Although visitors may bushwhack to new locations, it is expected that these activities would be addressed through management to limit impacts.

Succession

Effects from succession threats would be the same as described in Alternative 1.

Cumulative effects of Alternative 2

Cumulative effects would be the same as those described for Alternative 1.

Alternative 3

Direct and indirect effects would be the same as those described for Alternative 2.

Cumulative effects of Alternative 3

Cumulative effects would be the same as those described for Alternative 1.

Alternative 4

Hiking use/Trampling

Direct and indirect effects would be similar to those described for Alternative 1. However, in Alternative 4, there would be more emphasis on trail construction to meet demand, therefore, it is expected that even more hiking trails could be constructed in the next 20 years and that Canada mountain rice-grass would be at more risk of habitat loss. As in Alternative 1, though, standards and guidelines require surveys and allow management responses that should prohibit a level of loss that would result in population viability not being maintained on the Forest.

Succession

Effects from succession threats would be the same as described in alternatives 1, 2, and 3.

Cumulative effects of Alternative 4

Cumulative effects would be similar to those described under Alternative 1. Recreational demand is likely to continue increasing. The goal in Alternative 4 is to meet this demand, but not at the expense of natural resources. In the next two decades, some parts of the Forest and surrounding state parks may reach their capacity for being able to respond to demand without impacting resources or social experience. In any case, habitat loss is almost inevitable, but standards and guidelines should maintain some level of available habitat for this species.

Determination — Canada mountain ricegrass

Implementation of any alternative **may impact individuals**, **but would not likely cause a trend towards federal listing or a loss of viability**.

Rationale Summary

1. The one WMNF occurrence appears to have persisted for some number of years, despite being located adjacent to a hiking trail.
2. Canada mountain rice-grass uses a variety of habitats, including some that are periodically disturbed and could be improved through management.

Mountain sweet-cicely (*Osmorhiza berteroi*)

Distribution

Mountain sweet-cicely is found from Alaska east to Nova Scotia, south to Vermont and New Hampshire (though possibly extirpated in Vermont), also southwestern Canada south to California and New Mexico (Gleason 1963).

Life History

Mountain sweet-cicely is a perennial (USDA 2001). Pollination mechanisms are unknown, but seeds are likely dispersed in the fall and require winter cold to trigger germination. Seed germination rate decreases if seeds are not exposed to at least 2-3 weeks of dark and cold under snow cover (Baskin et al., 1995).

Habitat

The species prefers moist, well-shaded forest habitats. It may be found in areas that are less moist, but rarely in areas that are very wet or when tree cover is removed (Gleason and Cronquist 1963). In Maine, mountain sweet-cicely occurs in semi-rich hardwood forests. It is not a classic rich woods species, but occurs on moderately rich sites (SVE Upland Forest Panel 2002).

One occurrence on the WMNF is on a road shoulder, within the area that is typically mowed. It is subject to direct sunlight when the sun angle aligns with the road; otherwise it is in partial shade. The site is somewhat dry and well drained (J. Williams, pers. comm.).

Other members of the genus are often found adjacent to cellar holes and other heritage sites, as well as in forest stands that have been thinned, so the genus appears to be able to withstand some disturbance (SVE Upland Forest Panel 2002). The WMNF road shoulder occurrence seems to be adapted to routine road maintenance practices, which appear to have provided a seed bed and removed competition (J. Williams, pers. comm.).

Occurrences

Mountain sweet-cicely is known from 13 extant and 14 historic occurrences in 5 Maine counties, 6 extant and 15 historic occurrences in New Hampshire, and 1 historic occurrence in Vermont (ME DOC 1999, NHNHI 2001, VNNHP 2001, Engstrom 2004). Four extant and 5 historic populations occur on the WMNF.

Threats/Limiting Factors

Identified threats for mountain sweet-cicely include:

1. *Development* that results in habitat loss.
2. *Competing invasive species* may be a concern in this habitat.
3. *Herbivory* is a concern for many species in rich or semi-rich hardwoods (SVE Upland Forest Panel 2002).
4. *Climate change* could alter this species' local success if it resulted in a reduction in snow fall (Baskin et al., 1995).

The most limiting factors of concern under WMNF control are:

a. Activities that promote herbivory
b. Invasive species

Information Gaps

The SVE Upland Forest Panel (2002) did not identify any information gaps for *Osmorhiza berteroi*.

Pertinent Resource Actions and Mitigation

There are no standards or guidelines specific to mountain sweet-cicely.

Affected Environment

The area of analysis for mountain sweet-cicely is the ecological subsections that encompass the WMNF, plus the subsection that covers the Connecticut River Valley, where most patches of rich hardwoods habitat in New Hampshire occurs (Map G-01).

Habitat Trend

Mature, rich, northern hardwoods are relatively stable in the analysis area, although it typically occurs in small patches or even tiny pockets (SVE Upland Forest Plants 2002). Across the Connecticut River in Vermont, rich woods habitat is more common. Mountain sweet-cicely is not a classic rich woods species, so there may be more suitable habitat patches available. Some habitat has undoubtedly been lost to development and land clearing, but this trend would have been less since 1986 than in earlier centuries.

Population Trend

The WMNF holds the only extant occurrences within the analysis area. The Forest is of concern because historic locations have been searched with no occurrences found. Because of the large proportion of historic occurrences in New Hampshire (including several that have been looked for unsuccessfully), this species is considered in decline.

Environmental Effects

All alternatives

Direct and indirect effects for mountain sweet-cicely habitat would be similar to those described for squirrel corn (*Dicentra canadensis*) above. Both seem to tolerate some level of disturbance. One occurrence has likely persisted for some number of years with repeated roadside mowing through the site. Road maintenance activities would be the same in all alternatives. While that would not be a recommended practice through all areas of suitable habitat, this occurrence on the Forest would likely persist in all alternatives.

Other effects would be similar to those described for squirrel corn above.

Cumulative effects for all alternatives

The context of the WMNF within the analysis area is different for mountain sweet-cicely than it is for squirrel corn. The WMNF holds the only occurrences of the species, unlike squirrel corn, where there are many more occurrences outside the Forest. Therefore, the WMNF may play a more important role in this species conservation and cumulative effects are essentially the same as direct/indirect effects above.

Determination — Mountain sweet-cicely

Implementation of any alternative **may impact individuals**, **but would not likely cause a trend towards federal listing or a loss of viability**.

Rationale Summary

1. Although timber harvest and road/trail work have the potential to directly and indirectly impact individuals, mitigation to protect TES species and habitat features would be in place to reduce those impacts.

The extant occurrences on the Forest seem to be persisting. One WMNF occurrence in particular has at least 200 individuals at last count, despite repeated past disturbance. This occurrence is located in a very restricted area, so the risk of losing this occurrence to a stochastic event is high, and declining populations in general are cause for concern. However, we assume that declines would not be a result of Forest Service actions and that Forest occurrences would continue to persist.

American ginseng (*Panax quinquefolius*)

Distribution

Ginseng occurs from Maine across Canada to Ontario and possibly Manitoba, south to Kansas, Louisiana, Alabama, and Florida, although it is most characteristic of the Appalachian and Ozark mountain regions (NatureServe 2001n). The WMNF is at the northeastern edge of the species range.

Life History

Ginseng is a self-pollinating perennial. Plants are usually 3-4 years old before reproduction occurs (Persons 1994). Flowering occurs for 2-3 weeks in late June to July (Li 1995). Following flowering, berries appear. There may be as few as 2 and as many as 50 berries, each containing 1-3 seeds (Persons 1994). Older plants produce more seeds than younger plants (Persons 1994).

Seeds fall in August or September (Persons 1994), and dispersal may be aided by small mammals or possibly wild turkey or ruffed grouse (SVE Upland Forest Panel 2002). The plant overwinters as a root with a solitary bud and requires exposure to cold during the winter in order to break dormancy (Anderson et al., 1992).

The maximum age for ginseng is estimated at 25-30 years. However, under natural forest conditions, collecting has decreased the lifespan range and few plants live longer than 10-11 years (Anderson et al., 1992).

Habitat

In the Northeast, ginseng is most commonly found growing under sugar maple (NRCS 1999) in rich and semi-rich mesic forests and talus forests (NHNHI 1998). It grows on a wide range of soil textures and topographic conditions, but requires moist soils, although it is not found in wet hollows or swamps (NatureServe 2001n). Sandy loam soils appear to provide the best growing substrate (Li 1995), although limestone or marble parent materials are also identified as ideal (NatureServe 2001n). The best pH level for growing ginseng is 5.0 to 6.5; levels above this lead to physiological disorders (Li 1995). Ginseng also prefers habitat with high tree density and a heavy cover of shrubs (Anderson et al., 1992, NRCS 1999).

Anderson et al. (2002) identifies light levels of 8-30 percent for maximum growth; high light intensity reduces growth and may cause early senescence. However, one New Hampshire occurrence increased in size following an ice storm event that largely removed the tree canopy (S. Bailey, pers. comm.).

Most New Hampshire occurrences range from 1000 to 1800 feet, with one as high as 3,240 feet. In Vermont, elevations are lower and occurrences range from 140 to 1700 feet (NHNHI 2001, VNNHP 2001).

Associated species in Vermont include rattlesnake fern, wild leek, long-spurred violet, snakeroot, and bulbet fern (Jenkins 1981).

Occurrences

There are 26 extant and 9 historic occurrences in Maine, 33 extant and 12 historic occurrences in New Hampshire, and 44 extant and 2 historic occurrences in Vermont (MNAP 2001, NHNHI 2001, VNNHP 2001, J. Williams pers. comm., and additional data summarized in WMND Literature Review for *Panax quinquefolius*). The WMNF holds 22 extant and 2 historic occurrences and is central to the New Hampshire and Maine populations. Vermont occurrences tend to be concentrated in the Champlain Valley and southern Connecticut Valley.

Threats/Limiting Factors

Identified threats to ginseng include:

1. *Collecting* is the primary threat (SVE Upland Forest Panel 2002). Demand for wild ginseng roots is 300 percent higher than it has been in a three-year period (NRCS 1999).
2. *Timber harvesting* and *grazing* appear to be detrimental (Anderson et al., 1992). NHNHI (1998) suggests that single tree selection harvests would be less impactive than thinning or clearcutting.
3. *Trampling* is a threat where populations occur near trails or access points to recreation sites (J. Williams, pers. comm.)

The most limiting factors of concern under WMNF control are:

a. Collecting (through permit)
b. Timber harvest
c. Recreation activities, especially hiking

Information Gaps

No information gaps were identified for this species.

Pertinent Resource Actions and Mitigation

There are no standards and guidelines specific to ginseng.

Affected Environment

The area of analysis for ginseng is the ecological subsections that encompass the WMNF, plus the subsection that covers the Connecticut River Valley, where most patches of rich hardwoods habitat in New Hampshire occurs (Map G-01).

Habitat Trend

Mature, rich, northern hardwoods are relatively stable in the analysis area, although it typically occurs in small patches or even tiny pockets (SVE Upland Forest Panel 2002). Across the Connecticut River in Vermont, habitat is more abundant. Some habitat has undoubtedly been lost to

development and land clearing, but this trend would have been less since 1986 than in earlier centuries.

Population Trend

The SVE Upland Forest Panel (2002) states the population has declined substantially. Extirpations have occurred throughout the range as a result of the demand for ginseng in the oriental herb market.

Environmental Effects

Alternative 1

Collection

Collecting pressure would be the same in all alternatives. The trend of increasing interest in collecting ginseng for the herbal trade is expected to continue. As yet, there has been little impact from this activity on the WMNF, probably because there are other places throughout the species' range where the plant is more abundant. Ginseng collection is heavily regulated in the core of the range. In the next 10 years, populations elsewhere will likely continue holding the majority of the collecting pressure. Over the next 10-20 years, the future is more uncertain for collecting. However, because the core of the range holds so much more ginseng than the northeast, it is likely that collection pressure here would still be comparatively less. In terms of trade value, ginseng is too rare now and probably will always be too uncommon here to make a long-term commercial venture worthwhile, although some individuals may be lost to illegal harvest on occasion.

Timber harvest

Effects for ginseng related to timber harvest would be the same as those described for squirrel corn (*Dicentra canadensis*) above.

Hiking use/Trampling

Over the next 20 years, hiking pressure is likely to increase steadily throughout the Forest. The potential for trampling from increased recreation use along existing trails or trailheads would be the same in all alternatives because hiking use would be expected to increase at the same rate regardless of alternative. Because constructing 40 miles of new trail will not keep up with increasing demand, the proportion of hikers per trail mile would increase, so that the potential for trampling along trails would subsequently increase.

Cumulative effects of Alternative 1

Collection

Over the next 20 to 50 years, collecting pressure in the core of the range will likely increase. A Canadian study indicated the minimum viable population for ginseng is 170 plants and the maximum sustainable harvest level is slightly more than 5 percent (Nantel 1996). Few populations meet these criteria, so the likelihood that populations will continue to decline is high, especially from poaching. Assuming the core population continues to decline, collecting may become more influential around the White

Mountains. However, as stated above, the scarcity of the northeast occurrences makes an economic venture here unlikely.

Timber harvest
Cumulative effects to habitat would be the same as those described for squirrel corn (*Dicentra canadensis*) above. With so many extant occurrences, ginseng will likely persist over the next 20 to 50 years, despite outside influences such as development causing some habitat losses.

Hiking use/Trampling
Hiking is expected to continue increasing over time. At some point in the next 50 years, use may reach a capacity in terms of parking lots or other support facilities, but that threshold level has not yet been determined. As development around the Forest continues to increase and human populations in the northeast grow, the pressure for recreation opportunities will continue to increase. Some rare plants growing near existing trails may be lost to trampling, although other occurrences would continue to persist.

Alternative 2

Collection
Potential for collecting impacts would be the same as those described for Alternative 1.

Timber harvest
Effects from timber harvest would be the same as those described for squirrel corn (*Dicentra* canadensis) above.

Hiking use/Trampling
Projected impacts from hiker traffic would be similar to Alternative 1, although no additional trails would be constructed to meet demand. Therefore, impacts are anticipated to remain primarily at existing trail locations, including known sites. Although visitors may bushwhack to new locations, it is expected that these activities would be addressed through management to limit impacts.

Cumulative effects of Alternative 2

Cumulative effects from timber harvest would be the same as those described for squirrel corn (*Dicentra canadensis*) above. Cumulative effects from collecting and recreation activities would be the same as those described in Alternative 1.

Alternative 3

Collection
Potential for collecting impacts would be the same as those described for Alternative 1.

Timber harvest
Effects from timber harvest would be the same as those described for squirrel corn (*Dicentra* canadensis) above.

Hiking use/Trampling
Effects of trail construction and use would be the same as in Alternative 2.

Cumulative effects of Alternative 3

Cumulative effects of timber harvest would be the same as those described for squirrel corn (*Dicentra canadensis*) above. Cumulative effects of collecting and recreational activities would be the same as those described for Alternative 1.

Alternative 4

Collection
Effects from collecting would be similar to those described under Alternative 1.

Timber harvest
Effects from timber harvest would be the same as those described for squirrel corn (*Dicentra* canadensis) above.

Hiking use/Trampling
Alternative 4 would include construction of more trail miles than any other alternative, so the potential for trampling may apply to more patches of habitat. In addition, use is expected to increase on existing trails as well. The likelihood that the WMNF population would be smaller due to trampling would be greatest in this alternative, although occurrences away from trails should continue to persist.

Cumulative effects of Alternative 4

Cumulative effects would be the same as those described for squirrel corn (*Dicentra canadensis*) above. Cumulative effects of collecting and recreational activities would be the same as those described for Alternative 1.

Determination — American ginseng

Implementation of any alternative **may impact individuals**, **but would not likely cause a trend towards federal listing or a loss of viability**.

Rationale Summary

1. The northeast population is fairly stable, with a number of extant occurrences. The occurrences are spread across a number of ownerships, so that the population is not entirely on or off the Forest. This helps spread any potential threats that may predominate at certain sites.
2. Although collecting is a potential threat, it has historically been more of an issue in the core of the range.
3. Although timber harvest and road/trail construction have the potential to directly and indirectly impact individuals, mitigation to protect habitat features and protect TES species would be in place to reduce those impacts.
4. Hiking pressure will undoubtedly continue to threaten individual occurrences, but these would be limited primarily to those adjacent to trails. Even if individual occurrences are lost, others are likely to persist over time in all alternatives.

Silverling (*Paronychia argyrocoma*)

This plant was previously known locally by its varietal name, *Paronychia argyrocoma* var. *albimontana*, but has since been absorbed into the larger species.

Distribution

Silverling occurs in two separate metapopulations: a northern population found in Maine, New Hampshire, Massachusetts, and possibly Vermont; and a larger southern population extending from Maryland to Georgia and west to Tennessee and Kentucky (USDA, NRCS 2004).

Life History

Silverling is a perennial flowering plant, pollinated by bumblebees (and probably other insects, as well) (A. Schori, pers. comm.). Britton and Brown (1970) characterize it as growing in dense mats, which may indicate asexual budding.

Flowering occurs from July to September. Gravity, wind, and water are thought to be the primary agents of dispersal (Schori 2001).

Habitat

Silverling grows in rocky areas, with little or no soil (ME DOC 2002). It prefers bare granite slopes and mountaintops, but is also found in gravely riverbanks. Elevationally, silverling uses open, non-calcareous habitats in subalpine areas (up to 4,130 feet), as well as along low elevation riverbanks (down to 390 feet) (NHNHI 2001, Schori 2002, SVE Open and Rock Panel 2002).

It will occur with other short herbaceous plants and lichens (SVE Open and Rock Panel 2002) and can tolerate some shade during part of the day, but is never found in forested conditions. Silverling is not a strong competitor, so is generally outcompeted unless it is found in acidic, nutrient-poor environments (e.g., on granite, rhyolite, granitic and charnockitic gneisses, sandstone, and sands or gravels derived from those bedrocks) (Shori 2001).

Occurrences

There are 9 extant occurrences in Maine, 16 extant and 8 historic occurrences in New Hampshire, and 1 possible occurrence in Vermont (MNAP 2001, NHNHI 2001, VNNHP 2001). The WMNF contains 9 extant and 4 historic occurrences.

Threats/Limiting Factors

Identified threats for silverling include:

1. *Succession* (canopy closure)
2. *Wind scour* is the main cause of plant loss in mountain communities.
3. *Downslope movement* in mountain communities and flooding in riverine communities can both destroy existing populations and create suitable habitat for future populations (Schori 2002).

4. *Hiking/trampling* has reduced the number of individuals in many populations because of their location near trails. Riverside populations are susceptible to ATV traffic (MNAP 2001, ME DOC 2002, Schori 2001).
5. *Collection* has been cited as a possible factor causing the reduction of many existing populations of this species (ME DOC 2002).

The most limiting factors of concern under WMNF control are hiking/trampling, including proposed ATV use in low elevations.

Information Gaps

The SVE Open and Rock Panel (2002) identified the following information gaps for silverling:

1) Determine the cause of the decline in the northern population.
2) More life history information is needed.
3) ATV traffic has been identified as a threat, but it is unclear what effect current traffic has had on existing populations.
4) More information is needed on why the species isn't more common. Its habitat is abundant, but its distribution is restricted for some unknown reason(s).

Pertinent Resource Actions and Mitigation

There are no standards and guidelines specific to silverling, although direction to limit rock climbing use, protect vegetation at the cliff edge, and prohibit route cleaning where TES species occur, would help conserve this species and its habitat. Riparian and Aquatic Habitats standards and guidelines could help protect individuals if they should occur.

Affected Environment

The area of effects analysis for silverling is the WMNF proclamation boundary plus adjacent State Parks and the Appalachian Trail corridor that is managed by the Forest (Map G-01).

Habitat Trend

Habitat abundance is unknown, but silverling occupies the same rocky habitats that are popular for rock climbing (at summits), hiking, and possibly gravel mining, so it is likely that some habitat has been lost over time to human disturbance. Suitable habitat is currently considered abundant (SVE Open and Rock Panel 2002). Gravelly riverbank habitats are likely modified through natural events (e.g., ice scour), although the overall amount of habitat would be considered stable.

Population Trend

The SVE Open and Rock Panel (2002) indicates the northern (New England) population is declining for unknown reasons.

Environmental Effects

Alternative 1

Hiking use/Trampling

Recreational hiking and rock climbing is expected to increase steadily over the next 20 years. New standards and guidelines would help to direct attention to cliffs, coincident with some of these occurrences. Restricting outfitter/guide climbing party size would help limit negative effects to silverling, although once soil has been scraped from a site, it doesn't matter how many more users come afterwards. Protecting TES sites from route cleaning would protect known sites, assuming they can be identified to climbers. Prohibiting vegetation manipulation at the cliff edge may also help protect some silverling occurrences at different summits. However, because all cliffs are open to climbing unless closed, there is some additional risk to this habitat that doesn't occur to the same degree in other areas. In order to protect unknown occurrences from route cleaning activities, surveys would need to be completed prior to route development. If that does not occur, there would be some risk of impacting unknown occurrences.

With silverling, hiking traffic at rocky summits is likely to have more impacts than climbing because outside of the Presidential and Franconia ranges, hikers tend to leave marked trail locations and wander over the entire summit. Summits are generally small and easily degraded by repeated traffic. Site-specific mitigation measures such as signs can help focus traffic on marked trails, although it is likely that some people will continue to ignore or forget these instructions in favor of seeking summit views. Loss of individuals is likely, and unlike other species, when soils is removed from cracks or in shallow summit depressions, it may be hundreds of years before suitable habitat is created again. Also, in Alternative 1, additional trail construction may be built to meet demand. This is probably more likely in the second decade of Forest Plan implementation when demand would be higher than during the first decade. Locations of these trails are unknown at this time, but any additional trail to a summit could potentially increase habitat losses through hiker trampling. Although environmental education efforts, trail closures/relocations, or other mitigation measures could be implemented to protect individual colonies, population viability will likely decline.

Riparian habitats are also subject to hiker traffic in a similar way, but is assumed to be a lesser threat to existing populations than activities at summits.

ATV use

ATV traffic could be an impact to colonies in riparian zones. Illegal ATV use would likely occur to some extent in all alternatives, but effects of this activity cannot be predicted on so small an area as an individual colony without knowing location specifics. Under Alternative 1, approximately 60-90 miles of ATV trails could be designated on a case by case basis, but should not be constructed in areas where TES plants are located or

threatened by such activity. Therefore, it is less likely that silverling plants would be impacted in riparian zones compared to summit habitats.

Cumulative effects of Alternative 1

Hiking use/Trampling
In the next 20 years, recreational use in adjacent state parks is expected to increase similar to that on the Forest. Effects to silverling in the state parks would be the same as that described above for the WMNF. Habitat will not improve, but can only remain stable or get worse, unless perhaps fire or other natural disturbance sets back succession in places where it's limiting. In addition to recreation pressures, succession may result in loss of suitable habitat as shading increases at certain sites. Protecting ecosystem sustainability is a Forest Plan goal for all alternatives and maintaining viability is a mandate under the National Forest Management Act. At some point, it may be necessary to close trails or create physical barriers (e.g., scree walls) to restrict users to identified hiking trails. These strategies have worked before, so it is anticipated that the population would be maintained over the long term, albeit at smaller numbers with less suitable habitat.

ATV use
Interest in ATV use will probably increase as well. ATV trail construction on the WMNF would likely be located outside of an area where TES plants occur, so this should result in no effect to silverlings in the long term.

Alternative 2

Hiking use/Trampling
Projected impacts from hiker traffic and climbing activity would be similar to Alternative 1, although no additional trails would be constructed to meet demand. Therefore, impacts are anticipated to remain primarily at existing trail locations. Although visitors may bushwhack to new locations, it is expected that these activities would be addressed through management to limit impacts.

ATV use
Because ATVs are not allowed in this alternative, there would be no effect from this activity on silverling.

Cumulative effects of Alternative 2

Cumulative effects would be the same as those described for Alternative 1.

Alternative 3

Direct and indirect effects would be the same as those described for Alternative 2.

Cumulative effects of Alternative 3

Cumulative effects would be the same as those described for Alternative 1.

Alternative 4

Hiking use/Trampling
Direct and indirect effects would be similar to those described for

Alternative 1. However, in Alternative 4, there would be more emphasis on trail construction to meet demand, therefore, it is expected that even more hiking trails to summits could be constructed in the next 10 to 20 years and that silverling would be at more risk of habitat loss. As in Alternative 1, though, standards and guidelines allow management responses that should prohibit a level of loss that would result in population viability not being maintained on the Forest.

ATV use

In Alternative 4, one 20- to 30-mile ATV trail would be designated following site-specific analysis. As mentioned above, standards and guidelines should be able to mitigate the location of such a trail so TES plants are not impacted.

Cumulative effects of Alternative 4

Cumulative effects would be similar to those described under Alternative 1. Recreational demand is likely to continue increasing in every decade of Forest Plan implementation. The goal in Alternative 4 is to meet this demand, but not at the expense of natural resources. In 20 years, the Forest and surrounding state parks may have reached their capacity for being able to respond to demand without impacting resources or social experience. In any case, habitat loss is almost inevitable, but standards and guidelines should maintain some level of population viability for this species.

Determination — Silverling

Implementation of any alternative **may impact individuals**, **but would not likely cause a trend towards federal listing or a loss of viability**.

Rationale Summary

1. Standards and guidelines limit outfitter/guide climbing party size, which should help limit the number of climbers removing vegetation and soil from suitable habitat. New direction to restrict removal of vegetation at cliff summits should also help protect habitats.
2. Standards and guidelines for protecting TES species should help mitigate proposed construction of new trails and trigger action when resource damage is confirmed by existing activities.
3. Riparian standards and guidelines are in place to protect riverbank habitats, although these sites may be subject to natural disturbance events that may impact future occurrences.

Effective mitigation measures are known that can be implemented at the project level to limit impacts.

Sweet coltsfoot (*Petasites frigidus var. palmatus*)

Distribution

Sweet coltsfoot grows across Canada south into southern New England and New York, west to North Dakota and south along the west coast to California (Cherniawsky and Bayer 1998).

Life History

This species is a sexually reproducing perennial that also reproduces vegetatively through runners, producing very large colonies that consist of one or a few plants (Gleason and Cronquist 1991). Flowering occurs from April to June (Fernald 1950). Seeds are wind-dispersed (Fernald 1950), but seed production may be low if the plant relies primarily on vegetative reproduction. On the WMNF, reproduction occurs vegetatively. Sexual reproduction may also occur, but has not been confirmed.

Habitat

Sweet coltsfoot usually occurs in moist woods, fens, and swamps, but has also been found on relatively dry gravel roadsides in northwestern Canada. It will grow in moist woods and meadows, swamps, and fens (Gleason and Cronquist 1991). The SVE Upland Forest Panel (2002) identified it in cedar swamps or calcareous seeps, occurring in both mature and open habitats. Other New Hampshire occurrences have been recorded from a spring, a sloping calcareous fen, and a calcareous seepage swamp (NHNHI 2001). Disturbance may also benefit the species. Cherniawsky and Bayer (1998) state that this species grows in disturbed habitats such as road cuts, embankments, and in logged woods and Voss (1996) indicates that plants seem to bloom best along trails and after clearing.

Sweet coltsfoot will grow with trees but no information is available regarding percent cover or shrub layers that may be considered suitable, other than it will grow in thickets. In New Hampshire, *Petasites frigidus* grows in *Sphagnum* moss and other herbs and graminoids (NHNHI 2001).

This species is known from 860 feet elevation (NHNHI 2001) to alpine situations (Cherniawsky and Bayer 1998). In Vermont, it has been found from 100-2,000 feet high (VNNHP 2001).

Occurrences

There are 3 extant and 4 historic occurrences in New Hampshire and 6 extant populations in Vermont (NHNHI 2001, VNNHP 2001, Engstrom 2004). The species is fairly common in northern Maine (SVE Upland Forest Panel 2002).

Two extant occurrences are known from the WMNF, occurring in seep systems (Engstrom 2004).

Threats/Limiting Factors

Identified threats for sweet coltsfoot include:

1. *Lack of calcareous habitat* limits populations on the WMNF.
2. *Water level changes* can alter habitat conditions in seeps, swamps, and other wet environments.
3. *Hiking traffic* threatens one occurrence in Vermont (VNNHP 2001).
4. *Logging roads, skidder trails*, and *general soil disturbance* threatens one occurrence (VHHNP 2001), although logging activity appears to have no effect or even beneficial effects in some locations.

The most limiting factors of concern under WMNF control are:

a. Hiker traffic

b. Road/trail construction that alters hydrologic patterns in seeps.

Information Gaps

No information gaps were identified by the SVE Upland Forest Panel (2002).

Pertinent Resource Actions and Mitigation

There are no standards or guidelines specific to sweet coltsfoot, although Forest Plan direction would protect wetlands, vernal pools, and riparian habitats.

Affected Environment

The area of effects analysis for sweet coltsfoot is the HUC 5 subwatersheds that encompass the WMNF with some changes to remove some areas that would not be affected by WMNF activities (Map G-01). Sweet coltsfoot has also been found on gravel roadsides, but this is in northwest Canada. Occurrences in the northeast United States are all associated with more wet conditions, so this analysis will focus on those habitats.

Habitat Trend

Calcareous fens or swamps are uncommon in New Hampshire; they are more common in northern Vermont (NHNHI 2001). The habitat is presumed to be fairly stable, although some development has undoubtedly reduced available habitat within the entire analysis area.

Population Trend

The SVE Upland Forest Panel (2002) believes one occurrence on the Forest is probably stable. Although outlying populations may have declined, the species can tolerate some disturbance. However, with so few populations and so little information known about them (the species isn't tracked in Maine), it is difficult to determine population trends at this time.

Environmental Effects

All alternatives

In general, timber harvest and road/trail construction are the most likely activities that may impact this species or its habitat. However, because harvest around wetlands is typically done in the winter, it is unlikely that any open or forested wetlands would be negatively affected. Winter harvest operations compact the overlying snow base, but generally protect the plant community beneath it. Forest Plan direction would protect open and forested wetlands, so these features would be protected.

Seeps, though, may be more susceptible to impacts from these activities because they are not specifically protected. Calcareous seeps are somewhat

uncommon, but there is a chance that they could be impacted by summer harvest or road/trail construction activities. Harvest operations can directly affect seep habitats when equipment passes through them. Although harvest prescriptions that open the canopy and change light levels can affect seeps, sweet coltsfoot prefers more open conditions, so there should be no indirect effects from harvest.

However, road and trail construction can indirectly affect seeps by altering water movement in local areas, which can alter habitat conditions. Effects relating to this would be the same as those described for broad-leaved twayblade (*Listera convallarioides*) above.

Cumulative effects of all alternatives

Like broad-leaved twayblade, sweet coltsfoot only has one other known (historic) occurrence in the analysis areas. Cumulative effects related to seep habitats would be the same as those described for broad-leaved twayblade above.

Determination — Sweet coltsfoot

Implementation of any alternative **may impact individuals**, **but would not likely cause a trend towards federal listing or a loss of viability**.

Rationale Summary

1. Standards and guidelines should protect extant occurrence and most habitat types.
2. The SVE Upland Forest Panel believes the WMNF occurrences are stable despite some disturbance.

Wavy bluegrass (*Poa fernaldiana*)

Distribution

Wavy bluegrass is found from Newfoundland and Quebec south to alpine summits of Maine, New Hampshire, Vermont, and New York (Gleason and Cronquist 1991, Haines and Vining 1998, Hitchcock 1950). The SVE Alpine Plant Panel (2002) considers the WMNF to be at the southern limit of this species' range.

Life History

Wavy bluegrass grows as individual stems and in tufts, which can be fairly thick, but does not form turfs (SVE Alpine Plant Panel 2002). Flowering occurs from early July to early August (Young 1992). Mosses may be used as a seed bed (VNNHP 2001).

Habitat

Wavy bluegrass is typically found on wet cliffs, especially on little underhangs of the cliffs. It can also be found on very thin soils in the dry/mesic heath meadow system of alpine communities in New Hampshire, which includes an array of *Carex* meadows, strong heaths, *Diapensia*, fell fields, and barren rock. Areas that are kept wet from fog also support this species (SVE Alpine Plant Panel 2002).

Wavy bluegrass may be found with *Cardamine bellidifolia* on underhangs of wet cliffs (SVE Alpine Plant Panel 2002).

The dry/mesic heath meadow system is adapted to wind disturbance. Only plants adapted to strong wind conditions can compete in this environment. Other key factors of this habitat include cold and snow/ice blast (SVE Alpine Plant Panel 2002).

Human disturbance may be important to this species, but excessive disturbance is likely detrimental. One population is found near one of the alpine huts and the population size drops precipitously as the distance from the hut increases (SVE Alpine Plant Panel 2002).

Occurrences

There is 1 extant occurrence in Maine, 6 extant and 12 historic occurrences in New Hampshire, and 1 extant and 1 historic occurrence in Vermont (MNAP 2002, NHNHI 2005, VNNHP 2001). All of the extant occurrences in New Hampshire and 11 historic occurrences are from the WMNF.

Threats/Limiting Factors

The following have been identified as threats to the dry/mesic heath meadow system:

1. *Global warming, acid deposition*, and *air pollution* (SVE Alpine Plant Panel 2002, Ketchledge and Leonard 1984, Zika 1993).
2. *Excessive human disturbance*, i.e. trampling and "view seeking", especially on disjunct summits. This species would probably tolerate a higher level of trampling than other species in the same habitat, but at some point, a threshold of trampling would be reached at which negative effects would occur.

The most limiting factor under WMNF control would be human disturbance activities. Global warming, acid deposition, and air pollution are outside Forest Service control.

Information Gaps

The SVE Alpine Plant Panel (2002) identified the following information gaps for wavy bluegrass:

1) As this is a species where some level of disturbance is beneficial, but excessive disturbance is detrimental, information on "best" levels of disturbance would be helpful.
2) Determine disturbance dynamics of the dry/mesic heath meadow system.
3) Information is needed on the dry/mesic heath meadow system of lower elevation peaks as they may receive heavy recreational impacts.

Pertinent Resource Actions and Mitigation

No standards and guidelines specific to wavy bluegrass are proposed,

although Forest-wide direction related to protection of alpine communities would be provided in all alternatives.

Affected Environment

The area of effects analysis for wavy bluegrass is the WMNF proclamation boundary plus Franconia Notch, Crawford Notch, and Mt. Washington State Parks, which encompasses almost the entire alpine zone in New Hampshire. No alpine habitat exists in western Maine.

Habitat Trend

Habitat in the alpine zone has been reduced over time by hiker traffic, although this threat is considered greater outside of the Presidential Range.

Population Trend

The population is considered stable.

Environmental Effects

All alternatives

Direct, indirect, and cumulative effects would be the same as those described for arnica (*Arnica lanceolata*) above.

Determination — Wavy bluegrass

Implementation of any alternative **may impact individuals, but would not likely cause a trend towards federal listing or loss of viability**.

Rationale Summary

Mitigation to protect alpine plants and increase public education/awareness of rare alpine communities should reduce potential impacts in all alternatives. Although recreation use is expected to increase, implementation of Forest Plan standards and guidelines would keep the majority of the use on existing trails. Not every scenario can be anticipated, but many alpine species have persisted for years with heavy hiker traffic and little or no protection, so it is unlikely that a significant decline would occur during the next 15 years.

Robbins' (dwarf) cinquefoil (*Potentilla robbinsiana*)

Potentilla robbinsiana was delisted from Federally Endangered status in August, 2002, because populations had reached recovery levels and conservation efforts were in place to protect the species (USFWS 2002). At that time, the Forest Service automatically reclassified the species to a Regional Forester's sensitive species. The most popular common name currently used for this species is dwarf cinquefoil.

Distribution

Dwarf cinquefoil is endemic to the White Mountains of New Hampshire (USFWS 2002).

Occurrences

Dwarf cinquefoil is known from 4 extant and 1 historic population, all on the WMNF (NHNHI 2001 and data summarized in WMNF Literature Review for *Potentilla robbinsiana*). It is a relict species and has persisted at the 2 natural extant sites for approximately 9,000 years, when the alpine region was separated from the arctic (Spears 1989 in Cogbill 1993).

Life History

Potentilla robbinsiana is an obligate apomict (Löve and Löve 1965 in USFWS 1991; Löve and Löve 1966 in Cogbill 1993). Because of this, genetic variability is low (USFWS 1991); this strategy may put *Potentilla robbinsiana* at a competitive disadvantage compared to other plants (SVE Alpine Plant Panel 2002).

Rosette size is used to determine reproductive capability. Plants with a leaf rosette diameter less than 1.4 cm have not been observed to flower (Graber 1980). Flowering plants typically have rosette diameters ranging from 18-30 mm (USFWS 1991). Plants are unlikely to flower prior to 10 years of age (Graber and Crow 1982) and average 13 years to reach maturity (USFWS 1991). Of mature plants, 50-75 percent flower and produce an average of 3.1 flowers each (Graber 1980). Up to 52 flowers have been reported on a single plant (Kimball and Paul 1986 in USFWS 1991).

Leaves begin developing in May (Graber 1980, USFWS 1991) and continue until the end of the growing season in late August (USFWS 1991). Flowering typically begins during the first week of June, but may be earlier if the weather has been warm. Flowering peaks between June 10th and June 20th and is completed by June 26th, although occasionally flowers are found later into the season (Graber 1980). Seeds mature in mid- to late-July (Graber 1980, USFWS 1991). An average fruiting plant produces 21 seeds (1-115). In 1980, the entire Monroe Flats colony produced 24,000 viable seeds (Graber 1980).

Seed viability is high (averaging 90.4% in one study) (Graber 1980). Seeds overwinter, and then germinate in June and July (Graber 1980, USFWS 2001). However, seedling mortality is high, with over half of new seedlings succumbing in the first growing season (Graber and Brewer 1985). The most important cause of mortality is the harsh climate. Drought during hot, dry periods, and frost heaving during spring and fall are usually the main factors (Graber 1980).

The species does not compete well with other plants (Graber and Brewer 1985).

Dwarf cinquefoil is a long-lived perennial, with some large plants estimated to be 40 to 60 years old (Graber and Crow 1982).

Habitat

Dwarf cinquefoil is categorized in the dry/mesic heath meadow system of alpine communities in New Hampshire, but the subalpine bare rock summit community is more important to maintaining the full range of this species. Specific habitat for this species is either wind terraces (part of

the dry/mesic heath meadow system) or cliff ledges/cracks (part of the subalpine bare rock summit community) (SVE Alpine Plant Panel 2002).

Nearly barren fell-fields above 4,000 feet is considered preferred habitat (USFWS 1980 in USFWS 2001) and is rather rare, which likely limits this species' distribution. Dwarf cinquefoil is generally found on these habitats with a southern exposure and which are free of accumulated snow. Frequent high winds, ground fog, low temperatures, heavy icing, and highly variable weather conditions are characteristic (USFWS 1991). These harsh climate conditions help to reduce competition from other species (SVE Alpine Plant Panel 2002). Experts do not believe any suitable habitat remains to be discovered in the White Mountains (USFWS 2002).

Associated species include *Diapensia lapponica, Salix uva-ursi, Vaccinium uliginosum, Juncus trifidus, Agrostis borealis,* and *Carex bigelowii* (Graber and Brewer 1985).

Threats/Limiting Factors

Identified threats to dwarf cinquefoil include:

1. *Lack of available habitat* is considered the most limiting factor (SVE Alpine Plants Panel (2002))
2. *Global warming, acid deposition*, and *air pollution* may be a threat (SVE Alpine Plant Panel 2002, Ketchledge and Leonard 1984, Zika 1993).
3. *Hiker trampling* has been a major threat historically. Two populations in Franconia Ridge were destroyed due to hiker impacts and all plants within two meters of the Appalachian Trail were destroyed (USFWS 1980 cited in USFWS 2001). Posted signs were insufficient to protect areas. Prior to construction of a scree wall to block the Monroe Flats population, Graber and Crow (1982) observed trespass rates. Between June 15 and August 31, 1,936 hikers were counted, 194 (10%) of which walked past posted signs and trespassed in the *Potentilla robbinsiana* habitat. Hikers with day packs trespassed three times more than hikers with heavy backpacks ($p<0.005$).
4. *Hiker traffic* may also dislodge individual stones in suitable fell-field habitat. The minute spaces protected between stones often hold find soils and organic material that act as nurseries for Potentilla seedlings. If these microsites are blown away, seedlings cannot become established (Graber 1980, Graber and Crow 1982, Graber and Brewer 1985).
5. Although *collecting* for herbaria was once a significant threat, it is no longer considered a serious factor.

The most limiting factors of concern under WMNF control are hiker trampling near trails and hiker traffic off trails. Global warming, acid deposition, and air pollution are outside Forest Service control.

Information Gaps

The Alpine Plant Panel (2002) did not identify any information gaps specific to *Potentilla robbinsiana*.

Pertinent Resource Actions and Mitigation

No standards and guidelines specific to wavy bluegrass are proposed, although Forest-wide direction related to protection of alpine communities would be provided in all alternatives.

Affected Environment

The area of effects analysis for dwarf cinquefoil is the area around Mt. Washington and the Franconia Ridge where the species currently occurs. Extensive investigation and transplanting has taken place over time and it is felt that available habitat is limited to these specific areas.

Habitat Trend

Habitat in the alpine zone has been reduced over time by hiker traffic. Habitat was reduced prior to 1980, when it was noted that the Monroe Flats population was restricted to ¼ of the territory it occupied in 1934 (Steele, pers. comm. in Graber 1980). In the recent past, remaining *Potentilla* sites have been protected, either through Forest Supervisor closure orders or because they occur at some distance from trails.

Population Trend

Overall, the population has increased and is now considered stable or increasing (USFWS 2002). However, each of the individual sites has responded differently. The large Monroe Flats population appears to be increasing. During the time period 1973-1983, the number of mature plants here dropped from 1801 to 1547, a 14 percent loss (Graber and Brewer 1985). A decade later, in 1992, 1701 flowering plants were counted (Iszard-Crowley, pers. comm. in Cogbill 1993). Over the last 20 years, the population has remained relatively stable (Graber and Brewer 1985, Fitzgerald et al., 1990 in Cogbill 1993). Cogbill (1993) points out that the population has certainly been in the hundreds, if not the thousands, for the past 165 years. In 2001, the population numbered 14,195 individuals (USFWS 2001).

There are three peripheral populations to the main Monroe Flats population. All were identified after 1983. Fifteen flowering plants existed in 1985, which dropped to 9 flowering plants in 1992. Although these small subpopulations seem prone to extirpation, the main population continues to remain viable (Cogbill 1993).

The Franconia Ridge population was historically made up of several small populations scattered along the ridge. In the past 30 years, only 13 separate flowering plants have been seen. As of 1991, there were 5 remaining flowering individuals. Because suitable habitat is so limited, this population is not considered to be able to reach viable population levels and is considered imperiled (Cogbill 1993, USFWS 2002).

Two sites were established by transplanting in the 1980s. The Camel Patch site had 84 plants in 1984 and was supplemented annually from 1999 to

2001, at which time the population contained 40 adults and 57 juveniles (USFWS 2002).

The other transplant population is at Franconia and was established with 169 plants between 1988 and 1996. As of 2001, this population consisted of 75 adults and 179 juveniles (USFWS 2002).

Environmental Effects

All Alternatives

Under all alternatives, *Potentilla robbinsiana* would be given more protection than any other alpine species. Scree walls and Forest Supervisor closure orders specifically deter visitors from entering the Monroe Flats site. Of course, occasionally hikers disregard these measures, but this occurs infrequently and has not hindered the species recovery from Endangered Species listing. The other sites are less protected, but are also not adjacent to hiking trails, increasing their chances of avoiding hiker traffic. The Franconia Ridge population is somewhat inaccessible naturally and is not considered to have enough suitable habitat to maintain a viable population regardless of outside pressures.

Cumulative effects of all alternatives

Because the WMNF holds the entirety of this species, programmatic cumulative effects are virtually the same as direct/indirect effects. The future impact of global warming and climate change are unknown.

Determination — Robbins' cinquefoil

Implementation of any alternative **may impact individuals but would not likely cause a trend towards federal listing or loss of viability**.

Rationale Summary

Given this species' recent recovery from Endangered Species listing, the focus for monitoring in the next decade will be relatively intense. The likelihood of any planned activity resulting in impacts to this species is virtually nonexistent. The only way impacts could occur would be inadvertently through hiker trampling. Given the inaccessibility of the sites and clear markers instructing people to avoid the Monroe Flats area, this is more unlikely than for other alpine species.

Boott's rattlesnake-root (*Prenanthes (Nabalus) boottii*)

Since the last Regional Forester's sensitive species update, this species has undergone a taxonomic review and is now known as *Nabalus boottii*.

Distribution

Boott's rattlesnake-root is found from Maine to New York (Gleason and Cronquist 1991, Haines and Vining 1998, Slack and Bell 1995).

Life History

Boott's rattlesnake-root reproduces both vegetatively and sexually. As a biennial, it flowers once then dies, but may live several years as a vegetative individual before flowering. The high percentage of vegetative individuals (50-100%, often around 75%) in a population suggests several years are needed in a vegetative state before flowering occurs (NatureServe 2001q).

The ability to flower may be a factor of nutrient availability and disturbance. Flowering individuals on Mt. Washington are most likely found in disturbed areas, such as near a heavily used hut, along trailsides, and in unstable ravines (Rawinski 1986a in NatureServe 2001q). The SVE Alpine Plant Panel (2002) suggests Boott's rattlesnake-root tolerates disturbance better than other species of the snowbank/wet meadow/streamside community system and may compete better with disturbance.

Flowering occurs July to August (Gleason and Cronquist 1991) to September (Slack and Bell 1995). Insects are likely pollinators. Bumblebees were observed visiting plants on Mt. Washington (Brackley 1990 in NatureServe 2001q).

Habitat

Boott's rattlesnake-root is a component of the snowbank/wet meadow/ streamside community system, but may also be found in the dry/mesic heath meadow system of alpine communities. It does not occur in the wetter areas of either habitat system, but tends to occur in drier areas such as damp meadows (SVE Alpine Plant Panel 2002). NatureServe (2001q) characterizes three main habitat types for Boott's rattlesnake-root: 1) moist sites on tundra lawns or along streams; 2) cliffs and ledges, mostly in exposed areas; and 3) exposed, disturbed areas such as alongside trails. Plants are generally found in somewhat exposed and disturbed situations, such as fell-fields, steep slopes, ravines and streamsides, and anthropogenically disturbed sites (e.g., around the alpine huts).

Associated species in New Hampshire include: *Diapensia lapponica, Salix uva-ursi, Rhododendron lapponicum. Campanula rotundifolia, Potentilla tridentate, Juncus trifidus, Vaccinium uliginosum, Empetrum nigrum, Cornus canadensis, Carex bigelowii, Solidago cutleri, Minuartia groenlandica, Carex brunnescens, Hierochloe alpina, Woodsia glabella, Asplenium viride, Poa nuda, Solidago randii,* and *Aster acuminatus* (NH Plant Characterization Abstract, Global, updated September 21, 1998).

Hydrology, snow load, and wind disturbance are important in maintaining viability of the overall system in which Prenanthes boottii is found (SVE Alpine Plant Panel 2002).

Occurrences

There are 3 extant occurrences in Maine, 3 extant and 1 historic occurrence in New Hampshire, and 2 extant occurrences in Vermont. Of these, 4 extant and the historic occurrence are found on the WMNF (MNAP 2001, NHNHI 2001, VNNHP 2001).

Threats/Limiting Factors

Identified threats for Boott's rattlesnake-root include:

1. *Proximity to the Mt. Washington Auto Road*
2. *Maintaining an adequate amount of disturbance* to support the species, but not so much that habitat is destroyed. Boott's rattlesnake-root is found in areas where hiking activity is prevalent and disturbance seems to benefit the species. It has been found along trails, in blowouts, near huts, and in areas that were formerly grazed. It is especially abundant in a spoil pile created from concrete mixing for structures in the Presidential Range, perhaps due to calcium leaching (SVE Alpine Plant Panel 2002). However, trampling and disturbance by hikers are also considered the primary threats for *P. boottii* (NHNHI 2001).
3. *Global warming*, *acid deposition*, and *hydrologic change* may threaten alpine communities (SVE Alpine Plant Panel 2002)
4. *Air pollution* may threaten alpine species in general (Ketchledge and Leonard 1984, Zika 1993).

The most important limiting factor under WMNF control is disturbance, especially hiking traffic and other recreational uses. Global warming, acid deposition, and air pollution are outside Forest Service control.

Information Gaps

The SVE Alpine Plant Panel (2002) identified the following information gaps for Boott's rattlesnake-root:

1) Determine processes that distinguish the different community types within the snowbank/wet meadow/streamside/wet shrub ravine system.
2) There is a need for information on the patterns of distribution of communities within the snowbank/wet meadow/streamside/wet shrub ravine system.
3) Determine disturbance dynamics of the dry/mesic heath meadow system, especially on lower elevation peaks, as they may receive proportionately higher recreation impacts.

Pertinent Resource Actions and Mitigation

No standards and guidelines specific to Boott's rattlesnake-root are proposed, although Forest-wide direction related to protection of alpine communities would be provided in all alternatives.

Affected Environment

The area of effects analysis for Boott's rattlesnake-root is the WMNF proclamation boundary plus Franconia Notch, Crawford Notch, and Mt.

Washington State Parks, which encompasses almost the entire alpine zone in New Hampshire. No alpine habitat exists in western Maine.

Habitat Trend

Habitat in the alpine zone has been reduced over time by hiker traffic, although this threat is considered greater outside of the Presidential Range.

Population Trend

Given the limited number of occurrences, a population trend cannot be determined. However, local populations appear to be fairly well-defined with many individual plants (SVE Alpine Plant Panel 2002).

Environmental Effects

Alternative 1

Because of the community type in which this species is found, effects are expected to be somewhat similar to arnica described above. However, Boott's rattlesnake-root seems to favor disturbed areas more than other rare alpine plants. Although repeated trampling from hikers would not be likely to promote the species, it is possible that other smaller disturbances could improve habitat conditions more so than they would for arnica.

Indirectly, natural events such as blowouts and rockfalls probably create more habitat than any manmade activities that would be proposed.

Cumulative effects of Alternative 1

No future activities are known from the three state parks with alpine habitat. Recreation use is expected to increase over the next 20 years, but if hikers stay on the same trails, the difference in effects over time are likely insignificant. Although increased use may result in increased off-trail use, it is likely that these new areas would receive repeated traffic, which doesn't appear to be the kind of disturbance necessary to create suitable habitat. Therefore, there would be no cumulative effects beyond the direct and indirect effects already described above.

Alternative 2

Alternative 2 would be less likely than Alternative 1 to result in new creation of suitable habitat because mitigation would limit construction of new facilities and infrastructure in the alpine zone. Indirect natural disturbance would still occur and could provide habitat as described in Alternative 1.

Cumulative Effects of Alternative 2

Similar to Alternative 1, cumulative effects would be the same as the direct and indirect effects already described.

Alternative 3

Effects would be the same as those described for Alternative 2.

Cumulative effects of Alternative 3

Cumulative effects would be the same as those described for Alternative 2.

Alternative 4

Effects of Alternative 4 would be the same as those described for Alternative 2.

Cumulative effects of Alternative 4

Cumulative effects would be the same as those described for Alternative 2.

Determination — Boott's rattlesnake-root

Implementation of any alternative **may impact individuals but would not likely cause a trend towards federal listing or loss of viability.**

Rationale Summary

1. Mitigation to protect alpine plants and increase public education/awareness of rare alpine communities should reduce potential impacts in all alternatives. Although recreation use is expected to increase, implementation of Forest Plan standards and guidelines would keep the majority of the use on existing trails. Not every scenario can be anticipated, but many alpine species have persisted for years with heavy hiker traffic and little or no protection, so it is unlikely that a significant decline would occur during the next 15 years.

Pink wintergreen (*Pyrola asarifolia*)

Distribution

Pink wintergreen is distributed from Alaska to New Brunswick, south to Massachusetts, west to Indiana and Iowa and further west to California. It is prevalent in most western states and Canada, but New England is the southeastern limit of its range (SVE Upland Forest Panel 2002).

Life History

Pink wintergreen reproduces both sexually through flowers and asexually by root budding of shallow rhizomes. Vegetative reproduction dominates, especially in those plants removed from wetlands (SVE Upland Forest Panel 2002). Flowering occurs from May to mid-July; most plants are found either in small colonies (asexual reproduction) or with flowers or fruit.

Habitat

Pink wintergreen uses a variety of habitats, most of which have some rich character, e.g., enriched hardwoods, cedar swamps, alluvial soils). Nutrient levels appear more important than vegetation type, hydrology, or canopy cover in determining suitable habitat. In northern New England, it has been documented primarily in calcareous open wetlands, swamps, and rich woods and thickets, especially alluvial areas of river terraces (NHNHI 1998). USDA/NRCS (2001) considers this a facultative wetland species in the northeast, which may indicate a preference for wetlands habitats. The largest populations in Maine occur in relatively open conditions, such as along riverbanks (ME DOC 1999).

In the northeast, this species tends to occur at forest edges; plants with more light available to them are more robust and likely to flower (ME DOC 1999).

The one WMNF occurrence is growing in coarse sands of an abandoned secondary stream channel that cuts through a low terrace forest (NHNHI 2001).

Occurrences

There are 22 extant and 1 historic occurrences in Maine, 2 extant and 7 historic occurrences in New Hampshire, and 14 extant and 15 historic occurrences in Vermont (MNAP 2001, NHNHI 2001, VNNHP 2001). Only 1 extant occurrence is known on the WMNF.

Threats/Limiting Factors

Identified threats to pink wintergreen include:

1. *Canopy changes* that completely remove the canopy (e.g., logging, development) (NHNHI 1998).
2. *Projects that change existing water levels* (VNNHP 2001).
3. *Spruce cone rust fungus* could cause plant death if the infestation is sufficiently large (Cartar and Abrahams 2000).
4. Individual populations may be threatened by *trampling from hikers or ATV traffic* (VNNHP 2001).
5. Enriched hardwood habitats are *naturally rare* on the WNNF.

The most limiting factors of concern under WMNF control are:

a. Logging that drastically changes the level of canopy closure
b. Trampling from hikers or possibly ATV use

Information Gaps

The SVE Upland Forest Panel (2002) did not identify any information gaps for pink wintergreen.

Pertinent Resource Actions and Mitigation

No standards or guidelines are proposed specific to pink wintergreen, although Riparian and Aquatic Habitats standards and guidelines may help protect some habitats.

Affected Environment

The area of effects analysis for pink wintergreen is the ecological subsections that encompass the WMNF, along with the subsection that covers the Connecticut River Valley, where most patches of rich hardwoods habitat in New Hampshire occurs (Map G-01).

Habitat Trend

Mature, rich, northern hardwoods are relatively stable in the analysis area, although it typically occurs in small patches or even tiny pockets (SVE Upland Forest Panel 2002). In addition, across the Connecticut River in Vermont, abundant habitat exists. Some habitat has undoubtedly been lost to development and land clearing, but this trend would have been less since 1986 than in the 17th and 18th centuries. Similarly, wetland and riverine habitats are fairly common and stable, despite historic impacts and losses.

Population Trend

With such few occurrences on the WMNF and in New Hampshire, the population trend on the Forest is unknown. Based on the large number of extant versus historic populations in Maine and Vermont, it appears the population in these two states is stable. Existing populations are also probably stable within the entire analysis area, except where development or other land use changes are likely.

Environmental Effects

Alternative 1

Timber harvest

The biggest threat to this species is timber harvest, although other ground disturbing activities also have the potential to negatively impact individuals or habitat. Timber harvesting vehicles can unintentionally run over unknown individuals and cutting prescriptions can change the amount of canopy closure. If too much sunlight reaches the forest floor, microhabitats may become too dry to support this species. Effects would be most severe under even-aged regeneration treatments such as clearcutting and would be less impactive or even result in no effect with partial cuts such as single tree selection. Under all alternatives, TES plant surveys would be required prior to ground disturbance, so chances are good that known and new occurrences would be identified and mitigated prior to timber harvest or other activity. However, it is possible that an unknown occurrence could be overlooked or not have emerged at the time of survey. Alternative 1 proposes the greatest number of acres harvested through even-aged prescriptions and the second-greatest amount of total acres harvested (just behind Alternative 4). Therefore, the risk of impacting pink wintergreen, albeit small, is higher in this alternative than in alternatives 2 and 3. Even-aged regeneration harvests may be more detrimental to rich hardwood species because suitable unoccupied habitat could be made unsuitable for a time as light levels increase.

In riparian habitats, logging would be restricted within 25 feet of the bank of a perennial stream channel and crossings would only be allowed at designated locations. Other standards and guidelines would protect wetlands and riparian habitats within 100 feet of perennial streams (except for crossings). This would limit canopy changes and consequent light level increases. In general, this should help maintain wetland and riparian conditions and processes. There is a possibility that logging or recreational

activity could impact unknown individuals or unoccupied suitable habitat, but standards and guidelines would minimize these effects.

Hiking use/Trampling
Effects of hiker traffic would be the same as those described for broad-leaved twayblade (*Listera convallarioides*) above.

ATV use
Effects of ATV use would be the same as those described for Wiegand's sedge (*Carex wiegandii*) above.

Cumulative effects of Alternative 1

Outside of the Forest, the biggest threat to this species is loss of habitat caused by development. Chances are high that development trends will continue. Much of the habitat where pink wintergreen is found is at lower elevations, which is also where development is most likely. Because so many occurrences both on and off the Forest are considered stable, loss of some habitat over the next 20 to 50 years is not expected to change viability outcomes within the analysis area.

Alternative 2

Timber harvest
Effects of timber harvest and road/trail construction would be similar to Alternative 1, but there would be less chance of impacting an occurrence in Alternative 2 because the amount of proposed timber harvest activity would be reduced. Alternative 2 proposes 25 percent less of the total acres treated and approximately 60 percent of the even-aged regeneration treatments compared to Alternative 1, even though the land base on which timber harvest could occur would remain essentially the same.

Hiking use/Trampling
Effects of hiker traffic would be the same as those described for broad-leaved twayblade (*Listera convallarioides*) above.

ATV use
No ATV use would be allowed in Alternative 2, so there would be no effects from this activity.

Cumulative effects of Alternative 2

Cumulative effects would be similar to Alternative 1, but the Forest may contribute less to impacts within the entire analysis area.

Alternative 3

Timber harvest
Alternative 3 proposes the least amount of timber harvest, although the amount of total acres proposed for treatment is approximately the same as in Alternative 2. The risk of direct mortality would be the same as in Alternative 2, since approximately the same amount of acres would be treated. However, even-aged regeneration treatments would be reduced in Alternative 3, resulting in the least risk of indirect effects caused by habitat alteration.

Hiking use/Trampling
Effects from hiker traffic would be the same as Alternative 2.

ATV use
Like Alternative 2, no ATV use would be allowed in this alternative, so there would be no effects from this activity.

Cumulative effects of Alternative 3

Cumulative effects would be similar to those described in Alternative 2.

Alternative 4

Timber harvest
Alternative 4 proposes the greatest amount of acres treated by timber harvest of any alternative, although the number of acres harvested through even-aged regeneration prescriptions is less than in Alternative 1. The overall risk of impacting an unknown individual or habitat is greater than Alternative 1 because more acres would be treated. However, indirect effects of habitat loss through even-aged regeneration harvests would be less in this alternative compared to Alternative 1.

Hiking use/Trampling
Effects of hiker traffic would be the same as those described for broad-leaved twayblade (*Listera convallarioides*) above.

ATV use
Effects of ATV use would be the same as those described for Wiegand's sedge (*Carex wiegandii*) above.

Cumulative effects of Alternative 4

Cumulative effects would be similar to Alternative 1.

Determination — Pink wintergreen

Implementation of any alternative **may impact individuals, but would not likely cause a trend towards federal listing or a loss of viability**.

Rationale Summary

1. Although timber harvest has the potential to directly and indirectly impact individuals, mitigation to protect TES species would be in place to reduce those impacts.
2. Forest Plan direction for Riparian and Aquatic Habitats and Watershed would help protect some wet habitats near which pink wintergreen might be found.
3. In addition, habitat along the Wild River (where the one WMNF occurrence is located) is not likely to be substantially impacted in any alternative.

Livelong saxifrage (*Saxifraga paniculata*)

Distribution

Livelong saxifrage is circumboreal, south to New England, west to the northern Great Lakes, Minnesota, and Saskatchewan (Gleason and Cronquist 1991, Haines and Vining 1998, Voss 1985).

Life History

Livelong saxifrage reproduces asexually using runners (Lowe 1924). Flowering occurs in June (Jenkins 1982), July (Gleason and Cronquist 1991, Slack and Bell 1995), or from June to September (Young 1992).

Staszkiewica and Wojcicki (1978) report clones of the same phenotype and genotype can exist tens and even hundreds of years. The occurrence on the Forest has been known for approximately 100 years (SVE Open and Rock Panel 2002).

Habitat

Livelong saxifrage grows on exposed calcareous gravel and rocks (Haines and Vining 1998). The SVE Open and Rocks Panel (2002) considers it a species of limy, seepy, open cliffs. Variable levels of vegetation may occur at these cliffs, but all have a sparse canopy, if any, and minimal understory species. Livelong saxifrage tends to occur in small populations with small patches, which can occur up into the subalpine zone (SVE Open and Rocks Panel 2002).

Occurrences

There are 2 historic occurrences in Maine, 2 extant occurrences in New Hampshire, and 4 extant occurrences in Vermont (MNAP 2001, NHNHI 2001, VNNHP 2001). The WMNF only contains 1 extant occurrence.

Threats/Limiting Factors

Identified threats for the Open and Rock community include:

1. *Trampling* from hiking and rock climbing.
2. *Air pollution* may be a threat (Ketchledge and Leonard 1984; Zika 1993).
3. *Invasive species*.
4. *Lack of calcareous habitats* on the WMNF.

The most limiting factors of concern under WMNF control are:

a. Trampling

b. Invasive species

Air pollution is outside Forest Service control.

Information Gaps

The SVE Open and Rocks Panel (2002) identified the following information gaps for livelong saxifrage:

1) Lifespan information should be determined.

2) Pollinator information is lacking.

Pertinent Resource Actions and Mitigation

There are no standards and guidelines specific to livelong saxifrage, although direction to limit rock climbing and protect vegetation on and around cliffs could help mitigate negative effects to this species:

Affected Environment

The area of effects analysis for livelong saxifrage is the proclamation boundary of the WMNF, plus adjacent State Parks and the Appalachian Trail corridor that is managed by the Forest (Map G-01). Plants are unlikely to disperse a great distance away from the Forest.

Habitat Trend

Habitat is uncommon, but has been fairly stable in the recent past, although rock climbing has undoubtedly destroyed some potential colonization sites for cliff plants.

Population Trend

The population trend for livelong saxifrage is considered to be relatively stable. The occurrence on the Forest has been known for approximately 100 years (NHNHI 2001), indicating it is very persistent.

Environmental Effects

All alternatives

Livelong saxifrage would have direct, indirect, and cumulative effects similar to silverling (*Paronychia argyrocoma*) described above. Although they occupy slightly different habitat positions, the effects from rock climbing and hiker traffic would be similar. In addition, effects relative to invasive species would be similar to those described for piled-up sedge (*Carex cumulata*) above.

Determination — Livelong saxifrage

Implementation of any alternative **may impact individuals**, **but would not likely cause a trend towards federal listing or a loss of viability**.

Rationale Summary

1. Standards and guidelines limit outfitter/guide climbing party size, which should help limit the number of climbers removing vegetation and soil from suitable habitat.
2. Standards and guidelines for protecting TES species should help mitigate proposed construction of new trails and trigger action when resource damage is confirmed by existing activities.

3. Effective mitigation measures are known that can be implemented at the project level to limit impacts.
4. Known occurrences on the WMNF are very persistent, having survived for almost 100 years.
5. New Forest Plan direction to slow the spread of invasive species will reduce the risk of indirect impacts.

Moss campion (*Silene acaulis*)

This species was known for a time in New England by a varietal name (var. *exscapa*) and designated as such on the Regional Forester's sensitive species list in 2000, but it is no longer considered a valid taxon and so is referred to in this analysis by its current taxonomic name (A. Haines, pers. comm.).

Distribution

Moss campion is a circumboreal species that grows south to alpine summits in New Hampshire, Maine, Montana, Idaho, Oregon, and Washington (Gleason and Cronquist 1991, Haines and Vining 1998).

Life History

Moss campion grows in very localized mats (SVE Alpine Plant Panel 2002) and can produce three types of flowers: one hermaphroditic and two unisexual types based on the partial suppression of either stamens or carpels (Swales 1979). Flowering occurs in June (Slack and Bell 1995). Flower morphology is different between females and hermaphrodites (Sastad 1991). Both have comparable pollen loads, but pollinating bumblebees spend more time at female flowers (Shykoff 1992).

The percentage of individuals that set at least one fruit is higher (85%) in females than in staminate plants (11%) (Maurice et al., 1998). Seeds are probably not widely dispersed, since the species doesn't appear to spread rapidly (SVE Alpine Plant Panel 2002). Females also produce seedlings with the highest juvenile survivorship compared to hermaphrodites (Shykoff 1988).

Silene acaulis is a long-lived species, with total life spans approaching one century. Growth begins slowly, accelerates to a maximum rate of 2 to 3 cm per year, then decreases (Benedict 1989).

Habitat

Moss campion habitat is characterized as gravelly, rocky barrens of alpine areas (Haines and Vining 1998).

The SVE Alpine Plant Panel (2002) places moss campion in the dry/mesic heath meadow system of alpine communities. However, although the system has a fairly widespread distribution in the alpine zone, this species is much more sparsely distributed than the system would suggest.

Associated species in British Columbia include: *Carex scirpoidea*, *Caloplaca* spp. *Festuca ovina*, *Trisetum spicatum*, and *Luzula campestris*. *Silene acaulis*

is negatively associated with *Selaginella densa* and *Cetraria islandica* (Ratcliffe and Turkington 1987).

Occurrences

There is 1 extant and 1 historic occurrence in Maine and 2 extant and 5 historic occurrences in New Hampshire (MNAP 2001, NHNHI 2001). All of the New Hampshire occurrences are located on or immediately adjacent to the WMNF.

Threats/Limiting Factors

Identified threats to moss campion include:

1. *Erosion* near one extant occurrence as a result of plowing the Auto Road.
2. *Hiker trampling*.
3. *Global warming*, *acid deposition*, and *air pollution* may be threats to the dry/mesic heath meadow system.

The only limiting factor that the WMNF may influence through management is hiker traffic. Global warming, acid deposition, and air pollution are outside Forest Service control.

Information Gaps

The SVE Alpine Plant Panel (2002) identified the following information gaps for Silene acaulis:

1) Determine disturbance dynamics of the dry/mesic heath meadow system
2) Information is needed on the dry/mesic heath meadow system on lower elevation peaks, especially related to recreation use.

Pertinent Resource Actions and Mitigation

No standards and guidelines specific to arnica are proposed, although Forest-wide direction related to protection of alpine communities would be provided in all alternatives.

Affected Environment

The area of effects analysis for moss campion is the WMNF proclamation boundary plus Franconia Notch, Crawford Notch, and Mt. Washington State Parks, which encompasses almost the entire alpine zone in New Hampshire. No alpine habitat exists in western Maine.

Habitat Trend

Habitat in the alpine zone has been reduced over time by hiker traffic, although this threat is considered greater outside of the Presidential Range. The two extant occurrences are at continued risk because of increased erosion and recreation use near the Auto Road and the Cow Pasture.

Population Trend

With such few numbers of occurrences, the population trend is unknown, although the number of historic occurrences compared to current populations suggests a decline.

Environmental Effects

All Alternatives

Effects would be the same as those described for *Arnica lanceolata* above. There is little that can be done about the Auto Road occurrence since it is on privately owned land.

Cumulative effects of all alternatives

Cumulative effects would be the same as those described for arnica (*Arnica lanceolata*) above.

Determination — Moss campion

Implementation of any alternative **may impact individuals but would not likely cause a trend towards federal listing or loss of viability**.

Rationale Summary

1. Although this species is rare in the northeast, it is much more abundant to the north.
2. The occurrences along the Auto Road are threatened more by plowing and maintenance activities than other alpine species, but the Auto Road has been in place for many years with the same level of activity. The situation is certainly not optimal, but recent NHNHI descriptions of the occurrence indicate it is has good viability.

Mitigation to protect alpine plants and increase public education/awareness of rare alpine communities should reduce potential impacts in all alternatives. Although recreation use is expected to increase, implementation of Forest Plan standards and guidelines would keep the majority of the use on existing trails. Not every scenario can be anticipated, but many alpine species have persisted for years with heavy hiker traffic and little or no protection, so it is unlikely that a significant decline would occur during the next 15 years.

Nodding pogonia (*Triphora trianthophora*)

Distribution

Nodding pogonia occurs in Ontario and New England (except Connecticut and Rhode Island), south to Florida and west to Nebraska (except Pennsylvania, Minnesota, North Dakota, and South Dakota) and south to Texas (NatureServe 2001m).

Life History

Nodding pogonia appears aboveground for a short period in late summer during flowering and into the fall if a fruit develops. Substantial fluctuations

in above ground population size may occur from year to year, with periodic dormancy resulting in a site containing hundreds of above ground stems in some years and few or no stems in other years. Sporadic shoot production makes accurate assessment of population size extremely difficult (Williams 1994).

Flowering occurs in August in New England (Brown 1997). There is general consensus that an individual flower will only remain open and viable for pollination for a single day (Keenan 1986, Homoya 1993, Williams 1994). Flowers tend to open in synchrony with other plants in the population (Homoya 1993). A drop in nighttime temperatures often precipitates mass flowering in a population approximately two days later, although flowering may occur without such a temperature decrease (Luer 1975).

Pollinators include bumblebees, smaller bees, and flies (Williams 1994, Keenan 1996). Little is known about pollinators and because pollination, seed production, and seedling establishment do not appear to occur frequently, asexual reproduction through secondary "tuberoids" is likely to be the primary mechanism of reproduction (Williams 1994).

When pollination and fertilization do occur, capsule development and seed dispersal occur within approximately one month (Keenan 1998). Capsule production may be low, but with high capsule maturation (Williams 1994). The tiny seeds are likely wind-dispersed. Dressler (1981) notes seedling establishment rates are probably not very high because, like other orchids, seeds must disperse to sites with both suitable physical conditions and the presence of the appropriate fungi to form mycorrhizae. Emphasis on vegetative reproduction may result in decreased genetic variability in nodding pogonia (Williams 1994).

Nodding pogonia is closely associated with American beech (*Fagus grandifolia*), from which it may receive nutrients and photosynthates from beech trees via mycorrhizal fungi connected to both the beech tree and the orchid.

Habitat

In New England, nodding pogonia grows primarily in moist, beech-dominated woods in terrain formed leaf litter pockets. There are usually few, if any, herbaceous species growing adjacent to this species. Nodding pogonia prefers filtered light from a canopy closure of 70-80 percent (SVE Upland Forest Plants Panel 2002).

Although other herbaceous plants are not usually found adjacent to *Triphora trianthophora*, associated species that may be found nearby include *Epifagus virginiana*, *Monotropa uniflora, Uvularia sessilifolia, Gaultheria procumbens, Mitchella repens,* and *Medeola virginiana* (Ramstetter 2001).

Over 425 stems were located across approximately two acres on the WMNF in 2000; over half of the stems were growing in a recently logged area. At one site in Maine, approximately half of the plants occur in the open beech woods in heavy beech leaf litter; the other half occurs in a recently cut area.

Plants often grow beside rotten, downed logs, but never on top of them (Maine Critical Areas Program 1976, Keenan 1990).

Occurrences

There are 7 extant occurrences in Maine, 11 extant and 13 historic occurrences in New Hampshire, and 4 extant and 3 historic occurrences in Vermont (MNAP 2001, NHNHI 2001, VNNHP 2001). Seven extant occurrences and 1 historic occurrence are found on the WMNF.

Threats/Limiting Factors

Identified threats for nodding pogonia include:

1. *Squirrels*, who consume the underground "tuberoids" of this species. Slugs, insects, rodents, and deer can completely destroy aboveground portions of the plant (Keenan 1986, Williams 1994).
2. *Global warming* and/or *diseases* that affect beech distribution could impact *Triphora* populations.
3. *Development, timber harvest*, and *habitat alteration* are threats.

The most limiting factors of concern under WMNF control are:

a. Timber harvest

b. Road, trail, and facilities construction that results in habitat alteration

Global warming and diseases are outside Forest Service control.

Information Gaps

The SVE Upland Forest Plants Panel (2002) did not identify any information gaps for this species.

Pertinent Resource Actions and Mitigation

There are no standards or guidelines specific to nodding pogonia.

Affected Environment

The area of effects analysis for nodding pogonia is the boundary of the ecological subsections that encompass the WMNF (Map G-01). This is a reasonable boundary for a wind-dispersed plant. In addition, habitat for this species is widespread beyond the Forest's borders.

Habitat Trend

Nodding pogonia occurs in lower elevation, tillable habitat, so it is likely there was some historical loss to agriculture in some parts of its range. Some sites are known to have been lost to development in New England (Ramstetter 2001).

Population Trend

Orchids are notoriously difficult to monitor in terms of population trends because of their ephemeral and inconsistent appearance above ground. As

is common in other orchid species, nodding pogonia numbers have fluctuated at individual sites from year to year with no apparent reason or obvious trend.

Environmental Effects

Alternative 1

Timber harvest

Alternative 1 has the most acres of even-aged regeneration harvest and the second-highest total acres of harvest compared to the other alternatives. This alternative proposes the least amount of uneven-aged harvest in terms of acres. Because of required TES plant surveys prior to ground-disturbing activities, it is unlikely that a visible nodding pogonia occurrence would be directly impacted. However, because orchids do not always emerge every year, it is possible that a survey would not detect any individuals that were actually below ground. If they emerged at some point during active timber harvesting, it is possible that they could be directly impacted. However, because nodding pogonias also seem to prefer a more open canopy, certain timber harvest prescriptions such as single tree selection may improve habitat conditions by increasing filtered light levels, especially in stands with a large beech component. Prescriptions such as clearcutting that completely open the canopy would probably cause negative effects to undiscovered individuals or suitable habitat.

Road/trail/facilities construction

Other activities such as road, trail, and facilities construction may also result in negative impacts if they completely open the canopy. In Alternative 1, the risk from road/trail construction is increased, since this alternative would need the most new road construction to support the proposed timber outputs and anticipated summer motorized trail miles are highest in this alternative. Trail and other facilities construction could occur anywhere in nodding pogonia habitat, although it is estimated that compared to timber harvest, the acreage affected by these activities is very low.

Cumulative effects of Alternative 1

Timber harvest also occurs in potential habitat within the analysis area. The majority (that is not being cut for development purposes) appears to use single-tree selection methods (Thorne and Sundquist 2001). Timber harvest off Forest could have the same effects as described above, although harvests on private lands would not require rare plant surveys, so the risk of potential impact may be somewhat higher off Forest.

Cumulatively, the biggest threat to this species is loss of habitat through development outside of the WMNF. Many of the hardwood stands that could provide suitable habitats are in lower elevations that are also suitable for development. Over the past 20 years, housing and retail developments have expanded in many towns around the WMNF and there is no indication that this trend will reverse.

Approximately half of the extant occurrences found in Vermont, New Hampshire, and Maine are found in the analysis area. Some occurrences

may be lost in the next 20 years; however, the SVE Upland Forest Plants Panel (2002) did not predict that the risk of viability loss would change between now and the next 20 years, despite increasing development and continued harvest.

Alternative 2

Timber harvest

Alternative 2 would have fewer total acres treated through timber harvest and fewer even-aged regeneration harvest acres compared to Alternative 1, with slightly more uneven-aged treatments. Therefore, the risk of directly impacting an unknown occurrence would be reduced. The potential to improve habitat conditions by opening canopies would be increased.

Road/trail/facilities construction

Road construction in this alternative would be approximately 70 percent of Alternative 1, reflecting the proposed reduction in timber harvest acres. However, the magnitude of the difference is so small that it probably would not result in any measurable difference to *Triphora* success. Trail construction and other recreation infrastructure would be reduced compared to Alternative 1. No summer motorized use would be allowed in this alternative, so there would be no trails supporting this activity that could affect *Triphora* populations.

Cumulative effects of Alternative 2

Effects on non-WMNF lands would be the same as described in Alternative 1. Cumulatively, Alternative 2 has slightly less risk of impacting *Triphora trianthophora* because of Forest activities (see direct and indirect effects above).

Alternative 3

Timber harvest

Alternative 3 would have slightly more acres of timber harvest treated than in Alternative 2, although they are close enough that there would not be a measurable difference in the risk of direct impacts. However, Alternative 3 proposes a far greater proportion of harvests in uneven-aged prescriptions, so the chance of impacting Triphora occurrences by drastically altering habitat conditions is lowest in this alternative. This also provides more chance of improving habitat by creating suitable light conditions compared to alternatives 1 and 2.

Road/trail/facilities construction

Proposed road construction to support timber harvests would be slightly higher than Alternative 2 because of the greater proportion of uneven-aged prescriptions (which require more harvest area). However, the difference in the amount of new road construction proposed is so low that habitat effects would not be different.

Cumulative effects of Alternative 3

Effects on non-WMNF lands would be the same as described in Alternative 1. Cumulatively, Alternative 3 has slightly less risk of impacting *Triphora*

trianthophora because of Forest activities (see direct and indirect effects above).

Alternative 4

Timber harvest

Alternative 4 proposes the most acres of total timber harvest. The amount of even-aged regeneration harvest is comparable to Alternative 2, but the amount of uneven-aged harvest is closer to Alternative 3. The potential to improve habitat conditions would be similar to Alternative 3, but with a greater chance of impacting habitats at the same time.

Road/trail/facilities construction

Road construction to support timber harvest would be slightly higher than Alternative 1 because of the greater number of acres proposed for harvest, but as explained above, the difference in amount of road construction proposed in all alternatives is so low that the difference in effects would be negligible.

The potential for trail construction would probably be the highest in this alternative, which tries to respond to public demand and proposes a summer motorized trail area. At least some of these trails are likely to go through potential habitat given their landscape position. As with timber harvest, it is likely that known occurrences would be avoided, but if plant surveys did not reveal actual occurrences, some loss of individuals could occur. Since this alternative has the highest potential for additional trail construction, the risk is highest here.

Cumulative effects of Alternative 4

Effects on non-WMNF lands would be the same as described in Alternative 1. Cumulatively, Alternative 4 has effects similar to Alternative 1.

Determination — Nodding pogonia

In all alternatives, activities **may impact individuals, but would not likely cause a trend towards federal listing or a loss of viability**.

Rationale Summary

1. As is common with orchids, populations seem to have fluctuated from year to year, but continue to persist.
2. Timber harvest may cause negative effects, but single tree selection prescriptions could also improve habitat conditions by opening canopies and providing more filtered light conditions.

Boreal blueberry (*Vaccinium boreale*)

Distribution

Boreal blueberry is found in Newfoundland, Labrador, Quebec, Cape Breton and Gaspé, south to high mountains in Maine, New Hampshire, Vermont, and New York (Gleason and Cronquist 1991; Haines and Vining 1998; Vander Kloet 1977). Vander Kloet (1977) considers the New England occurrences to be outliers.

Life History

Boreal blueberry produces through both sexual and asexual means (Eriksson 1992 in Vander Kloet and Hill 2000).

Flowering occurs from June to late July (Gleason and Cronquist 1991; Young 1992), about two weeks before the more common *V. angustifolium* (Vander Kloet 1977). Fruits appear in August (Young 1992) and are dispersed more quickly than the other *Vaccinium species* (Vander Kloet and Hill 2000). Being close to the ground, many seeds are deposited close to parent plants. Others are dispersed by birds, although passage of berries through a frugivore decreases percent germination of defecated seeds by at least 15 percent (Vander Kloet and Hill 2000).

Two phenotypic forms of this species occur: one approximately 20 cm tall and one that grows very close to the ground (SVE Alpine Plants Panel 2002).

Habitat

The habitat for boreal blueberry is characterized as alpine meadows and high elevation exposed, gravelly or rocky sites (Gleason and Cronquist 1991; Haines and Vining 1998, SVE Alpine Plant Panel 2002). In New Hampshire, the species is placed in the dry/mesic heath meadow system of alpine communities, although it may also occur in the subalpine heath krummholz and the snowbank/wet meadow/streamside community systems, as well as on bare rock subalpine summits (SVE Alpine Plant Panel 2002).

As with most alpine plant communities, the dry/mesic heath meadow system is limited by elevation. The system forms a large and widespread patch matrix in the Presidential Range and is also found on the disjunct alpine summits in small patches. Wind disturbance is an important factor in determining the distribution of this system. Only plants adapted to wind are found here. Vaccinium boreale is found in very acidic conditions, so nutrients are not a limiting factor (SVE Alpine Plant Panel 2002).

Associated species in New England include *V. angustifolium, V. uliginosum*, and *V. vitis-idaea* (Bliss 1963, D. Sperduto 1993, Sperduto and Cogbill 1999). Vaccinium boreale is almost always found in mixed communities, so it is at least a fair competitor (SVE Alpine Plant Panel 2002).

Occurrences

There are 9 extant and 1 historic occurrences in Maine, 13 extant and 2 historic occurrences in New Hampshire, and 3 extant occurrences in Vermont (MNAP 2001, NHNHI 2001, VNNHP 2001, and data summarized in WMNF Literature Review for *Vaccinium boreale*). The WMNF holds 14 extant and 1 historic occurrences.

Threats/Limiting Factors

Identified threats for boreal blueberry include:

1. *Hiker traffic* and other trampling is the primary threat to this species, especially along trails and on disjunct summits where recreationists leave the trail to access more open views.
2. *Global warming, acid deposition*, and *hydrological changes* may be threats (SVE Alpine Plant Panel 2002).
3. *Air pollution* may threaten alpine species (Ketchledge and Leonard 1984, Zika 1993).
4. *Winter camping* (i.e. digging snow caves) and other recreational uses in the late winter/spring may cause impacts to the snowbank/wet meadow/streamside community (SVE Alpine Plant Panel 2002).

The most limiting factors of concern on the WMNF are:

a. Trampling

b. Recreation use in winter/spring

Global warming, acid deposition, and air pollution are outside Forest Service control.

Information Gaps

The following information gaps were identified by the SVE Alpine Plant Panel (2002):

1) Determine the extent and abundance of this species.
2) Determine disturbance dynamics of the dry/mesic heath meadow system
3) Information is needed on the dry/mesic heath meadow system on lower elevation peaks, especially related to recreation use.
4) Determine effects of winter camping and other late winter/spring recreational uses.

Pertinent Resource Actions and Mitigation

No standards and guidelines specific to arnica are proposed, although Forest-wide direction related to protection of alpine communities would be provided in all alternatives.

Affected Environment

The area of effects analysis for boreal blueberry is the WMNF proclamation boundary plus Franconia Notch, Crawford Notch, and Mt. Washington State Parks, which encompasses almost the entire alpine zone in New Hampshire. No alpine habitat exists in western Maine.

Habitat Trend

Habitat in the alpine zone has been reduced over time by hiker traffic, although this threat is considered greater outside of the Presidential Range.

Population Trend

This species appears to be expanding, but this may be because previously confusing taxonomy has been clarified and the plant is being identified in more places (SVE Alpine Plant Panel 2002).

Environmental Effects

All alternatives

Effects of all alternatives would be similar to those described above for arnica (*Arnica lanceolata*).

Cumulative effects of all alternatives

Cumulative effects would be similar to those described for arnica (*Arnica lanceolata*) above.

Determination — Boreal blueberry

Implementation of any alternative **may impact individuals but would not likely cause a trend towards federal listing or a loss of viability**.

Rationale Summary

Mitigation to protect alpine plants and increase public education/awareness of rare alpine communities should reduce potential impacts in all alternatives. Although recreation use is expected to increase, implementation of Forest Plan standards and guidelines would keep the majority of the use on existing trails. Not every scenario can be anticipated, but many alpine species have persisted for years with heavy hiker traffic and little or no protection, so it is unlikely that a significant decline would occur during the next 15 years.

Chapter 4 — Regional Forester Sensitive Species (Animals)

White Mountain fritillary (*Boloria montinus montina*)

Current taxonomy of this species is somewhat disputed. McFarland (2003) indicates it should probably be called *Boloria titania montinus*, although it is still listed as *Boloria montinus montina* on the Regional Forester's sensitive species list.

Distribution

The White Mountain fritillary is endemic to the alpine zone of the White Mountains in New Hampshire (McFarland 2003).

Life History

Reproduction

First-instar larvae hibernate during their first winter and complete development the following summer (Opler and Krizek 1984, Seidl 2002). No obligate larval host plants are known, although possible species include willows (*Salix* spp.), alpine smartweed, alpine marsh violet (*Viola palustris*), *Viola adunca*, and *Vaccinium* spp. Adults fly from mid-July to early August (McFarland 2003). Males patrol for females during warmer daylight hours. Eggs are laid on the underside of vegetation in mid-summer (Opler and Krizek 1984).

Foraging

Although no obligate host plants have been located, other *Boloria montinus* taxa feed on plants from the Polygonaceae, Salicaceae, Ericaceae, and Violaceae families (Seidl 2002). Several species of *Salix*, *Viola*, and *Vaccinium* occur in the WMNF's alpine zone and any or all could serve as possible host plants. Adults feed on nectar from goldenrods and possibly aster species and McFarland (2003) notes that "a map of Alpine Goldenrod would probably overlap exactly with occurrences of adult *B.t. montinus* because of the species' intense affinity for nectaring this plant."

Habitat

In general, the White Mountain fritillary's habitat may be characterized as a narrow zone from the end of treeline to the beginning of the alpine. The subspecies is found in alpine/subalpine meadows near the lower boundary of the alpine zone and into valleys of the subalpine zone, often near mountain streams (Fiske 1901; Opler and Krizek 1984; USGS 2001). McFarland (2003) notes it is restricted to wet meadows, wet springs, and streamside alpine communities above 1220 meters elevation. This is most likely heath-shrub-rush, cushion-tussock, herbaceous snowbank, and streamside alpine and subalpine plant communities.

Occurrences

Fourteen historic and six extant occurrences are known from Mt. Washington. Historic occurrences date from 1870 to 1980 (McFarland 2003). In addition, occurrences are known from Mt. Jefferson, Mt. Adams, and Mt. Madison (D. Chandler, pers. comm.).

Threats/Limiting Factors

Identified threats for this subspecies include the following:

1. *Climate change* may be the most important limiting factor if global warming reduces or eliminates suitable habitat (McFarland 2003, SVE Lepidoptera Panel 2002)
2. *Atmospheric deposition* may also be a potential threat (McFarland 2003, SVE Lepidoptera Panel 2002)
3. *Trails and other recreation facilities* in the alpine zone likely impact just over two percent of the potentially suitable habitat (McFarland 2003). Activity at mile 5 of the Auto Road is especially of concern (SVE Lepidoptera Panel 2002).
4. *Overcollection* for research or personal use (SVE Lepidoptera Panel 2002).
5. *Increasing solar UV-B light levels* caused by depletion of the ozone layer may indirectly affect butterflies and other lepidoptera through changes in toxic chemical properties of host plants (McFarland 2003).

The most limiting factors of concern under WMNF control are:

a. Hiker trampling and construction of additional recreational facilities.

b. Overcollection (through authorizing research permits)

Climate change, atmospheric deposition, and increasing solar UV-B light levels are outside Forest Service control.

Information Gaps

The SVE Lepidoptera Panel (2002) identified the following information gaps:

1. Identification of host plants
2. Additional research is needed to determine whether this taxon is a distinct species or a subspecies
3. Determination of population trend
4. Determination of population structure

Pertinent Resource Actions and Mitigation

There are no standards or guidelines specific to White Mountain fritillary, but standards and guidelines to protect alpine and subalpine vegetation would benefit this species.

Affected Environment

The scope of effects analysis for this subspecies is the WMNF alpine zone, since the subspecies is restricted to this habitat.

Habitat Trend

McFarland (2003) notes that just over two percent of suitable habitat for this subspecies has been reduced through construction of recreational infrastructure. However, it is assumed that in the last decade, habitat has remained relatively stable, since little additional construction has occurred.

Population Trend

Since the species has been present in the White Mountains for many decades, it is assumed to be reproducing, although whether or not the population is increasing or decreasing is unknown. It has seemed to persist in small numbers throughout the last two centuries (summarized by McFarland 2003).

Environmental Effects

Alternative 1

Under Alternative 1, the White Mountain fritillary would continue to persist as habitat conditions would remain stable over the planning period. Recreation activity will likely increase, but should not alter habitat conditions significantly. No new trails or facilities would be added in the alpine zone, so habitat impacts would be based on current infrastructure. Greater recognition of the alpine zone's unique features should also help protect endemic species. Having persisted at low population levels for some time, it is not expected that the White Mountain fritillary would experience measurable negative effects under Alternative 1.

Cumulative effects of Alternative 1

The most significant threat to this species is probably global warming, since it has the potential to greatly alter precipitation and subsequently vegetation. Many alpine species already survive in a narrow window of habitat suitability and may not easily adapt to changes that would occur relatively rapidly. Whether or not the White Mountain fritillary could persist in the face of such change is unknown, although it is unlikely that global warming would change habitats so radically over the next planning period that this species would be extirpated.

Alternative 2

Effects of Alternative 2 would be effectively the same as those in Alternative 1. The only difference is that the alpine zone would be identified as a separate management area in Alternative 2. However, all of the standards and guidelines would be applied to both alternatives, so the on-the-ground effects would be the same.

Cumulative effects of Alternative 2

Cumulative effects of Alternative 2 would be the same as those described in Alternative 1.

Alternative 3

Effects of Alternative 3 would be effectively the same as those in Alternative 2.

Cumulative effects of Alternative 3

Cumulative effects of Alternative 3 would be the same as those described in Alternative 1.

Alternative 4

Effects of Alternative 4 would be the same as in Alternative 1. Although facilities may be increased to meet demand in this alternative, they are unlikely to occur in the alpine zone because of the need to protect many rare resources here.

Cumulative effects of Alternative 4

Cumulative effects of Alternative 4 would be the same as those described in Alternative 1.

Determination — White Mountain fritillary

For all alternatives, actions **may impact individuals, but would not likely cause a trend towards federal listing or loss of viability**.

Rationale Summary

1. Habitat has remained stable for this species and should be maintained in the future.
2. The population appears to have persisted throughout the last 200 years; although future use may increase in the alpine/subalpine zone, it is not expected to impact habitats to the point where wildlife species should be measurably affected.
3. Global warming may be the biggest factor in determining the persistence of the White Mountain fritillary and other alpine species, but this is outside Forest Service control.

White Mountain butterfly (*Oeneis melissa semidea*)

Current nomenclature of this species uses the common name White Mountain Arctic, although it is still listed as White Mountain butterfly on the Regional Forester's sensitive species list.

Distribution

As its name suggests, the White Mountain butterfly is endemic to the alpine zone of New Hampshire's White Mountains (Fiske 1901, USGS 2001).

Life History

Reproduction

White Mountain butterflies pass their first winter as an instar and the second winter as mature larvae (USGS 2001, McFarland 2003). It is assumed that the earliest breeding occurs would be the third summer. They produce one generation of young per year (USGS 2001, McFarland 2003). Males use rock piles for 'hill topping' where they wait for females to fly by then initiate pursuit (USGS 2001, SVE Insect Panel 2002). Eggs are laid on sedges (*Carex bigelowii*) or on the ground around them (McFarland 2003, Opler and Krizek 1984).

Adults fly from mid-June to late July (Opler and Krizek 1984); known flight dates are June 27-July 22 (McFarland 2003).

Habitat

This subspecies appears to be restricted to the alpine zone of the Presidential Range in the White Mountains, although there is some potential for it to occur elsewhere in the White Mountains where alpine habitats exist. It is locally abundant in sedge meadows, usually above 1500 meters elevation, with few found in between sedge patches (McFarland 2003). Habitat is generally rocky (SVE Lepidoptera Panel 2002). The White Mountain butterfly has only one known host plant, Bigelow's sedge (*Carex bigelowii*), which is identified as a component of four subdivisions of the more broadly defined dwarf shrub/sedge-rush meadows community in New Hampshire: (1) Alpine heath snowbank; (2) Bigelow's sedge meadow; (3) Sedge-rush-heath meadow; and (4) Dwarf shrub-bilberry-rush barren (Sperduto and Cogbill 1999). Bigelow's sedge is also documented from rocky ledges, which implies rock outcrops and talus in the alpine may be used. Of the 107 peaks in the White Mountains, the alpine-heath-snowbank community and sedge-rush-heath meadow community are found on ten peaks each (primarily the Presidentials, including Mt. Washington, and the Franconia Range). The Bigelow's sedge meadow community is found on five peaks in the Presidentials. The dwarf shrub-bilberry-rush barren is present on found on 24 peaks, scattered throughout the alpine zone (Sperduto and Cogbill 1999).

Occurrences

McFarland (2003) documents six historic records on Mt. Jefferson, 51 historic records on Mt. Washington, four extant occurrences on Mt. Washington, and one extant record on Mt. Adams. Some of these may occur on other lands, e.g., Mt Washington State Park, but all are within the WMNF proclamation boundary.

Threats/Limiting Factors

Threats to this subspecies include the following:

1. *Climate change* is considered the most important limiting factor if global warming results in a reduction of habitat (McFarland 2003, SVE Lepidoptera Panel 2002).

2. *Atmospheric deposition* is a potential concern (McFarland 2003, SVE Lepidoptera Panel 2002).
3. *Overcollection* of the subspecies for research or personal use is a potential concern (SVE Lepidoptera Panel 2002), although McFarland (2003) indicates significant collecting in the past does not seem to have harmed populations over the long term.
4. *Trampling* has degraded extensive *Carex* meadows, including patches of *C. bigelowii*. These species appear to recover once the disturbance is removed (SVE Alpine Plant Panel 2002).
5. *Increasing solar UV-B light levels* caused by depletion of the ozone layer may indirectly affect butterflies and other lepidoptera through changes in toxic chemical properties of host plants (McFarland 2003).

The most limiting factors of concern under WMNF control are:

a) Trampling (hiker traffic) in the alpine zone

b) Overcollection

Climate change, atmospheric deposition, and increasing solar UV-B light levels are outside Forest Service control.

Information Gaps

The SVE Lepidoptera Panel (2002) identified the following limiting factors:

1. Additional taxonomy work to determine whether the White Mountain butterfly should be classified as a distinct species or a subspecies.
2. Accurate population trends.
3. Population structure characteristics.

Pertinent Resource Actions and Mitigation

There are no standards or guidelines specific to White Mountain butterfly, although standards and guidelines to protect alpine and subalpine vegetation would benefit this species.

Affected Environment

The scope of effects analysis for the White Mountain butterfly is the WMNF alpine zone, since the subspecies is restricted to this area.

Habitat Trend

Habitat was likely reduced when hiking trails, the Appalachian Mountain Club huts, the Cog Railway, and the Auto Road were constructed. Off-trail hiking may have also had some negative impacts, although it is unlikely that it would have resulted in much permanent habitat reduction. In the last fifteen years, little construction has occurred and the habitat has likely remained relatively stable.

Population Trend

The population trend for this species is somewhat unclear because the species has a tendency to be abundant in very small patches that may be overlooked when monitoring large areas. Reports from the 1800s indicate the species was "exceedingly abundant", "abundant", and "very abundant" at various times during the century (Scudder (1889), Oakes (1826), Morrison (1874) summarized by McFarland (2003)). Later reports in the 20th century also point to similar relative abundance: "great numbers" "relatively large numbers" (Anthony (1970) and Pavulaan (1984) summarized by McFarland (2003)), although sometimes extensive searches in the same locations result in very few or no individuals seen (McFarland 2003).

Environmental Effects

Effects for all alternatives would be the same as described for the White Mountain fritillary above.

Determination — White Mountain butterfly

Under all alternatives, actions **may impact individuals, but would not likely cause a trend towards federal listing or loss of viability**.

Rationale Summary

See White Mountain fritillary above.

Wood turtle (*Clemmys insculpta*)

Current taxonomy for this species is now *Glyptemys insculpta*, although it is still listed as *Clemmys insculpta* on the Regional Forester's sensitive species list.

Distribution

The wood turtle is distributed throughout the northeastern U.S. (including all of the New England states) in New York, south through Pennsylvania, New Jersey, Maryland, and northern Virginia and West Virginia; in the upper Midwest including Michigan, Wisconsin, eastern Minnesota, and northern Iowa; and in southeastern Canada (including New Brunswick, Nova Scotia, Quebec, and Ontario) (Klemens 1993, Ernst et al., 1994).

Northern New England is central to the wood turtle's North American range. Habitat for the wood turtle is probably not ideal on a large portion of the WMNF due to elevation and steepness of waterways in headwater areas. However, some streams and rivers in the lower parts of drainages on the Forest may be in appropriate habitat (SVE Amphibian and Reptile Panel 2002). Most records are south of the Forest, however, one occurrence was reported as far north as Pittsburg.

Life History

Reproduction

Age at sexual maturity varies geographically, often with delays at northern latitudes. Sexual maturation was estimated at fourteen years in New Jersey (Farrell and Graham 1991) and 17-18 years in Ontario (Brooks et al., 1992). Because rates of nest predation can be extremely high in some areas, turtles rely on high adult survival rates so that nests can be produced over many years (Arvisais et al., 2002). There is no evidence of multiple clutches within a year, and there is some uncertainty whether mature female wood turtles reproduce every year (Ross et al., 1991, SVE Amphibian and Reptile Panel 2002). Clutch size varies from 5-12 eggs (Hunter et al., 1999) In New Hampshire, the mean was eight with a range of six to nine eggs (Tuttle and Carroll 1997).

Breeding occurs primarily in the spring and fall (Farrell and Graham 1991, Klemens 1993), but may occur in the middle of summer (July) (Parren 2001). The breeding season is shorter in colder areas where turtles remain in hibernation for longer periods (Harding and Bloomer 1979).

Nests are excavated in sandy-gravelly soil from mid-May through July (Klemens 1993), often near water. In New Hampshire, nest sites were located in sandpits 60 meters (197 ft) on average from a brook (Tuttle and Carroll 1997). Incubation period varies with changing environmental factors such as temperature; ranges from 48 to 71 days have been observed (Harding and Bloomer 1979). Gender of hatchling turtles is genetically determined, unlike most other species of turtles which are determined by incubation temperatures (Taylor 1993). Hatchlings emerge from the nest chamber between mid-August and early October (Ernst et al., 1994). Oliver and Bailey (1939) presumed hatching occurred in September. No evidence exists for hatchlings overwintering in nests.

Nesting success is generally very low from predation and cool summer temperatures (at northern latitudes) (Brooks et al., 1992). Harding (1990) estimated egg and hatchling mortality to be at least 98 percent. Although little is known about juvenile wood turtles, they seem to use mostly aquatic habitats in Michigan and New Jersey (Harding and Bloomer 1979).

To compensate for high nestling mortality, wood turtles have long life spans. A wild-caught female wood turtle in Pennsylvania was at least 46 years old (Ernst 2001) and wood turtles have lived to 58 years in captivity (Oliver 1955 cited in Harding and Bloomer 1979).

Dispersal

Wood turtles are frequently found within 300 meters of aquatic habitats, but may move large distances from water in search of nest sites. Parren (2001) observed a wood turtle 427 meters (1400 ft) from a stream in Vermont; in Pennsylvania, some females traveled 900-1000 meters (2,952-3,281 ft) while in search of nest sites (Ernst 2001), and in Minnesota, female wood turtles traveled up to 6.9 km (4.3 mi) in search of nesting sites (Buech et al., 1997b). These nesting excursions occurred during May-July. This

contradicts a Michigan study that showed over 95 percent of individuals were recaptured within 305 meters (1000 feet) of their original capture point (Harding and Bloomer 1979). Wood turtles displayed homing ability when intentionally displaced within 2 km of their home ranges (Carroll and Ehrenfeld 1987).

Home ranges are often elongated due to predominant use near streams (Strang 1983). The longest axes of home ranges were 507 meters (1,663 ft) in Quebec (Daigle 1997), 478 meters (1,568 ft) in New York (Barzilay 1980 cited in Daigle 1997), and 447 meters (1,467 ft) (Strang 1983) and 463 meters (1,519 ft) (Kaufmann 1995) in Pennsylvania. Wood turtles at the northern edge of the range had larger home ranges (e.g., 28.3 ha/69.9 ac in Quebec; Arvisais et al., 2002) than in more southern locations (3.3 ha/8.15 ac in Pennsylvania; Kaufmann 1995). Arvisais et al. (2002) hypothesize that home range size increases with increasing latitude. Home ranges in New Hampshire were 5.8 ha/14.3 ac (males) and 3.9 ha/ 9.6 ac (females) (Tuttle and Carroll 1997).

Relationships with Other Species

Wood turtles are opportunistic omnivores and will eat a wide variety of vegetation, including grasses, leaves, and berries, as well as mushrooms, mollusks, insects, slugs, earthworms, tadpoles, dead fish, and newborn mice (Oliver and Bailey 1939, Harding and Bloomer 1979, Strang 1983, Ernst et al., 1994, Compton et al., 2002).

Wood turtles are not primary prey for any species, but eggs may be preyed upon by skunks, raccoons, coyotes, feral cats, and dogs (Harding and Bloomer 1979). Juvenile turtles are vulnerable to the above predators, in addition to snapping turtles, some birds, and large fish (Harding and Bloomer 1979). Raccoons and skunks may prey on adults (Farrell and Graham 1991, Brooks et al., 1992).

Habitat

Wood turtles use a variety of aquatic and terrestrial habitats that may vary geographically, as well as among individuals (Kaufmann 1992, Compton et al., 2002). Throughout their range, wood turtles spend the winter hibernating in slow-moving streams, rivers, and some ponds, although no evidence of lakeshore use is known. Sites frequently used for hibernation include undercut banks, muskrat burrows, root masses along stream edges, and submerged logs. In the spring (March-April), turtles emerge from aquatic wintering areas. Breeding occurs in shallow streams. In early summer (May-July), females search for a site with open canopy and sandy or gravelly substrate in which to excavate their nest. Nest sites were selected near water, but also elevated at least one meter above the normal water level, very sandy, bare of vegetation, and exposed to solar radiation (Buech et al., 1997a). In addition to natural nesting sites such as sandbars, cut banks, or other eroded features, manmade sites such as gravel pits, railroad beds, and road grades have also been used (Brooks et al., 1992, Buech et al., 1997a).

Summer habitat use varies geographically. In the Midwestern states, wood turtles tend to be largely aquatic, whereas in the eastern portion of the range, wood turtles spend considerable time in upland habitats (Harding and Bloomer 1979, Ernst 1986, Kaufmann 1992, Compton et al., 2002, D. Carroll pers. comm.). Although usually in close proximity to permanent streams, other habitats used during this time include bogs, wet meadows, upland fields, farmland, and deciduous forests (Harding and Bloomer 1979, DeGraaf and Yamasaki 2001). In fall (October-November), turtles return to the aquatic environment to overwinter.

In Maine, wood turtles were found near streams and rivers that had moderate forest cover. Within activity areas, wood turtles selected sites that were near water, non-forested, and with low canopy cover (Compton et al., 2002). Compton et al. (2002) attributed this difference in selection at the two spatial scales to a preference for forest edges, where basking and feeding opportunities were abundant. In cooler climates, open areas for basking are important. Dense riparian forbs and shrubs provide important cover.

Wood turtles may be found in forest interiors, but it is not preferred habitat. The use of forest habitats with a limited understory often is limited to travel between preferred habitats. Alder, silky dogwood, and arrowwood are good cover plants along riparian areas and other edges. A mixture of herbs and grasses (e.g., meadowsweet, goldenrod), shrubs (e.g., silky dogwood), and vines (e.g., woodbine, grape) reduce detection from humans and other predators and provides an abundance of food for the turtles (D. Carroll, pers. comm.).

Human disturbance can influence wood turtle success. Wood turtles are moderately tolerant of some types of habitat alteration such as timber harvesting (Kaufmann 1992), but intense development and high recreational use can have devastating effects on a population. Two wood turtle populations in Connecticut were extirpated following an increase in recreational activity (Garber and Burger 1995).

Oliver and Bailey (1939) reported an altitudinal range of 43 to 352 meters (140 to 1155 ft) for wood turtles. The SVE Amphibian and Reptile Panel (2002) supported this, suggesting that wood turtles probably don't occur above 2,000 feet. It is likely that turtles are not reacting to elevation so much as the lack of slow, deep streams that are more prevalent at lower elevations (Klemens 1993).

Occurrences

Wood turtles are known from 86 extant and 13 historic occurrences in New Hampshire, 110 extant and 13 historic occurrences in Maine, and 80 extant and 10 historic occurrences in Vermont (Kanter et al., 2001, Hunter et al., 1999, MDIFW 2002, J. Andrew, pers. comm.). Only four occurrences (Rumney, Stark, Thornton, and Wentworth, NH) are known from within the WMNF proclamation boundary, although population sizes are unknown. The number of historic occurrences within the Forest is unknown.

Threats/Limiting Factors

The following threats have been identified for wood turtle:

1. *Habitat loss, degradation*, and *fragmentation* (Klemens 1989, Burger and Garber 1995). In southern New Hampshire and other parts of New England, rapid development and increases in human populations are leading to losses of suitable habitat (Vogelmann 1995, Tuttle and Carroll 1997).
2. *Road construction* causes habitat loss and degradation, increased contact with humans, and direct mortality of both young and adult wood turtles (Brooks et al., 1992).
3. *Stream alteration* (e.g., stabilization, channelization, and dam construction) can adversely affect populations (Buech et al., 1997a). Turtles hibernating in the undercut banks of streams can freeze when water discharge is stopped (SVE Amphibian and Reptile Panel 2002).
4. *Succession* may be a threat if the disturbance regime is inadequate, usually because anthropogenic disturbances alter the natural disturbance regime (e.g., natural flooding).
5. *Human activity*, such as trail construction/use and trout stocking, make local populations vulnerable to extirpations (D. Carroll pers. comm.). Garber and Burger (
6. (1995 *In* Bowen and Gillingham 2003) found the average age of a Connecticut population increased significantly upon the opening of suitable habitat to recreation activity and that the population was extirpated within ten years.
7. *Human development* can lead to an increase in generalist predators, such as raccoons and skunks, which are often responsible for high rates of nest mortality (Oehler and Litvaitis 1996, Brooks et al., 1992, Burger and Garber 1995). Some researchers consider egg predation the greatest threat (Brooks et al., 1992).
8. *Collection*, especially where development pressure is not great.
9. Hatchlings are vulnerable to *predation* and *road mortality* while traveling from nest sites to aquatic habitats.

The most limiting factors of concern under WMNF control are:

a. Human activity near potential wood turtle habitats
b. Road construction
c. Collection
d. Stream alteration
e. Loss of habitat, especially nest sites or terrestrial basking areas.

Information Gaps

The following were identified by the SVE Amphibian and Reptile Panel (2002):

1. Habitat use and dispersal of juvenile wood turtles
2. Occurrences, abundance, and population trends, especially in the WMNF

Pertinent Resource Actions and Mitigation

There is no direction specific to wood turtles proposed in any alternative, although Riparian and Aquatic Habitats standards and guidelines would help protect some habitats.

Affected Environment

The scope of effects analysis for wood turtle is the HUC5 subwatersheds that encompass the WMNF, with some changes to exclude some areas unlikely to be affected by Forest activities (Map G-01).

Habitat Trend

Overall, urbanization and agricultural activities have resulted in habitat loss and degradation (SVE Amphibian and Reptile Panel 2002). The Forest tends to be predominantly rocky and sandy; open nesting habitat is naturally limited. Also, wood turtles are only found along slow-moving water, which is also more prevalent in watershed valley areas off the Forest.

Population Trend

In 1939, Oliver and Bailey reported "In New Hampshire the wood turtle appears to be second only to the painted turtle in abundance." Wood turtles are considered to be in decline throughout their range (reviewed by NatureServe 2001b). Wood turtle populations were dramatically reduced and fragmented due to collection for the food and pet industry (Harding and Bloomer 1979). Low recruitment has played a role in population declines (Klemens 1989) and the SVE Amphibian and Reptile Panel (2002) believes lack of juvenile recruitment is a critical problem for this species' recovery.

Environmental Effects

Alternative 1

Under Alternative 1, wood turtle nesting habitat could be created either directly or indirectly as a result of vegetation management activities, e.g., creating/maintaining openings on sandy soils near suitable streams. Additional road construction may occur to some extent to support the amount of vegetation management proposed, but whether or not locations would be suitable is unknown. Stream alteration activities are probably limited in terms of effects to wood turtle because stream projects generally are not located in wood turtle habitat.

Campgrounds and dispersed campsites in wood turtle habitat likely result in campers removing wood (potential basking sites) from nearby streams. Additional mitigation to protect the riparian zone could improve wood

turtle habitat, although the species' use of artificial structures (roadbanks, railroad grades, etc.) near water is noticeable. Given the limited habitat on the Forest and the focused area where this activity occurs, it is unlikely that any negative effects to wood turtle habitat would result. Collection pressure around the WMNF is unknown, but would be assumed to continue at current levels, regardless of alternative.

Recreation use would increase under all alternatives. Riparian and Aquatic Habitats standards and guidelines would mitigate trail construction near wood turtle activity areas, but more use on the Forest would make it more likely that human activity could conflict with wood turtles. This would be the same in all alternatives.

Cumulative effects of Alternative 1

Based on number of occurrences in each state, the WMNF clearly does not support a significant proportion of the regional population. This is more a function of the natural difference in habitats between the mountainous White Mountain region and the flatter, wider valleys off-Forest. Within the analysis area, wood turtles are likely more abundant offForest where the larger rivers slow and spread as they reach lower elevations. Unfortunately, valleys tend to be developed before mountainous areas and development on private lands will likely continue its increasing trend. State Best Management Practices can help mitigate loss of riparian habitats during development, but some suitable habitat will likely be lost in the future, especially since wood turtles spend much of their time some distance beyond the immediate stream channel. This probably won't change the role of the WMNF in supporting regional populations, simply because the Forest would still have such limited habitat compared to surrounding areas. The WMNF may eventually become a refugium of protected habitat, but it will be so naturally limited that the continued persistence of wood turtles is questionable over the next century.

Alternative 2

Under Alternative 2, timber harvest and supporting road construction would be reduced from Alternative 1 levels, although the magnitude of the difference isn't so great that any difference in effects to wood turtles could be measured. Other activities would result in effects comparable to Alternative 1. Again, though, the magnitude of change between the two alternatives is so minimal that effects to wood turtles could not be measured.

Cumulative effects of Alternative 2

Cumulative effects would be the same as those described for Alternative 1.

Alternative 3

Effects of Alternative 3 would be the same as those described for Alternative 2.

Cumulative effects of Alternative 3

Cumulative effects would be the same as those described for Alternative 1.

Alternative 4

Alternative 4 would have the same effects as those described for Alternative 2.

Cumulative effect of Alternative 4

Cumulative effects would be the same as those described for Alternative 1.

Determination — Wood turtle

Implementation of any alternative **may impact individuals but would not likely cause a trend towards federal listing or a loss of viability.**

Rationale Summary

1. There are few wood turtles known from the Forest and few areas of suitable habitat. Mitigation to protect riparian habitats would be implemented in all alternatives and pre-project surveys would be conducted to identify potential upland habitat. Project mitigation such as seasonal harvest restrictions would then help to limit impacts to wood turtles, so the likelihood of affecting an individual wood turtle is small.

Timber rattlesnake (*Crotalus horridus*)

This species is considered extirpated from the Forest.

Distribution

The timber rattlesnake has a fairly extensive range in the eastern U.S., but actual occurrences are spotty. Total range includes: Central New England to northern Florida, west to eastern Texas, central Oklahoma, eastern Kansas, southeastern Nebraska, southern and eastern Iowa, and southeastern Minnesota. Sizeable populations remain in the Appalachian Mountains from Pennsylvania through the Virginias, across eastern Kentucky and Tennessee to northeastern Alabama, in the Ouchita and Boston mountains of Arkansas and extreme eastern Oklahoma, in heavily wooded sections of the southeastern Coastal Plain from North Carolina to northeastern Florida and west to Louisiana and southern Arkansas, and in the Piedmont in central North Carolina and Pine Mountain of west-central Georgia (Martin in Tyning 1992).

Life History

Reproduction

Age at sexual maturity varies geographically, often with later ages at northern latitudes (Brown 1992 cited in Aldridge and Brown 1995). In Pennsylvania, the smallest female to reach sexual maturity was estimated to be 5 years old (Galligan and Dunson 1979), while in northeastern New York, sexual maturity was attained in 4-6 years in males (Aldridge and Brown 1995) and in 7-11 years for females (Brown 1991). Further south in the Appalachian Mountains, age of sexual maturity averaged 7.8 years (range 5-11 years, Martin 1993).

Frequency of reproductive events is also restricted, particularly in northern areas. Reproductive cycles were apparently biennial in Wisconsin (Keenlyne 1978) and Kansas (Fitch 1985), but females reproduced closer to every three years (or greater) in northern New York (Brown 1991). Females are slow to recover body mass following reproduction events (Brown 1991), so the more infrequent reproduction in northern climates may result from the difficulty in meeting energy requirements during a short activity season (Galligan and Dunson 1979). Timber rattlesnakes in New York were active for only 4.6 months (from early May through September) and in hibernation for 7.4 months (Brown 1991).

Clutch size varies geographically; northern populations often produce smaller numbers of young. Average size in Pennsylvania was 7 young (Galligan and Dunson 1979) and 9.3 (range 4-14) in northeastern New York (Fitch 1985).

In northern regions, breeding occurs primarily in mid-summer to early fall (Martin 1993, Aldridge and Brown 1995). Females store sperm until gestation begins the following spring (Carlton and Weisburd 1991). Pregnant females are relatively sedentary, remaining near protected sites (Brown et al., 1982).

Juvenile mortality rates are unknown, but are assumed to be high, since a number of mammalian and avian predators coexist in the same habitats.

Lifespan for adults is probably 20-25 years at the most in New York (Brown 1991), although captive specimens have lived to 36 years (Cavanaugh 1994).

Dispersal

Timber rattlesnakes move from spring breeding sites to communal winter hibernation sites and back again. Gravid females move shorter distances than males and non-gravid females (Reinert and Zappalorti 1988). Females moved an average of 280 meters (919 ft) from den sites and one male traveled 1400 m (4,593 ft) (Brown et al., 1982), although movements as large as 7.2 km (4.5 miles) have been recorded from den sites (Brown in Tyning 1992). The same migratory route may be taken while traveling to and from den sites (Brown et al., 1982).

Males tend to have larger activity areas than females (Reinert and Zappalorti 1988). Mean home range size varies from 65 to 202 hectares (160 to 500 ac) for males and 138 to 328 hectares (42 to 100 ac) for non-gravid females (Brown in Tyning 1992). Gravid females in the Appalachian Mountains usually remained within 500 m (1,640 ft) of winter dens (Martin 1993).

In order for a population to be recovered, Martin (in Tyning 1992) estimated that a minimum of 30 to 40 adults and 4 to 5 adult females would be required. Given the late age of maturity and slow rate of reproduction, recovery likely would take many years.

Relationships with Other Species

Timber rattlesnakes will den communally with other snake species (Conant and Collins 1998, Hunter et al., 1999), including black racers (*Coluber constrictor*), northern copperheads (*Agkistrodon contortrix*), rat snakes

(*Elaphe obsoleta*), and garter snakes (*Thamnophis sirtalis*) (Galligan and Dunson 1979).

Timber rattlesnakes feed primarily on warm-blooded prey, especially small mammals (Reinert et al., 1984).

Habitat

Petersen and Fritsch (1986) describe habitat in the northeast as mountainous terrain characterized by steep ledges and rock slides. Den sites are usually rocky and may occur within fissures or crevices in a ledge, talus below cliffs, and open scree (Galligan and Dunson 1979, Martin 1993). However, vegetation immediately surrounding the den site may be brushy. In Connecticut, mountain laurel (*Kalmia latifolia*), blueberry (*Vaccinium* spp.) and huckleberry (*Gaylussacia baccata*) are characteristic around a known den site (Petersen and Fritsch 1986). In New York, den sites were surrounded by grassy clearings and woodlands of red oak (*Quercus rubra*), shagbark-hickory (*Carya ovata*), and hophornbeam (*Ostrya virginiana*) (Brown 1991).

After emerging from den sites in the spring, snakes move to open rocky outcrops to bask (Bushar et al., 1998) before dispersing to summer habitats, although females will spend most of their time basking on exposed rocks (Martin 1993).

Summer habitat for males and non-gravid females is deciduous and mixed forests, sometimes several miles from den sites. Wright and Wright (1957) reported that oak, oak-pine, or oak-laurel-poplar-chestnut hills were preferred, but that berry patches, brambles, and second-growth clearings may also be used.

Suitable elevations in northern New England are probably range from 400 to 1,200 feet (SVE Amphibian and Reptile Panel 2002).

Occurrences

There are 3 historic occurrences in Maine, 1 extant and 5 historic occurrences in New Hampshire, and 11 extant and 12 historic occurrences in Vermont (MDIFW 2002, Oliver and Bailey 1939, SVE Amphibian and Reptile Panel 2002, VNNHP 2001, Carlton and Weisburd 1991, DesMeules in Tyning 1992). The species is considered extirpated from the WMNF, but was historically known from Albany Township, Maine (1863) and New Hampshire towns of Jackson, Bartlett, and Conway (Oliver and Bailey 1939, Taylor and Soha in Tyning 1992).

Threats/Limiting Factors

The following threats have been identified for timber rattlesnake:

1. *Habitat loss, degradation*, and *fragmentation* can reduce success. Logging and human developments are the most common causes.
2. *Direct mortality from motorized vehicles* in the summer. Males are especially susceptible between July and September.
3. *Human persecution* is a large threat. In addition to direct mortality,

collection or hunting can cause significant impacts since timber rattlesnakes den communally.

4. *Increasing generalist predators* (e.g., raccoons, foxes) that have responded to an abundance of human-related food sources (e.g., crops and garbage) (Oehler and Litvaitis 1996) could cause additional predation risk.

The most limiting factors of concern under WMNF control are:

a. Timber harvest levels

b. Recreational development, which also could indirectly lead to direct mortality

c. Road or summer motorized trail construction

Information Gaps

The SVE Amphibian and Reptile Panel (2002) did not identify any specific information gaps other than to validate whether or not the species still exists on the WMNF.

Pertinent Resource Actions and Mitigation

No standards or guidelines are proposed specific to timber rattlesnake.

Affected Environment

The scope of effects analysis for timber rattlesnake is the WMNF proclamation boundary (see Figure 4). This species does not disperse a great distance and populations outside the Forest are considered isolated.

Habitat Trend

South-facing rocky habitats with open canopies are naturally limited in northern New England, but are probably not declining or rare. However, timber rattlesnakes are extremely vulnerable to human disturbance (Carlton and Weisburd 1991) and areas of limited human disturbance are declining.

Population Trend

Having been extirpated from the Forest, clearly this species has suffered a population decline. It is considered to be declining throughout the northeast (Stechert in Tyning 1992).

Environmental Effects

Alternative 1

Alternative 1 proposes the second most acres of total timber harvest, the most amount of even-aged regeneration harvest (which has the most likelihood of causing significant habitat changes), and the second highest amount of road construction to accompany harvest. Since timber rattlesnakes are extirpated, there would be no direct effects, although changes to habitat could occur. At the Forest scale, it would not appear

that the amount of timber harvest would cause measurable negative impacts to this species. Timber sales generally avoid rocky habitats and since so much of the Forest has closed canopied stands, prescriptions that opened the canopy could improve habitat conditions. Increasing the amount of even-aged regeneration harvests over current conditions could also increase prey populations by creating better small mammal habitat.

Roads managed by the Forest Service would not likely change much over the planning period. Although traffic levels may increase as recreation use increases, the magnitude of this is unknown and consequently, the risk of direct mortality from motorized vehicles is also unknown. It would seem, though, that in most cases, a timber rattlesnake trying to disperse to the WMNF would have to cross at least one major road. Increasing traffic levels may make this more difficult.

Motorized summer trail use would be on a case by case basis up to about 60 miles, which is the same as the current Forest Plan. Determining the effects is difficult without knowing the specifics of a proposed location, but it is unlikely that a trail would occur in rocky habitats preferred by timber rattlesnakes for winter denning. Given that rattlesnakes do not disperse very far from their den sites, it may be unlikely that a proposed trail would cross suitable habitat. However, any proposed trail would likely be in the lower elevations rather than up high, so it would almost assuredly fall in the same elevational range as the snake's habitat.

Cumulative effects of Alternative 1

Because the WMNF population of timber rattlesnakes is extirpated, the Forest is dependent on nearby populations to provide dispersers. However, reaching the Forest will become more and more difficult as time goes by. Right now a snake would have a difficult time successfully crossing a major highway such as I-93 because of the heavy summer traffic levels. Other perimeter Forest roads and highways are also being proposed for NHDOT improvements (widening, straightening curves, etc.) which will lead to increased traffic speeds. Even without road improvement projects, traffic levels are expected to increase during the summer as recreation use increases over the next 20 years. The nearest known population is also a long way away in terms of dispersal distance for the species.

In addition, development around the Forest, especially to the south, will continue to erode suitable timber rattlesnake habitat, resulting in even less likelihood of source populations being available to provide dispersers to the WMNF. If timber rattlesnakes don't occupy the Forest soon, it is likely that source populations will either be too far away (isolated) and/or barriers to movement will be too significant to overcome without reintroduction.

Alternative 2

Effects of Alternative 2 would be similar to Alternative 1, except the results from timber harvesting (both positive and negative) and road construction would be less. Effects from existing road use would be the same as Alternative 1, but since there would be no summer motorized trail use in

Alternative 2, the chances of direct mortality from that activity would be reduced compared to Alternative 1.

Cumulative effects of Alternative 2

Cumulative effects would be the same as those described in Alternative 1.

Alternative 3

Effects of Alternative 3 would be the same as described in Alternative 2. Alternative 3 proposes timber harvest on approximately the same number of acres. Road use and summer motorized trail use would be the same as in Alternative 2.

Cumulative effects of Alternative 3

Cumulative effects would be the same as those described in Alternative 1.

Alternative 4

Total timber harvest in Alternative 4 is the highest of all alternatives, but the amount of even-aged regeneration harvest is comparable to Alternative 2. Effects from timber harvest (both positive and negative) would be intermediate between alternatives 1 and 2. Road use would be similar to Alternative 1. Also, since a summer motorized trail would be proposed in this alternative, the risk of direct mortality from ATVs would be increased in this alternative similar to Alternative 1, although the area where summer motorized trails could be designated is relatively small compared to the amount of suitable habitat on the Forest.

Cumulative effects of Alternative 4

Cumulative effects of activities around the Forest would be similar to Alternative 1. It is unknown whether an increase in Forest infrastructure would lead to similar development increases in nearby communities (e.g., additional hotels being built to accommodate more visitors). Presumably, some increase is likely and no alternative would propose more development than Alternative 4, therefore, this alternative could result in the most barriers to recolonization of the WMNF.

Determination - Timber rattlesnake

Since timber rattlesnakes are extirpated from the WMNF, there would be **no impact** to individuals from any alternatives. Should timber rattlesnakes recolonize the Forest, all alternatives may impact individuals, but would not result in a trend towards federal listing or loss of viability.

Bicknell's thrush (*Catharus bicknelli*)

Distribution

Bicknell's thrush is found only in the northeastern U.S. and eastern Canada during the summer. Within that area, the breeding range is limited and fragmented. Rimmer et al. (2001a) give a detailed account: "Breeding is documented north to southwestern Quebec in the Réserve la Veredrye, southeastern Quebec along the north shore of the St. Lawrence River and

Gaspé Peninsula (Ouellet 1993, 1996), the Magdalen islands, Quebec (probably extirpated; Ouellet 1996, McNair pers. comm.), northwestern and north-central New Brunswick (Erskine 1992, Nixon 1996), and Cape Breton island, Nova Scotia, including the small outlying Paul and Scaterie islands (Erskine 1992, D. Busby pers. comm..). Southern breeding limits are reached in the Catskill Mountains of new York (Atwood et al., 1996, Peterson 1988), the Green Mountains of southern Vermont (Atwood et al., 1996, Kibbe1985), the White Mountains of central New Hampshire (Atwood et al., 1996, Richards 1994), the mountains of western and central Maine (Adamus 1988, Atwood et al., 1996), south-coastal New Brunswick (possibly extirpated; Erskine 1992, Christie 1993), and southwest-coastal Nova Scotia (probably extirpated; Erskine 1992, D. Busby pers. comm..). Possible but unconfirmed local and sporadic breeding has been documented in north-coastal Maine (Atwood et al., 1996, Rimmer and McFarland 1996)." Approximately 90 percent of the global breeding population is found in the U.S., which is estimated at less than 100,000 individuals (Rimmer et al., 2001a).

Wintering distribution appears to be confined to the Greater Antilles, primarily in the Dominican Republic (Rimmer et al., 2001a).

Life History

Reproduction

In an analysis by Rimmer et al. (2001a), the most Bicknell's thrush breeding in Vermont were at least two years old. Arrival at breeding sites in the White Mountains probably occurs in late May, with egg laying ranging from June 21-July 14 in New Hampshire (Wallace 1939, Richards 1994). Based on mist-net recaptures, females are site faithful, but construct new nests annually (Rimmer et al., 2001a). Females build the nest and incubate the eggs, although both parents feed the chicks (Wallace 1939). Males may attend more than one nest (Rimmer et al., 2001a). Usually only one brood is raised with a clutch size of 3-4 eggs (Wallace 1939, Rimmer et al., 2001a). Incubation lasts approximately two weeks and fledging occurs between nine and thirteen days later. Greater than 60 percent of broods were raised to fledging over four years in Vermont (Rimmer et al., 2001a). Success rates of Vermont nests appear to be biennial in response to balsam fir cone production and red squirrel (*Tamiasciurus hudsonicus*) population cycles. A six-year study demonstrated that high cone crops every other year led to high red squirrel densities the following year, with subsequent lower Bicknell's thrush nest survival (Rimmer et al., 2001a).

Dispersal

Migration probably occurs some time in September, based on fall records in Massachusetts and Connecticut. Records south of the breeding grounds suggest an offshore migration south of Virginia (Rimmer et al., 2001a).

Relationships with Other Species

The primary predator on Bicknell's thrush is the red squirrel. Other potential predators are sharp-shinned hawk (*Accipiter striatus*), long-tailed weasel

(*Mustela frenata*), northern saw-whet owls (*Aegolius acadicus*), blue jay (*Cyanocitta cristata*), common raven (*Corvus corax*), eastern chipmunk (*Tamias striatus*), boreal red-backed vole (*Clethrionomys gapperi*), deer mouse (*Peromyscus maniculatus*), red fox (*Vulpes fulva*), coyote (*Canis latrans*), and raccoon (*Procyon lotor*) (Wallace 1939, Rimmer et al., 2001a).

Habitat

Bicknell's thrush nests in high elevation conifer forests, composed primarily of balsam fir (*Abies balsamea*), with smaller components of spruce (*Picea rubra* and *P. mariana*), white birch (*Betula papyrifera*), mountain ash (*Sorbus* spp.), and other hardwood species (Rimmer et al., 2001a). In the northeastern U.S., this type of habitat is generally found above 915 meters (3,000 ft) elevation (Wallace 1939, Atwood et al., 1996). Within this habitat, Bicknell's thrush is often found in constantly disturbed locations such as fir waves or along the edges of human-created openings (Rimmer et al., 2001b). Nixon et al. (2001) found Bicknell's thrush using newly regenerating clearcuts.

VINS (unpublished data cited in Rimmer et al., 2001a) used an elevation-based model to identify the amount of potentially suitable conifer-dominated montane forest habitat in the U.S. They found New Hampshire holds 45 percent of the habitat (49,733 ha/122,800 ac), then Maine (23%; 26,048 ha/64,366 ac), the Adirondack Mountains (23%, 23,037 ha/56,925 ac), the Green and Taconic Mountains of Vermont (8%, 8,610 ha/21,276 ac), and the Catskill Mountains (1%, 506 ha/1,250 ac). Atwood et al. (1996) rank the White Mountains second in priority order of preferred montane breeding habitat, behind the Adirondack Mountains. Following the White Mountains are west and central Maine, Green and Taconic Mountains of Vermont, and Catskill Mountains of New York. Hale (2001) observed the relative density of Bicknell's thrush rises with increased elevation, but that there is less land area at higher elevations. Lambert et al. (2001) also determined that minimum nesting elevations decreased by 84 meters (275 ft) for every degree of latitude northwards. Therefore, more habitat would be needed in northern parts of the range.

Edge may be an important component of the habitat, as disturbed areas often have small naturally occurring openings (SVE Bird Panel 2002). Rimmer et al. (2001a) suggest that active vegetation management can be planned to improve habitat, e.g., maintaining low spruce-fir thickets in bands three to seven meters (10-23 ft) wide of gradually increasing height along ski trails can provide nesting and foraging areas.

Occurrences

Rimmer et al. (2001a) notes birds were present on 38 of 60 (63%) peaks in the Green Mountain National Forest from Deerfield Ridge in the south to Mt. Ellen in the north and on 67 of 80 (84%) peaks in the White Mountain National Forest from Sandwich Mountain in the south to The Horn (northeast of Mt. Cabot) in the north.

Within the WMNF, Bicknell's thrush is considered relatively abundant (Rimmer et al., 2001a).

Threats/Limiting Factors

Identified threats for Bicknell's thrush include:

1. *Winter habitat loss.* This appears to pose the greatest threat to long-term species viability (Rimmer et al., 2001a).
2. *Breeding habitat loss.* Increasing recreational and commercial uses may contribute to habitat loss and fragmentation. Skiing, hiking, and mountain biking are activities of concern, especially relative to expansion or increased seasonal use of existing ski areas.
3. *Human disturbance*. Although Bicknell's thrush can tolerate some human disturbance, cumulative effects of increasing human use are unknown (Rimmer et al., 2001a; SVE Bird Panel 2002). Commercial uses such as wind towers and communication sites are often proposed on mountaintops and require clearing of treed vegetation around each site and could contribute to habitat loss (Lambert 2001).
4. *Increasing mercury* in high elevation areas (Rimmer et al., 2001a).
5. *Global climate change* could greatly reduce current forest composition (Rimmer et al., 2001a).

The most limiting factors of concern on the WMNF are development and increasing human use. Loss of winter habitat, increasing mercury in high elevation areas, and global climate change are outside Forest Service control.

Information Gaps

The SVE Bird Panel identified the following information gaps for Bicknell's thrush:

1) More information is needed on breeding ecology in various habitats, e.g., are birds more successful reproducing in certain habitats?
2) Effects of calcium availability as a result of acid deposition in high elevation spruce-fir, especially on egg-laying ability.
3) Effects of hikers and dogs, especially adjacent to trails.

Pertinent Resource Actions and Mitigation

Proposed standards include the following specific to Bicknell's thrush management:

- Projects must not result in a net decrease of suitable Bicknell's thrush habitat (dense softwood stands above 3,000 feet in elevation).

Affected Environment

The area of effects analysis is the ecological subsections that encompass the WMNF (Map G-01). Birds are mobile and can occupy suitable habitat some distance away, although the WMNF holds the bulk of available habitat for this species locally.

Habitat trends

High elevation forests in the northeastern U.S. have been degraded during the 1960s and 1970s, likely because of atmospheric deposition. Ski areas have also reduced habitat, although suitable habitat can be managed between individual runs (Rimmer et al., 2001a).

Population trends

Point count data from eight years of high elevation breeding bird surveys on the WMNF shows an annual decline of 8.3 percent. Similar point count data on the Green Mountain National Forest shows an annual increase of 3.9 percent. Since neither data set has high statistical power, they are only suggestive of trends (Rimmer et al., 2001a).

Environmental Effects

Alternative 1

Under Alternative 1, new trails would not likely be constructed in Bicknell's thrush habitat because new standards would limit trail construction in Bicknell's thrush habitat. Existing ski areas may propose expansions, but none are known at this time. In any case, the standard that projects must not result in a net decrease in suitable Bicknell's thrush habitat should mitigate effects.

Recreation use in this habitat is expected to increase following past trends (see Recreation effects section). However, whether or not current use is contributing to population declines of species such as Bicknell's thrush is unknown. In theory, increased recreation use may lead to more dogs in high elevation habitats, which if not restricted to the trail can harass local wildlife. People are also known to attract (through food handouts) more generalist species such as red squirrels, which are known to eat birds' eggs and are considered a significant predator on Bicknell's thrush. Studies in Wyoming found increased human intrusion in an area lead to sometimes significantly higher numbers of gray jays (*Perisoreus canadensis*) being present (Gutzwiller et al., 2002). Gray jays are a known nest predator on many bird species, so increased human activity may lead to increased rates of nest predation. Loss of productivity, displacement to suboptimal habitat, and unnecessary energy consumption are all known wildlife responses to recreationists (summarized by Vaske et al., 1983). The level to which any of these effects is currently occurring is unknown, but given the high use levels in these habitats, some level of effect would be expected. Additional studies are needed to determine specifically the extent to which recreation activity contributes to negative impacts of high elevation birds.

Cumulative effects of Alternative 1

There are no other future actions known in this habitat type beyond the projected increasing recreation use. During the planning period, the WMNF would continue to support a large proportion of habitat within the region, but whether or not the quality of that habitat would change relative to other areas is unknown.

Alternative 2

Effects would be the same as those described for Alternative 1 because backcountry recreation use would be expected to increase at the same level.

Cumulative effects of Alternative 2

Cumulative effects would be the same as those described in Alternative 1.

Alternative 3

Effects would be the same as those described for alternatives 1 and 2 because backcountry recreation use would be expected to increase at the same level.

Cumulative effects of Alternative 3

Cumulative effects would be the same as those described in Alternative 1 and 2.

Alternative 4

Effects would be the same as those described for alternatives 1, 2, and 3 because standards would limit impacts in Bicknell's thrush habitat.

Cumulative effects of Alternative 4

For all alternatives, the WMNF is a stronghold of summer habitat for Bicknell's thrush. Other habitat exists elsewhere in New England, but not to the extent that it occurs on the Forest. Thus, negative impacts here potentially have large effects on the regional population. If recreation use levels are contributing to the population decline of this species, Alternative 4 could exacerbate this situation more than the other alternatives if more users are drawn to suitable habitat with additional facilities and infrastructure (even though these may be outside suitable habitat). Depending on the magnitude of the increase in recreation use, habitat quality may be significantly reduced. However, until monitoring determines the exact cause of the population decline, effects are unknown.

Determination — Bicknell's thrush

Implementation of any alternative **may impact individuals but would not likely cause a trend towards federal listing or loss of viability**.

Rationale Summary

1. Nothing is specifically planned to promote increased use in high elevation spruce-fir habitats and as yet, recreation use impacts have not yet been proven, but it is suspicious that the breeding bird data from the WMNF shows such a rapid decline while other areas in the northeast are stable or increasing. It is assumed that if recreation use levels were proven to contribute to significantly declining trends on the Forest, action would be taken to mitigate the effects.

American peregrine falcon (*Falco peregrinus*)

Distribution

Peregrine falcons are widely distributed across northern North America, breeding from the subarctic boreal forests of Alaska and Canada south to Baja California, Sonora, and the highlands of central Mexico. Reintroduction efforts in the Midwest and northeast U.S. have restored breeding to many historic areas, and nesting now occurs within the historical range in all states east of the 100^{th} meridian, except Rhode Island, West Virginia, and Arkansas (USFWS 1999c).

The WMNF is centrally located relative to peregrine breeding in northern New England. Peregrines breeding on the WMNF presumably migrate to South America during the winter.

Life History

Reproduction

Peregrines generally reach sexual maturity at two years of age (USFWS 1998b). The nest is just a scrape or depression on a cliff ledge, although some will also accept man-made nest boxes on buildings or bridges. They produce a clutch of two to five eggs (usually 4) and only one brood per year is produced (DeGraaf and Yamasaki 2001). In New Hampshire, egg laying usually occurs in April, but may be as late as early May (Lanier and Bollengier 1994). Incubation lasts approximately one month (USFWS 1998b).

Chicks are born altricial and are defended vigorously by both parents, although nests may be abandoned if the birds are severely or continuously harassed (USFWS 1998b). At four weeks of age, the chicks are active and wander about the nest ledge, exercising their wings (Lanier and Bollengier 1994).

Peregrine pairs are monogamous and breed in the same territory or breeding area for their entire life (unless one mate dies or is outcompeted and replaced) (USFWS 1998b).

Foraging

Peregrines are predators, feeding primarily on other medium-sized birds. In New York and New England, the most common prey types were American robin (*Turdus migratorius*), blue jay (*Cyanocitta cristata*), common grackle (*Quiscalus quiscula*), European starling (*Sturnus vulgaris*), evening grosbeak (*Coccothrautes vespertinus*), killdeer (*Charadrius vociferous*), mourning dove (*Zenaida macroura*), northern flicker (*Colaptes auratus*), red-winged blackbird (*Agelaius phoeniceus*), ring-billed gull (*Larus delawarensis*), rock dove (*Columba livia*), short-billed dowitcher (*Limnodromus griseus)* and wood duck (*Aix sponsa*) (Corser et al., 1999).

Dispersal

Peregrines in New England are migratory. The first arrivals in the spring generally are observed in late February or early March, but may visit a

number of different cliffs through March and April (Lanier and Bollengier 1994).

Peregrines are top predators and may live 18-20 years. The annual survival rate for Midwestern populations from 1982-1995 was 93 percent for females and 79 percent for males (Kitchell 1999b).

Habitat

Peregrines will occupy a variety of habitats, from open tundra and seacoasts to forests to urban cities. The most critical habitat component for peregrines is suitable cliff ledges for nesting. Prey items must also be available that can be taken in flight, so openings may be beneficial, especially near riparian areas.

Occurrences

As of 2004, there were 15 active and breeding territories in New Hampshire and 16 in Maine. Of these, 9 are located on the WMNF (data summarized in WMNF Literature Review for American peregrine falcon).

Threats/Limiting Factors

The SVE Bird Panel (2002) identified the following threats to peregrines:

1. *Human disturbance*, especially from rock climbing.
2. *Predation* of young and eggs, especially by raccoons that may be tied to human use in the area.
3. *Pesticides*, which are still found in central and South America.
4. *Limited number of nest sites*.

The most limiting factors that could be managed on the WMNF are human disturbance and any effects that may have on predator abundance. Use of pesticides outside the WMNF and the natural lack of suitable nest sites are outside Forest Service control.

Information Gaps

The SVE Bird Panel (2002) identified the following information gaps:

1) Criteria for determining suitability of cliff sites for nesting
2) Continued toxicological effects

Pertinent Resource Actions and Mitigation

There are no standards and guidelines specific to peregrine falcons, although direction for rock climbing could mitigate negative impacts to peregrines.

Affected Environment

The area of effects analysis for peregrine falcons is the ecological subsections that encompass the Forest (Map G-01). Peregrines are highly mobile and can easily travel great distances to other suitable sites off-Forest.

Habitat Trends

Nesting sites for peregrine are assumed to have remained stable over time, as cliff faces are generally fixed. However, recreation pressure from rock climbing has increased over time so there is more activity presently at suitable nest sites than prior to reintroduction. Mitigation in the form of informal climbing route closures appears to have been effective, with many peregrines successfully reproducing despite climbing activity on the same cliff face (but at some distance from the aerie). Closures are only implemented during the critical establishment and nesting time; at other times of the year climbers may access aerie sites (C. Martin, pers. comm.).

Population Trends

Peregrines were reduced continent-wide by the widespread use of organochlorine pesticide contamination following World War II and were extirpated from the northeast U.S. by the mid-1960s. Two subspecies of peregrines (including *F.p. anatum*, the subspecies in the eastern U.S.) were listed under the Endangered Species Act in 1970. Recovery plans developed in the mid-1970s proposed reintroduction of captive-raised peregrines to historic areas following the banning of DDT in 1972 (USFWS 1999c). On the WMNF, more than 75 captive-reared peregrines were introduced at two release sites in the late 1970s and early 1980s (Lanier and Bollengier 1994). Despite some lingering localized effects, the peregrine population throughout its range, including the northeast, has increased steadily. The reproductive performance in the White Mountain subpopulation has been somewhat lower than surrounding populations, but this has been attributed to the lower percentage of rock doves and mourning doves (which tend to be associated with more agricultural habitats) in their diets (Corser et al., 1999). Corser et al. (1999) postulate that because doves are granivores, they would accumulate less organochlorine contamination than the omnivores that were more present in the diet of the White Mountain peregrines.

Environmental Effects

All alternatives

In all alternatives, standards and guidelines would be implemented to protect cliff resources. In the recent past, climbers have willingly responded to voluntary seasonal route closures instituted to protect peregrines from disturbance during the breeding season. It is expected that the climbing community would continue to honor these or more formal closure orders, so that peregrines would be protected during nesting. There are available, unoccupied breeding sites on or near the WMNF that could be utilized as the population continues to grow. Although climbing use is expected to increase in all alternatives, nesting peregrines are fairly obvious. Past experience indicates monitoring can identify peregrines nesting at new locations prior to the main climbing season, so that mitigation can be implemented without impacting reproducing birds.

Recreation use on the Forest is expected to increase in all alternatives. More people could lead to more littering, especially at dispersed campsites, which subsequently can attract potential predators such as raccoons. Assuming that climbers would be the primary users near cliffs, limits on climbing party size should help limit the number of people in the general vicinity. Predator level may increase, but probably would not lead to measurable chick losses compared to the current condition.

Cumulative effects for all alternatives

Nest sites are limited by the natural availability of cliffs. At some point (probably in the next 20 to 50 years), this habitat will become saturated in the analysis area. Development around some suitable cliffs has rendered these sites unusable for the time being. Perhaps peregrines will adapt to more disturbance, as they have utilized tall buildings and other structures in more urban settings. In any case, peregrine recovery should be maintained in all alternatives.

Determination — American peregrine falcon

Implementation of any alternative **may impact individuals**, **but would not likely cause a trend towards federal listing or loss of viability**.

Rationale Summary

1. New standards and guidelines that restrict outfitter/guide climbing group size should help limit the number of people using cliff habitats.
2. Historically, the climbing community has been very supportive of seasonal route closures, which have proven effective in promoting successful reproduction.
3. Suitable, unoccupied habitats are available on the Forest and within the analysis area.
4. If food resources are available, peregrines are known to nest on tall buildings, bridges, and other manmade structures with surrounding human disturbance that far exceeds levels on the WMNF. It may be possible for them to adapt over time to greater numbers of people, as long as it is a gradual increase and prey is abundant.

Common loon (*Gavia immer*)

Distribution

Common loons breed in Alaska and northern Canada east to Iceland, then south to central Massachusetts and west to Montana and California. In New England, loons breed throughout Maine, New Hampshire, and Vermont. They are also found in the Quabbin and Wachesett reservoirs in Massachusetts. The southern limit of the breeding range has receded northward (DeGraaf and Yamasaki 2001).

Wintering occurs on the Atlantic coast from Newfoundland to the Gulf of Mexico (DeGraaf and Yamasaki 2001).

Life History

Reproduction

Immature loons typically spend several years on the ocean before moving inland to breed, usually no earlier than four years after hatching. In New England, loons rarely arrive before April 1 and may not arrive until well into June. One brood of one or two chicks is raised per year. In New Hampshire and Maine, egg dates fall between June 2 and August 10. Incubation lasts 28-29 days on average (summarized by DeGraaf and Yamasaki 2001).

Young are born precocial and nestlings are soon moved from the nest to shallow water where they are protected from strong wind and waves and small fish or other prey are abundant. Both parents defend, feed, and carry young for several weeks (up to eight weeks for feeding). Most juveniles can fly at 11-12 weeks (Rimmer 1992).

Dispersal

Juveniles become independent between mid-September and mid-November after flight ability is acquired and they can catch their own food. Parents typically leave their territory when juveniles are 12-15 weeks old; juveniles remain on their natal lakes for 1-3 weeks longer (Mcintyre and Barr 1997).

Chick survival is relatively high; fledging success was approximately eighty percent in one study (Rimmer 1992). The oldest banded bird recovered was 7 years and 10 months; lifespan is assumed to be similar to the Arctic Loon, which can live as long as 25-30 years (Mcintyre and Barr 1997).

Relationships with Other Species

Adults have few known predators (NatureServe 2001d), but will defend their nests against many chick predators (Mcintyre and Barr 1997). Primary predators on eggs and chicks include American crows, common ravens, herring gulls, and raccoons. Snapping turtles, northern pike, muskellunge, walleye, red fox, mink, and skunk are other documented predators. Otters and bald eagles are also possible predators.

Competition with aggressive non-native mute swans (*Cygnus olor*) has been documented in Michigan (NatureServe 2001d).

Habitat

Common loons breed on small and large oligotrophic lakes containing fish. Nests have occurred on lakes as small as four hectares (10 acres), but loons prefer larger waterbodies with islands that are more protected for nesting and allow a long stretch of water for flight take-off. Clear water to a depth of at least three meters (10 ft) is essential for foraging, as is an area of shallow water for teaching young to forage (SVE Bird Panel 2002, Fichtel 1985, Strong 1985). Young rearing areas tend to be less than two meters (6.5 ft) deep and close (<150 m/492 ft) to land. Adults without chicks tended to occur in more moderate depth (1.1-4.0 m/3.6-13.1 ft) and were further from land (51-150 m/167-492 ft) (Strong 1985).

A study of New Hampshire lakes showed loons preferred larger, deeper, warmer lakes, presumably because larger lakes typically have a larger fishery and warmer surface temperatures may support the presence of yellow perch, a primary food source for loons (Blair 1992). Waterbodies less than 80 ha (198 ac) generally support only one pair (Rimmer 1992).

Although impoundments have been used successfully for nesting, water levels must remain stable during breeding (SVE Bird Panel 2002). Artificial nesting islands have been successful (WMNF unpublished breeding records).

Occurrences

At least three territorial and/or breeding pairs occurred on the WMNF from 1996-2000 (K. Taylor, pers. comm.). The WMNF contains limited potential lake habitat.

Threats/Limiting Factors

The following threats have been identified for loons:

1. *Shoreline development* is the main threat in New England (SVE Bird Panel 2002). Hatching success seems to decline as development and human use increases (Rimmer 1992).
2. *Lead poisoning* has caused about half of all adult loon deaths on freshwater lakes in New England. The survival rate for birds that have ingested even one lead sinker or jig is zero percent, even with rehabilitation efforts (Pokras 2002).
3. *Lake acidification* may impact nestling survival (Rimmer 1992). Acid precipitation adversely affects *Daphnia*, a key lower link in the loon's food chain. *Daphnia* died more quickly when exposed to water of pH 4.6 and 6.0 (Dunn undated).
4. *Disease* may impact populations. Loons are susceptible to epidemics of type C and type E botulism, as well as aspergillosis and internal parasites (Rimmer 1992).
5. *Water level fluctuation* can reduce nesting success, especially on impoundments (DeGraaf and Yamasaki 2001).
6. *Direct mortality* may occur as loons are killed intentionally by sport and commercial fishermen who consider them competition (Rimmer 1992).
7. An *increase in predators* such as raccoons may occur as human activity and debris increases (Lee and Arbuckle 1987).
8. *Sibling aggression* may be severe and may result in the death of the subordinate chick. In addition, adult loons may fight amongst themselves and kill chicks that wander in from adjacent territories (Rimmer 1992).
9. *Entanglement* in sports fishing line, gill nets, and commercial fish traps may kill loons (Rimmer 1992).

On the WMNF, the most limiting factor under WMNF control would be human disturbance on and around lakes/ponds, which could indirectly lead to increased predators. Shoreline development outside the WMNF, acidification, disease, direct mortality from fishermen or indirect mortality from their gear, and sibling aggression are outside Forest Service control.

Information Gaps

The following have been identified as information gaps for common loon:

1) Detailed information on distribution and abundance of wintering loon populations (Rimmer 1992).
2) Wintering and migration habitat and impacts upon them (SVE Bird Panel 2002).

Pertinent Resource Actions and Mitigation

There are no standards and guidelines proposed specifically for common loon, although Riparian and Aquatic Habitats standards and guidelines would help protect lake and pond habitats.

Affected Environment

The scope of effects analysis for common loon is the HUC 5 subwatersheds that encompass the WMNF with some changes to exclude areas unlikely to be affected by Forest activities (Map G-01).

Habitat Trend

Habitat is much reduced because of shoreline development and recreational activity. Hammond and Wood (1976) evaluated 767 New Hampshire lakes and ponds greater than 10 acres. Several hundred had a history of supporting loons, but by 1976, that number had fallen to just 84.

Population Trend

Historic population levels were likely much higher for this species, then crashed to very low levels as a result of shooting and egg collection at the turn of the 20th century. Recently, loon populations have increased (86 nesting pairs in 1986 and 127 in 1993), but will never return to historic levels because of loss of habitat (Richards and Elkins 1994).

Environmental Effects

All alternatives

Under all alternatives, it is possible that incidental recreation use could disturb nesting loons, but historically loons on the WMNF have nested either in isolated portions of ponds away from foot traffic or the ponds themselves have been in more remote locations. It is doubtful that additional recreation facilities or infrastructure would be placed near known loon breeding areas because Riparian and Aquatic Habitats and Threatened, Endangered, and Sensitive Species standards and guidelines would protect

their habitats. There are so few suitable loon lakes and ponds on the Forest and it seems unlikely that another resource's needs would be so tied to one of these areas that it would supercede the goal to "protect critical habitat and key habitat features upon which threatened, endangered, and sensitive species depend." Therefore, habitat should be maintained in its current condition.

Cumulative effects of all alternatives

Within the analysis area, there are few lakes of sufficient size to support breeding loons. Development on private lands will continue encroaching on suitable loon habitat. However, this condition may soon be approaching a limit. Many waterbodies are either already developed or include conservation lands or restrictions that will limit future development. In addition, outside influences such as boat motor restrictions and legislation to ban the use of lead fishing tackle should help slow the population decline. The amount of suitable habitat will never be restored to historic conditions, but loon numbers may level out as other factors provide positive population influences. In the larger picture, the most productive loon populations in New Hampshire are at Squam Lake to the south and in the Connecticut Lakes to the north, both of which are outside the analysis area. Maine has so many suitable lakes, their loon surveys cover only a small sample of them. Although the WMNF can contribute to regional loon populations, the Forest's naturally limited habitat will limit the number of birds that can be added, regardless of alternative.

Determination — Common loon

Implementation of any alternative **may impact individuals**, **but would not likely cause a trend towards federal listing or a loss of viability**.

Rationale Summary

1. Standards and guidelines to protect key TES habitat features and Riparian and Aquatic Habitats standards and guidelines would protect lakes with loon nesting. Existing recreation activity may result in some harassment towards loons, but this is predicted to occur infrequently.
2. Outside influences, such as banning lead fishing tackle, will help promote improved reproduction.

Eastern small-footed bat (*Myotis leibii*)

Distribution

The small-footed bat ranges from southeastern Ontario and southern Quebec, through New England and south to New York, Pennsylvania, West Virginia, Kentucky, and eastern Tennessee. South of there it occurs primarily in mountainous areas, from the Appalachian Mountains south into the Carolinas, northern Georgia, and northern Alabama and west through the Cumberland and Ozark Plateaus through Missouri and Arkansas. It has been recorded at elevations between approximately 250 and 675 meters (820-2,214 ft) (Bat Conservation International 2001).

Life History

Reproduction

Based on other *Myotis* species (Wimsatt 1945), females likely mate their first year prior to entering hibernation (at age six months or less), while males likely mate prior to entering hibernation during their second year (at age 1.5 years or less).

Gestation lasts approximately two months and begins when females arouse from hibernation. Small-footed bats produce one young per year (Barbour and Davis 1969). Nursery colonies of up to 20 individuals have been documented from buildings, and clusters of up to five females and their young were found using crevices in a concrete bridge in Kentucky (Bat Conservation International 2001). In New Hampshire, small-footed bats emerge from hibernation in April (UNH 1998), so young are born in June. Nursing is complete by the second week in August (Bat Conservation International 2001). During the summer, males are non-reproductive and separate from females.

During their return to hibernacula, eastern small-footed bats are among the last of the woodland bats to arrive, as late as November in New Hampshire (UNH 1998). They are similarly among the first to leave in the spring. They survive extremely cold, dry conditions that would kill most other cave-dwelling bats (Bat Conservation International 2001).

The lifespan of the small-footed bat is believed to be between six and twelve years (Belwood 1998). Yearly survival rates appear lower for females (42%) than for males (76%), perhaps due to greater demands of reproduction on females, higher metabolic rates and longer sustained activity during summer days, and greater exposure to possible diseases and/or parasites in maternity colonies (Hitchcock et al., 1984).

Dispersal

Eastern small-footed bats appear to only move short distances (<40 km/25 mi; Best and Jennings 1997) between summer and winter habitats, although the northernmost populations may migrate a short distance south (Bat Conservation International 2001). Hitchcock (1965) documented two individuals in Ontario that traveled 16 and 19 km (10 and 12 mi), respectively, from hibernation sites to maternity roosts.

Foraging

Little is known of the small-footed bat's emergence patterns or nocturnal activities. Based on other similarities in known behavior between western and eastern small-footed bats, it is assumed that eastern small-footed bats mostly feed over ponds and along stream margins in woodlands, as well as along cliff ledges, catching similar prey such as moths, flies, caddisflies, beetles, true bugs, and leafhoppers (Choate et al., 1994, Bat Conservation International 2001).

Relationships with Other Species

Predators are likely to include domestic and feral cats, raccoons, owls, and

snakes that feed opportunistically on bats in trees, buildings, or in cracks and crevices in rocky areas (Erdle and Hobson 2001).

Habitat

Eastern small-footed bats are generally found in hilly or mountainous areas in both deciduous and coniferous forests. In winter hibernacula, they prefer more severe environmental conditions than other bats, seeking out dry passages in relatively cold caves where temperatures drop below freezing and humidity is low (Barbour and Davis 1969). They frequently roost close to cave mouths where they are subjected to drafts (Barbour and Davis 1969, Krutzch 1966). In Pennsylvania, Dunn and Hall (1989) found 52 percent of small-footed bats in surveys hibernated in caves less than 150 m (500 feet) in length, thus subjecting them to colder ambient temperatures than would occur in larger caves. Best and Jennings (1997) documented that bats will leave a site if temperatures rise above 4ºC (40º F). Forested conditions may be important near hibernacula in influencing humidity and temperature levels within the hibernacula (Erdle and Hobson 2001).

During the summer, maternity roosts have been found under rocks on hillsides and open ridges, in cracks and crevices in rocky outcrops and talus slopes, beneath the bark of dead and dying trees, and in buildings (Webb and Jones 1952, Hitchcock 1965, Tuttle 1964, Barbour and Davis 1969, Handley 1991, Whitaker and Hamilton 1999). The SVE Mammal Panel (2002) suggests small-footed bats may also use stone walls for roosting. Of the few roost locations known, only a few individuals were reported under tree bark; because of the low number of records, it is difficult to determine the significance of trees or snags as potential roost habitat (SVE Mammal Panel 2002).

Small-footed bats generally roost alone or in small groups, although in northern latitudes, groups of 35 or more have been found in tightly packed clusters beneath rocks and in rock crevices in cliff faces or talus slopes (Bat Conservation International 2001). There is no evidence that small-footed bats use manufactured bat houses.

Proximity to water may be an important factor for roosts (Erdle and Hobson 2001). For bats in general, water is important when they emerge from warm summer day roosts; this is probably true for small-footed bats as well (SVE Mammal Panel 2002). Netting efforts have caught small-footed bats over water, along road corridors, and near cliff edges, flying at or below canopy height (Choate et al., 1994).

Occurrences

Occurrences on the WMNF are sparse. Small-footed bats have been recorded in the Bartlett Experimental Forest (M. Yamasaki, pers. comm.) and the closest known hibernaculum is near the WMNF boundary in Gorham. In 2004, 3 small-footed bats were captured at two different sites on the Forest (Bat Conservation and Management 2004)

Further from the WMNF, a lactating female was captured in New Boston, New Hampshire (approximately 70 miles from the Forest boundary), in

2002 (S. von Oettingen, pers. comm.). Another hibernaculum in Stockbridge, Vermont supported approximately 25 small-footed bats in 1999 (up from seven in 1991). Eight other Vermont sites have small-footed bat records (NatureServe 2001c). Only one occurrence (1993) is known from Maine, in an abandoned gold mine in Milton Township (MNAP 2001).

Threats/Limiting Factors

The following threats have been documented for small-footed bats:

1. *Habitat destruction* and/or *development* (in rural or suburban environments and for agriculture, road construction, etc.) are likely to negatively affect bats if potential roost sites and foraging areas (including bodies of water and insects they produce) are altered. Loss of mine habitat can also occur through placement of new structures that act as barriers or change climate conditions.
2. *Disease* may affect individuals. Rabies can strike all bats, although it is presumed to have a low incidence of occurrence in small-footed bats, similar to other bats (Constantine 1979). The potential effect of the West Nile virus is unknown. As yet, it has not been detected in small-footed bats, but has been documented to kill big brown bats and little brown bats in New York (CDC 2002).
3. Bats in general have a low threshold for disturbance. *Repeated disturbance* can cause them to abandon their roosts (Belwood 1998) or result in direct mortality during both winter and summer.
4. *Pesticides*, such as *Bacillus thuringiensis kurstaki*, designed to attack moth pests (EPA 2002) could wipe out the food source for any bat that feeds on moths.
5. *Traffic* on well-traveled roads and highways causes direct mortality to many bats and is probably a concern for this species. Lightly traveled roads are used for flight corridors and foraging (SVE Mammal Panel 2002).
6. *Global warming* may affect small-footed bat populations if their insect prey is reduced as a result. Increasing temperatures could also make hibernacula conditions unsuitable. Conversely, caves and mines that were previously unsuitable could be made suitable, especially at northern latitudes.
7. Both male and female small-footed bats will roost in bridges with features like expansion joints. *Bridge maintenance activities* (e.g., cleaning, painting, and repairs) have the potential to cause disturbance if done during the non-hibernation season. Replacement of bridges with these features with newer designs may not provide the same suitable roosting conditions.
8. *Recreational rock climbers* are increasingly believed to have potential to seriously harm small-footed bats roosting in cracks and crevices of rocky outcrops and similar environments. Instances of this

happening have been recorded in North Carolina (McClanahan and Stihler cited in Erdle and Hobson 2001).

9. *Wind turbines* used to generate electricity in some parts of the U.S. have been shown to cause bat mortality (Osborn et al., 1997).

On the WMNF, the most likely threats or causes of greatest concern would be:

a. Disturbance to summer roosts, especially by rock climbing

b. Habitat alteration, primarily through timber harvest, but also any activity that may affect potential roosts or water sources.

c. Direct mortality over roads

d. Construction (either directly through Forest Service action or indirectly through approval of special use permits) of structures such as wind turbines or cell towers that can lead to bat collisions.

Disease, pesticide use outside the WMNF, disturbance and/or direct mortality at hibernacula, and global warming are outside Forest Service control.

Information Gaps

The SVE Mammal Panel (2002) identified the following information gaps for small-footed bats:

1) Local habitat use, especially in summer

2) Presence in potential hibernacula

Pertinent Resource Actions and Mitigation

There are no standards and guidelines specific to small-footed bat, although direction for rock climbing (Recreation standards and guidelines), road upgrades in lynx habitat (Threatened, Endangered, and Sensitive Species standards and guidelines), riparian and aquatic habitat protection, wildlife reserve trees (Wildlife guidelines), and mitigation for tower construction (Wildlife guidelines) could benefit this species:

Affected Environment

The scope of effects analysis for small-footed bat is the WMNF proclamation boundary, plus Franconia Notch, Crawford Notch, and Mt. Washington State Parks and an area to the north of the Forest that includes the Gorham hibernaculum (see Figure 4). Small-footed bats typically travel much smaller distances than other bat species and the Gorham mine is the only known hibernaculum near the Forest. In addition, the Forest holds the majority of cliffs near the mine, so this analysis area should encompass the bulk of the rocky habitats near the hibernaculum.

Habitat Trends

Range-wide, potential hibernacula have probably declined as mines or other underground sites have been reclaimed without bat-friendly

considerations. However, within this analysis area, there are few of these opportunities. Natural crevices, cliffs, and other rock features have likely remained stable over time, but may not be considered suitable if frequent disturbance (e.g., rock climbing) has occurred during the non-hibernation season. The number of available tree roosts has probably fluctuated over time, but with so few small-footed bats documented on or near the Forest and an abundance of mature trees, this is probably a moot point.

Population Trends

The small-footed bat appears to have always been rare locally, so it is somewhat unknown if population numbers have changed (SVE Mammal Panel 2002). Overwintering numbers at the Gorham mine increased from three individuals in 1993 to nine individuals in 2004 (J. Lougee, pers. comm.). The population at the Stockbridge, Vermont mine seemed to increase from 7 to 25 between 1991 and 1999 (NatureServe 2001c), although it is unknown whether this is truly a population increase or just additional bats hibernating here instead of elsewhere.

Environmental Effects

Alternative 1

Rock climbing

Recreational hiking and rock climbing is expected to increase steadily over the next 20 years. New standards and guidelines would help to direct protection to cliffs, where small-footed bats are most likely to be roosting. Restricting climbing party size would help limit the number of users on a particular route, but may not completely prevent a bat being killed as it is scraped out of its roost. Bats often stay tight in their roosts; it is unknown how often a small-footed bat would fly off in the face of approaching disturbance or stay put, risking direct contact. It would seem, though, that as rock climbing increases in popularity, more routes will be developed on the Forest and the risk of potential disturbance, if not outright injury or death, will subsequently increase for this species.

Rock climbing would only be a threat to bats roosting on climbing route sites on appropriate cliffs. There is some thought that small-footed bats also occupy other rock features (e.g., cracks in boulders, historic rock walls, rock slides, and other non-climbable rock situations (Bat Conservation and Management, Inc. 2003) that would remain more or less undisturbed in all alternatives.

Timber harvest

If small-footed bats are roosting in trees, Alternative 1 creates the greatest potential for direct impacts because it has the most volume of timber proposed for harvest. However, like the Indiana bat discussed previously, small-footed bats would be focused on specific features such as sloughing bark or cavities for roost sites. Standards and guidelines for wildlife reserve trees would mitigate the loss of suitable roost trees and reduce the risk of harming a small-footed bat. In theory, cutting trees could also indirectly harm bats by reducing the amount of suitable roost trees available.

However, in Alternative 1, over 400,000 acres are in management areas where timber harvest is not allowed. These management areas provide ample mature trees and snags that can provide suitable roost sites. In addition, even in management areas 2.1 and 3.1, only a portion of the land base would be considered suitable for timber harvest (e.g., some stands are inaccessible or other resource protection standards and guidelines would restrict harvest in them). Trees on the remaining portion will continue to mature and provide additional suitable habitat. The chance that the loss of a suitable unoccupied roost tree would indirectly affect small-footed bat on the Forest is so small as to be discountable.

Road mortality

Road use is expected to increase steadily over the next 20 years. Recreation use (both directly such as driving for pleasure and indirectly to get to another recreation activity) is likely to result in more cars on existing Forest roads. The risk of colliding with a bat would subsequently increase. How often a bat collides with a vehicle now is unknown, so it may be that additional traffic would not result in a measurable difference. The guideline under Rare and Unique Features to limit road upgrades would help mitigate this risk occurring on additional roads.

Towers

The risk of a bat colliding with a cell tower, wind turbine, or other large structure will probably increase over the next 20 years. The WMNF has already received a number of permit requests for these kinds of structures, which would be allowed to some extent in the Forest Plan. Cell tower size is anticipated to decrease as the demand for digital technology increases, but the national push for clean energy will likely lead to greater demand for wind tower structures and the WMNF holds suitable sites. Guidelines to mitigate collisions would be applied to these kinds of proposals, but their effectiveness would have to be monitored. It is assumed that some bats would still be killed, since mitigation measures are not completely effective, but that the population could probably survive the occasional loss of an individual.

Cumulative effects of Alternative 1

Cumulatively, the biggest threat for small-footed bats would be if anything were to negatively affect the hibernaculum. At this time, it appears that the location is stable and will remain so into the near future.

Over the next 20 years, rock climbing is anticipated to continue increasing, although at some point, it is likely that all available climbing routes will have been developed, so the threat to small-footed bats would level off.

Trees would continue to mature in the state parks and would be available for roosting, although there would be no lack of available habitat on the WMNF.

Effects of road use through the state parks would be the same as on the WMNF, although bat use may be less likely there since the roads are primarily highways, not the smaller forest roads that bats would be likely to use as travel corridors. Over the next 50 years, some additional roads will probably be upgraded and result in higher traffic speeds; however, it

seems unlikely that this would cause a measurable difference in collision risk. The road system is fairly well established and major changes are not expected, therefore, effects should be similar to the direct and indirect effects described above.

Effects of tower structures would be the same as on the WMNF, should they choose to allow them. It is assumed that the number of structures would increase off-Forest as well, adding to potential collision effects. Structures outside the Forest also may not utilize mitigation measures to avoid collisions, so the risk of impacts may be more likely outside the Forest.

Alternative 2

Effects of rock climbing would be the same as those described in Alternative 1.

Effects of timber harvesting would be the same as those described in Alternative 1, although the magnitude would be less in Alternative 2. Alternative 2 proposes approximately two-thirds of the volume being harvested in Alternative 1, so the risk of direct impacts would be reduced proportionally. As in Alternative 1, the risk of indirect impacts would be insignificant and discountable.

Effects of road use and permitting tower structures would be the same as those described in Alternative 1.

Cumulative effects of Alternative 2

Over a 20 year period, cumulative effects are essentially the same as those described in Alternative 1. The only difference between the alternatives is the volume of timber proposed for harvest. This may decrease the potential for risk, albeit small, for this species over the long term.

Alternative 3

Effects would be similar to those described for Alternative 2. The only difference would be the amount of timber harvest proposed, which is approximately half of Alternative 1 and 25 percent less than Alternative 2. The risk of directly impacting a roosting bat would be subsequently reduced in this alternative.

Cumulative effects of Alternative 3

Cumulative effects would be similar to those described in Alternative 2, with a proportionate reduction in risk of effects from timber harvest.

Alternative 4

Effects of rock climbing would be the same as those described in Alternative 1.

Effects of timber harvest would be similar to those described in Alternative 1. However, Alternative 4 proposes approximately fourteen percent less timber volume than Alternative 1, although more acres would be treated. The risk of impacting a small-footed bat is probably comparable to Alternative 1. Although the amount of volume would be less, operations would be spread over more acres, which could result in enough additional

disturbance to make the effects from these alternatives more or less the same.

Effects of road use and permitting tower structures would be the same as those described in Alternative 1. Even though there would be more recreational facilities and infrastructure in Alternative 4, it is anticipated that these would all be accessed by short spurs from existing roads and no new roads would be proposed.

Cumulative effects of Alternative 4

Cumulative effects would be comparable to those described in Alternative 1.

Determination - Eastern small-footed bat

Implementation of any alternative **may impact individuals, but would not likely cause a trend towards federal listing or loss of viability**.

Rationale Summary

1. Rock climbing will continue to increase, but standards and guidelines to limit use and protect resources should help to limit effects somewhat. In addition, other rock habitats not used for climbing should still provide ample habitat opportunities.
2. There is some risk of direct mortality from timber harvest operations. However, the chance of this occurring is relatively small compared to the number of trees that will be cut and the number of suitable roost trees available.
3. The current road system is not expected to increase in the future, although increased use on existing roads could result in some direct mortality. Guidelines to limit road upgrades that result in increased speed levels would also help mitigate this effect.

Tower structures would increase the risk of bat collisions, but mitigation measures would help lessen this effect.

Northern bog lemming (*Synaptomys borealis sphagnicola*)

Nine subspecies of *Synaptomys borealis* have been described across its range. The subspecies *sphagnicola* is the subspecies found in northern New England (Clough and Albright 1987).

Distribution

The northern bog lemming is found in northern New Hampshire; on Mt. Katahdin, Maine; and in New Brunswick and Quebec east and south of the St. Lawrence River (DeGraaf and Yamasaki 2001).

Life History

Little is known about this subspecies. Age at sexual maturity is unknown. Breeding occurs between May and August. Litter size is typically four and adults may produce two to three litters per year (DeGraaf and Yamasaki 2001).

Home range size for the related *Synaptomys cooperi* is estimated as 0.04 ha (0.11 ac) for males and 0.06 ha (0.14 ac) for females (Getz 1960).

Habitat

DeGraaf and Yamasaki (2001) describe habitat as mossy spruce woods, low elevation spruce-fir, hemlock and beech forests, sphagnum bogs, damp weedy meadows, alpine sedge meadows. They use underground burrows and shallow surface runways. Summer nests are found underground, but winter nests are located on the ground surface.

The one extant New Hampshire occurrence was found in an actively harvested red spruce/fir/hemlock stand, with a ground cover of moss on poorly drained soil (Yamasaki 1997).

Occurrences

There are 4 extant and 2 historic occurrences of this subspecies in Maine and 1 extant and 2 historic occurrences in New Hampshire (MNAP 2001, DeGraaf and Yamasaki 2001). Of these, the New Hampshire occurrences are all from the WMNF or occur adjacent to it.

Threats/Limiting Factors

Threats to this subspecies are unknown.

Information Gaps

The SVE Mammal Panel (2002) stated next to nothing is known about this subspecies because it is so hard to capture and study.

Pertinent Resource Actions and Mitigation

There are no standards or guidelines specific to northern bog lemming.

Affected Environment

The scope of effects analysis for northern bog lemming is the WMNF (see Figure 4). This species is very uncommon and would not travel a great distance; therefore the scope of effects would be limited to local areas.

Habitat Trends

Habitat for this subspecies is considered stable.

Population Trends

Although relatively little is known, the subspecies was discovered over 100 years ago and has persisted, albeit in very few known occurrences (SVE Mammal Panel 2002, T. French, pers. comm.).

Environmental Effects

Alternative 1

No threats are known for this species, although it could be presumed that timber harvest or other activities that would cause large shifts in habitat condition could cause an impact. In addition, actions that use or allow motorized vehicles are more likely to directly kill an individual or nest. Alternative 1 would have the most timber harvest activity of all alternatives and would also consider summer motorized use anywhere that timber harvest could occur. The chance that either of these activities would cause a direct impact to a northern bog lemming is very remote, but without any specific threats, this is the only way to compare alternatives.

Cumulative effects of Alternative 1

Because the northern bog lemming has persisted over time with timber and recreation activities, presumably continuation of these activities would have no additional effect on the species or its habitat.

Alternative 2

Alternative 2 would prohibit motorized summer ATV use, so there could be no direct effects from that activity. Timber harvest would be reduced compared to Alternative 1. The extant occurrence is in the Wild River drainage, which would be recommended for wilderness designation in this alternative.

Cumulative effects of Alternative 2

Cumulative effects would be similar to Alternative 1.

Alternative 3

Alternative 3 proposes timber harvest levels between alternatives 1 and 2; therefore effects would be intermediate between these alternatives.

Cumulative effects of Alternative 3

Cumulative effects of Alternative 3 would be intermediate between alternatives 1 and 2.

Alternative 4

Alternative 4 proposes the most acres of timber harvest; therefore, the possibility of directly impacting a northern bog lemming is proportionally higher. Alternative 4 also allows summer motorized use on designated trails in Management Area 2.1, but this would be restricted to one of two specific areas, neither of which would likely be northern bog lemming habitat because of lynx guidelines that limit new trail construction in spruce-fir habitats. Therefore, there would be no effect as a result of this activity.

Cumulative effects of Alternative 4

Cumulative effects of Alternative 4 would be similar to Alternative 1.

Determination — Northern bog lemming

Implementation of any alternative **may impact individuals, but would not likely cause a trend towards federal listing or loss of viability**.

Rationale Summary

Northern bog lemmings have apparently persisted for the last century despite much more habitat altering activities than are proposed here. Although habitat conditions may be altered locally, there is no reason to believe the subspecies would not continue to persist regardless of alternative.

Chapter 5 – New England Cottontail

The New England cottontail (*Sylvilagus transitionalis*) is under consideration for federal listing under the Endangered Species Act (USFWS 2003a, USFWS 2004). It is not a Regional Forester's sensitive species or considered a species of potential viability concern because its occurrence on the WMNF is questionable. Nonetheless, an analysis is included here in order to address potential concerns from the U.S. Fish and Wildlife Service should the species be listed in the near future.

Distribution

Until recently, the New England cottontail was considered a single taxa occupying a fairly widespread range, albeit with a spotty distribution, from New England, west to New York and south along the Appalachian range. In 1992, the taxa was revised into two separate species, the New England cottontail to the north and the Appalachian cottontail (*Sylvilagus obscurus*), to the south (Chapman et al. in USFWS 2004). The historic range of the New England cottontail is believed to have occurred from New York east of the Hudson River, Connecticut, Massachusetts, Rhode Island, southern Vermont, New Hampshire south of the White Mountains, and four counties in southern Maine (summarized in USFWS 2004). The New England cottontail is currently restricted to small patches of suitable habitat in eastern New York, several counties in Connecticut, parts of Rhode Island, a few locations in eastern Massachusetts and in the Berkshire Mountains, several counties in southern New Hampshire, and two coastal counties in southern Maine. The WMNF is at the far northern end of the species' range.

Life History

Reproduction

Sexual maturity is probably reached in the second year. Litters average five (range = one to eight) following a 28-day gestation period; two or three litters may be produced each year. Breeding occurs between March and September, but generally peaks between March and July (summarized by DeGraaf and Yamasaki 2001).

Nests are made in a depression in the ground, usually in brush or woods rather than in grasslands (NatureServe 2001a).

Little is known about lifespan.

Dispersal

Home range in northern populations varies from less than 0.5 ha to 3-4 ha (1.2-9.8 ac). For females in western Maryland (*S. obscurus*), home range was approximately 2-10 ha (4.9-24.7 ac); males were less variable at 4-9 ha (9.8-22.2 ac). Home ranges may be linear, e.g., when along brushy borders of marshes and fields (NatureServe 2001a).

No information was identified on dispersal distances.

Relationships with Other Species

Studies reviewed in NatureServe (2001a) suggest competition between New England cottontail and eastern cottontail has contributed to the decline of the New England cottontail. Probert and Litvaitis (1995) found that New England cottontails are often dominant over eastern cottontails when food and cover were manipulated. However, eastern cottontails, which occupy a wider variety of habitat types, can move into new disturbance patches sooner than New England cottontails. Once eastern cottontails are established, it appears New England cottontails cannot successfully displace them.

Habitat

The New England cottontail occupies early successional habitats. Historically, natural disturbances such as hurricanes and other wind events, beaver activity, and even Native American burning of old fields would have maintained habitat conditions (summarized by USFWS 2004). Suitable habitat may be found where forest or shrub lands provide dense understory growth and food and cover are in close proximity (Barbour and Litvaitis 1993).

Patches of suitable habitat must be fairly close together; isolated patches of suitable structure are used much less frequently. In winter, habitat use occurs more frequently when patches are greater than ten hectares (22 ac). Ideally, habitat patches 15-75 ha (37-185 ac) in size and less than 500 m (1,640 ft) between patches may be more successful when managing for New England cottontail. HHHHabitat Although cottontails will use smaller patches, sex ratios become skewed and survival rates drop, suggesting that these patches act as population sinks to dispersing juveniles (Barbour and Litvaitis 1993, Villafuerte et al., 1997).

Brown and Litvaitis (1995) found that cottontails were more successful when the following habitat factors were relatively low: a) the perimeter-to-area ratio of an occupied patch; b) the amount of coniferous forest within one kilometer (0.62 mi) of a patch, and c) the amount of disturbed habitat within 0.5 km (0.3 mi) of a patch. The amount of water within one kilometer and an index of landscape evenness were greater for surviving cottontails. Habitat features in the vicinity of patches occupied by cottontails apparently influenced the distribution and movements of predators, while features of the patches themselves influenced cottontail exposure and predator success.

Occurrences

On the WMNF, extant populations, as well as historical occurrences, are unknown, although anecdotal evidence exists that New England cottontails have been observed on the Forest on two separate occasions.

Threats/Limiting Factors

The only limiting factor that could be influenced by WMNF actions would be the loss of early successional habitats.

Information Gaps

The SVE Mammal Panel (2002) identified the following information gaps for this species:

1. lack of survey data on the WMNF
2. Northern extent of current range is unknown

Pertinent Resource Actions and Mitigation

There are no standards or guidelines specific to New England cottontail, although habitat could be provided in differing amounts based on habitat objectives in different alternatives.

Affected Environment

The scope of effects analysis for the New England cottontail is the WMNF south in New Hampshire, where most current occurrences are found. Individuals do not likely disperse a great distance from their natal area.

Habitat Trends

In New Hampshire and much of the northeast, early successional habitat that could have supported New England cottontails has been lost due to forest maturation after farm abandonment (NatureServe 2001a). Suburbanization and forest maturation in New England have resulted in small isolated patches, where cottontails are vulnerable to local and regional extirpations (DeGraaf and Yamasaki 2001).

Population Trends

Loss of suitable habitat as forests matured led to large declines in cottontail distribution (NatureServe 2001a). DeGraaf and Yamasaki (2001) believe that increased proportions of agricultural and developed lands can be expected to produce more medium-sized carnivores and thus potentially increase predation rates.

Environmental Effects

There are no known occurrences of New England cottontail currently on the WMNF. Therefore, there would be **no effect** to this species under any alternative. However, the alternatives may differ in terms of the potential to create suitable habitat. Some amount of habitat would be maintained in all alternatives through such activities as maintaining powerline rights-of-way and through Riparian and Aquatic Habitats standards and guidelines, so these are not addressed here because they don't differ by alternative.

Alternative 1

Timber harvest is the most obvious activity that could be used to set back succession and maintain or increase the acres of suitable habitat. Given that New England cottontails are more successful when the perimeter-to-

area ratio is low, larger harvest units would be better than smaller ones. Even-aged regeneration harvests would be the most efficient way to provide this habitat.

Alternative 1 proposes the most amount of even-aged regeneration harvest of any alternatives, creating approximately 17,000 acres of new habitat per decade during the first 20 years of Forest Plan implementation. Some (or perhaps many) of these units may be too far north of the cottontail's current range to be considered available habitat; however, in a general sense, Alternative 1 would create the most amount of habitat.

Cumulative effects of Alternative 1

Development is probably the biggest threat to all habitats south of the WMNF. Many towns are rapidly clearing forested land to create homes as the human population continues to grow and spread northward from Massachusetts. While not all of these lands hold suitable habitat, once developed, the opportunity to create or enhance habitat conditions is foregone. As it is, much of the naturally maintained habitat for this species along the coastal region has already been lost to development (Lorimer and White 2003). Fewer areas of suitable habitat in their historic range may force adaptations that push the species northward. Under Alternative 1, there would likely be enough suitable habitat to support persistence of New England cottontail on the Forest. Eventually (e.g., over the next 50 years), the Forest's role may become more important in maintaining this species in the region.

Alternative 2

Alternative 2 proposes one-third fewer acres (approximately 21,400 acres over 20 years) of suitable habitat compared to Alternative 1. As in Alternative 1, only a portion of these acres would likely be placed towards the south of the Forest where New England cottontail would be most likely to occur. Individual cottontails may be able to persist on the Forest, but they could be more isolated from each other than in Alternative 1.

Cumulative effects of Alternative 2

Cumulative effects of Alternative 2 would be similar to those described in Alternative 1, although in the larger picture, the Forest's ability to serve a key role in maintaining cottontail populations would be less likely.

Alternative 3

Alternative 3 would create approximately 9,600 acres of early successional habitat over 20 years. Given that these acres would be scattered across all Management Area 2.1 lands on the Forest, this may not provide enough suitable habitat for New England cottontail to persist on the Forest, although brushy riparian habitats would be available to supplement habitats created through timber harvest.

Cumulative effects of Alternative 3

Because of the limited amount of regeneration habitat being provided on the WMNF in Alternative 3, it is unlikely that the Forest could serve a role in this species persistence in the region. Cottontails may still occur on the

Forest, but because habitats would be so few and far between, the Forest would more likely serve as sink habitat and not contribute to the larger population.

Alternative 4

Alternative 4 would create approximately the same amount of regeneration habitat as Alternative 2, so for this species, the effects of these two alternatives would be the same.

Cumulative effects of Alternative 4

The cumulative effects of Alternative 4 would be similar to those described for Alternative 2.

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