WILDLIFE AND FISH

Introduction

The Lewis and Clark National Forest Plan, Forest-wide Objectives place emphasis on recovery of federally listed Threatened and Endangered species and on maintenance of Forest Sensitive Species. The National Forest Management Act specifies categories for the selection of Management Indicator Species (MIS) to be considered in all project planning: threatened and endangered species, species with special habitat needs that may be influenced significantly by planned management programs, species commonly hunted, fished or trapped, non-game species of special interest, and additional species for which population changes are believed to indicate the effects of management activities on other species of selected major biological communities or on water quality.

Table III-76 displays the Threatened, Endangered, Sensitive, and Management Indicator species present on the Lewis and Clark National Forest (LCNF) with information on the extent to which each species is included in the analysis of impacts, and the rationale for the level of analysis. In this table the following abbreviations are used: T= Threatened, E=Endangered, C=Candidate, PT=Proposed Threatened, S=Sensitive, MIS=Management Indicator Species, O=Other.

Wildlife and Fish Analysis Documentation Summary

Table III-76. Wildlife and Fish Analysis Table

Species Name	Habitat Preference and Occurrence in Project Area	Location of Documentation	Rationale and Other Information
Threatened, Endangered, and Proposed Species			
Grizzly Bear (T)	Ranges widely through variety of habitats; prefers low-elevation riparian zones, avalanche chutes in spring/early summer; high elevation steep slopes for denning. Jefferson Division is outside NCDE Recovery Zone and is not considered occupied habitat.	Analysis in Biological Assessment*	Not present in project area. Potential for expansion into area.
Gray Wolf (E)	Ranges widely through variety of habitats; prey availability is key to denning and rendezvous sites. No den sites in analysis area, recent sightings in Castles, Crazies and Little Belt Mountains. Jefferson Division populations are considered experimental, non-essential by the USFWS.	Analysis in Biological Assessment*	Likely use of project area and potential for expansion in area. Primary concerns are maintenance of prey base and potential for direct mortality. Access restrictions and habitat guidelines and requirements for elk meet needs for gray wolf; therefore analysis for elk are surrogate for gray wolf.
Bald Eagle (T)	Preferred nesting areas adjoin large bodies of water; nest and perch in large diameter snags or trees. Project area is primarily migration habitat; no known nests.	Analysis in Biological Assessment*	Little nesting habitat and no known nests within project area.

Species Name	Habitat Preference and Occurrence in Project Area	Location of Documentation	Rationale and Other Information
Lynx (T)	Ranges widely through variety of habitats. Multi-story conifer habitat key to foraging; prefers woody debris for denning. Habitat and species present.	Analysis in DEIS and Biological Assessment*	Primary concern is potential effects of compacted over-snow routes and areas on lynx.
Sage Grouse (S,C)	Sagebrush benches and irrigated cropland. Limited habitat in project area, population exists adjacent to the project area.	No further analysis will be completed, documentation in Biological Assessment*	No increased access to existing habitat proposed in any alternative.
Mountain Plover (PT)	Grazed shortgrass prairie; prairie dog towns. Habitat does not exist in the project area.	No further analysis will be completed, documentation in Biological Assessment*	Not in project area.
Forest Sensitive Species			
Peregrine Falcon (S)	Nests on cliffs adjacent to grassland, riparian openings or bodies of water. Nesting habitat exists with one eyrie within the project area and one adjacent.	No further analysis will be completed, documentation in Biological Evaluation**	No increased access to nesting habitat proposed in any alternative.
Northern Goshawk (S)	Nests in mature/over-mature forest; forages in variety of successional stages. Nest sites and habitat within the project area.	No further analysis will be completed, documentation in Biological Evaluation**	No new access or changes to existing nesting habitat proposed in any alternative.
Flammulated Owl (S)	Semi-arid cool sites of mid-elevation pine communities. Nests in existing cavities. Little or no habitat exists in the project area. Species is not known to occupy the project area.	No further analysis will be completed, documentation in Biological Evaluation**	Not in project area.
Burrowing Owl (S)	Open areas with low ground cover and abandoned small mammal burrows. Little habitat exists in the project area.	No further analysis will be completed, documentation in Biological Evaluation**	No increased access to existing habitat proposed in any alternative.
Blackbacked Woodpecker (S)	Mature/over-mature forest and recently burned areas. Habitat exists within the project area.	No further analysis will be completed, documentation in Biological Evaluation**	No new access or changes to existing habitat proposed in any alternative.
Townsend's Big-eared Bat (S)	Generally inhabits caves or buildings. Little known habitat in project area; species not known to occupy project area.	No further analysis will be completed, documentation in Biological Evaluation**	No new access or changes to habitat proposed in any alternative.
Wolverine (S)	Wide ranging use of variety of habitats. Natal denning in high-elevation cirques. Habitat and species present	Analysis in DEIS and Biological Evaluation**	Likely present in low densities in much of project area. Primary concerns are potential for snowmobiling impacts to alpine denning areas.

Species Name	Habitat Preference and Occurrence in Project Area	Location of Documentation	Rationale and Other Information
Harlequin Duck (S)	Low-gradient, fast-flowing streams with cobble to boulder substrate. Habitat does not exist in project area.	No further analysis will be completed, documentation in Biological Evaluation**	Not in project area.
Fisher (S)	Prefer forested areas of continuous cover; closely associated with riparian areas. Marginal habitat occurs in project area, species not known to exist in project area.	No further analysis will be completed, documentation in Biological Evaluation**	Not in project area.
N.Bog Lemming (S)	Thick mats of sphagnum moss in bogs, fens, or other wet areas. Some habitat in project area, species not known to occur.	No further analysis will be completed, documentation in Biological Evaluation**	Not in project area.
Westslope Cutthroat Trout (S)	Cold streams with high water quality and few competing fish species. Spawn in late spring/early summer in gravel riffles with low sediment levels. Pure strain and hybridized populations occur in project area.	Analysis in DEIS and Biological Evaluation**	Present in numerous streams within project area; other streams are potential candidates for population expansions. Primary concerns are stream sedimentation, habitat security, disturbance to spawning sites, and illegal harvest.
Western Toad (S)	Breeds in shallow, silt-bottomed ponds with little flow. Breeding sites documented in several locations in the project area.	No further analysis will be completed, documentation in Biological Evaluation**	Existing known breeding habitat limited to specific sites. No significant effect on habitat or populations is expected.
Northern Leopard Frog (S)	Low elevation ponds and slow-moving streams and rivers. Habitat is not known to exist in the project area and no leopard frogs have been found in Forest Service surveys.	No further analysis will be completed, documentation in Biological Evaluation**	Not in project area.
Greater Short-horned Lizard (S)	Habitat found on rodge crests between coulees, and in sparse, short grass and sagebrush with sun-baked soil. Limited habitat in project area.	No further analysis will be completed, documentation in Biological Evaluation**	No increased access to existing habitat proposed in any alternative.
Management Indicator Species			
Elk (MIS)	Wide ranging through variety of habitats. Habitat and population exists	Analysis in DEIS	Subject to regulated and permit harvest. Primary concerns are potential for displacement due to recreational travel, and potential for increased hunting pressure. Will be used as a surrogate for mule and white-tailed deer, bobcat, black bear, gray wolf and mountain lion. Of these wide-ranging species, elk are the most sensitive to displacement caused by recreation, and they serve as important prey for gray wolf and mountain lion.

Species Name	Habitat Preference and Occurrence in Project Area	Location of Documentation	Rationale and Other Information
Mule Deer (MIS)	Wide-ranging through variety of habitats. Habitat and population exists	Analysis in DEIS	Subject to regulated harvest. Access restrictions and habitat guidelines and requirements for elk meet needs for mule deer; analysis limited to winter range.
White-tailed Deer (MIS)	Deciduous riparian and low-elevation grass and cropland. Primary habitat at lower elevation and private land, limited habitat and seasonal presence within project area.	No further analysis will be completed	Subject to regulated harvest. Access restrictions and habitat guidelines and requirements for elk meet summer needs for white-tailed deer; therefore analysis for elk serves as surrogate for whitetail deer. Winter habitat outside of project area.
Black Bear (MIS)	Wide ranging through variety of habitats. Habitat and population exists.	No further analysis will be completed	Subject to regulated permit harvest. Access restrictions and habitat guidelines and requirements for elk meets needs for black bear; therefore analysis for elk serves as surrogate for black bear.
Bighorn Sheep (MIS)	Open grassland and savannah in proximity to cliff habitats. No potential habitat exists in project area.	No further analysis will be completed	Not in project area.
Mountain Goat (MIS)	High elevation meadows in proximity to cliff habitats. Potential habitat exists in project area. Occassional sightings in Smith River Corridor, no reproduction known.	No further analysis will be completed	Occupied habitat does not exist within the project area.
Mountain Lion (MIS)	Wide ranging through variety of habitats. Habitat and population exist.	No further analysis will be completed.	Highly adaptable to environment, subject to regulated permit harvest. Management of prey base (wild ungulates) aids in management of lion. Access restrictions and habitat guidelines and requirements for elk meet needs for lion; therefore analysis for elk is surrogate for mountain lion.
Blue Grouse (MIS)	High-elevation timber/grassland mosaics. Winter in high elevation conifer stands. Habitat and population exist.	No further analysis will be completed.	No new access or changes to existing habitat proposed in any alternative.
Brook, Rainbow Trout (MIS)	Cool streams and rivers with sand or gravel substrate. Brook trout spawn in fall and are less sensitive to effects of roads and trails. Rainbow trout are spring spawners and their redds are vulnerable to damage at stream crossings. Habitat and populations exist.	Limited further analysis in the form of generalized inferences about effects on fish habitat and risk levels for travel plan alternatives will be completed.	Standards for protecting water quality and minimizing impacts of roads and trails provide a measure of protection for fish habitats. Regulations generally prevent overharvest of accessible populations.
Beaver Habitat (MIS)	Variety of riparian habitats. Habitat and population exists.	No further analysis will be completed	No new access or changes to existing habitat proposed in any alternative.

Species Name	Habitat Preference and Occurrence in Project Area	Location of Documentation	Rationale and Other Information
Bobcat (MIS)	Prefers rough broken terrain, open or semi-open overstory canopy; use of riparian corridors to link habitat segments. Habitat and population exist.	No further analysis will be completed.	Access restrictions and habitat guidelines and requirements for elk meet needs for bobcat; therefore analysis for elk is surrogate for bobcat.
Golden Eagle (MIS)	Nests on cliffs or open, high-relief areas. Nest sites within the project area.	No further analysis will be completed.	No new access or changes to existing nesting habitat proposed in any alternative.
Prairie Falcon (MIS)	Nests on cliffs adjacent to grasslands and large openings. Nest sites within the project area.	No further analysis will be completed.	No new access or changes to existing nesting habitat proposed in any alternative.
Northern 3-Toed Woodpecker (MIS)	Mature and old-growth forest. Habitat and species exist.	No further analysis will be completed	No new access or changes to existing nesting habitat proposed in any alternative.
Other Species of Concern			
Neotrop Birds (O)	General forest species are present, habitat does not exist for species that are restricted to special habitats (ie, shortgrass prairie, sagebrush, marshlands, post fire, older forests of the cedar-hemlock type) or have demonstrated downward trends.	No further analysis will be completed.	No new access or changes to existing mix of vegetative types or to specific habitats proposed in any alternative.
Amphibians (O)	Habitat for amphibians exists; Columbia spotted frogs and tiger salamanders have been found in the project area. Breeding sites have been located.	No further analysis will be completed.	No significant effects on habitat or populations is expected.

* Biological Assessment will be prepared for Preferred Alternative once it is chosen (prior to the FEIS and Record of Decision) and will become part of the project file.

** Biological Evaluation will be prepared prior to the FEIS and Record of Decision and will become part of the project file.

As indicated in the above table, potential impacts of the alternatives on the following species or their habitats will be analyzed in detail: Canada lynx, elk, mule deer, wolverine, and westslope cutthroat trout. Elk appear to be more sensitive than many other species to displacement caused by recreation, they migrate over long distances between critical seasonal ranges, and they serve as important prey for some carnivore species. They will therefore be used as an analysis surrogate for several other species, as noted in the table.

The list of Threatened and Endangered species found on US Fish & Wildlife Service website ***http://montanafieldoffice.fws.gov/Endangered_Species/Listed_Species/Forests.html***, dated April 17, 2006, was confirmed on May 15, 2006. The Region One Sensitive Species list was updated in October 2004, and two species (northern goshawk and black-backed woodpecker) were added to the list by order of the Regional Forester in April 2005.

Wildlife Issues

During the scoping period, three significant issues were identified as requiring detailed analysis. These issues are:

1. The potential for recreational travel to displace wildlife.

2. The effects of recreational travel on seasonally important wildlife habitats.

3. The potential effects of snow compaction on wildlife (specifically Canada lynx).

Some of these issues are of concern for all wildlife species on the Jefferson Division, while others are of concern in the context of only one or a few species. The analysis presented below is organized around these issues, with sections for particular species within each issue discussion as appropriate.

Scope of Analysis

The entire travel planning area will be considered for direct and indirect effects for most species considered. Cumulative effects analysis will be considered at the scale most appropriate for the species being considered. Additionally Canada lynx will be analyzed by Lynx Analysis Unit (LAU) (Map 13), and elk and mule deer will be analyzed by hunting district (Map 10). Hunting districts were chosen because they are consistent with the scale of analysis recommended by Christensen et al. (1993:3) for managing elk habitat and because hunting districts are utilized by MFWP to manage population objectives specific to each area. Most wildlife species analyzed will also be considered at the scale of specific seasonal habitats (Maps 11, 12, 17, 18, 19, 20).

Wildlife Affected Environment

Because of the nature of analysis required for this project, the format for the Wildlife and Fish section of Chapter 3 varies slightly from that used for other resource areas. Existing condition is described in one section for all wildlife populations and habitats to be analyzed in detail. The issues are discussed separately under appropriate headings. The cumulative effects considered for wildlife are the same or similar for all wildlife issues, and will be discussed in a single section at the end of the analysis. Issues and analysis for fish, including cumulative effects, are considered under a separate heading.

1. EXISTING CONDITION

<u>a. Natural Characteristics</u>

Threatened and Endangered Species

<u>Canada Lynx</u>

Within Montana, the Canada Lynx is listed as a Threatened species with the United States Fish and Wildlife Service (USFWS). The USFWS identified the primary factor causing the lynx to be listed as the lack of guidance for conservation of lynx and snowshoe hare habitat in National Forest Land and Resource Plans and Bureau of Land Management Land Use Plans

given that a substantial amount of lynx habitat in the contiguous U.S. is federally managed (USDI 2000). It has an S3 status with the Montana Department of Fish Wildlife and Parks (MT FWP) which is defined as "Potentially at risk because of limited and potentially declining numbers, extent and/or habitat, even though it may be abundant in some areas." The Forest identifies the lynx as a Management Indicator Species, and they have been documented on the Jefferson Division. Location and distribution information included Forest and District records of both sightings and track surveys, the National Heritage Program, and MT FWP track survey and trapping records. In the Recovery Outline (USFWS 2005) habitat and occurrence within the contiguous U.S. is categorized as core area, secondary area, and peripheral area. The analysis area is identified as secondary area, which is "those with historical records of lynx presence with no record of reproduction; or areas with historical records and no recent surveys to document the presence of lynx and/or reproduction. If future surveys document presence and reproduction in a secondary area, the area could be considered for elevation to core."

Lynx in the contiguous U.S. are at the southern margins of a widely distributed range across Canada and Alaska. Home ranges vary from 12-83 mi^2 (as cited in USFWS 2005), with home ranges of males being larger than females. Home ranges are quite variable and increase in size during hare population lows (Ruediger et al. 2000). Lynx occur in mesic coniferous forests that have cold, snowy winters (generally referred to as boreal forest) and that provide a prey base of snowshoe hare (Ibid). The southernmost extent of the boreal forest that supports lynx occurs in the contiguous U.S. in the Northeast, western Great lakes, northern and southern Rockies, and northern Cascades (Ibid). A population can only persist in a large boreal forest landscape that contains the appropriate forest types, snow depths, and high snowshoe hare densities. Lynx avoid large openings but often hunt along edges in areas of dense cover (Ibid). They are highly mobile; they make long exploratory movements outside of their home ranges, and can disperse great distances particularly when prey becomes scarce.

East of the Continental Divide lynx inhabit subalpine forests (generally subalpine fir) at higher elevations (5,500' to 8,000'). Secondary habitat is intermixed Englemann spruce and Douglas-fir habitat types where lodgepole pine is a major seral species (Ruediger et al. 2000). Throughout their range, shrub-steppe habitats may provide important linkage habitat between the primary habitat types described above (Ibid). Lynx are adapted to deep snow (large, furred feet contribute to low foot loading), and lynx occur primarily in habitats with relatively uniform and moderately deep snowfall. Disturbances that create early successional stages such as fire, insect infestations, and timber harvest, provide foraging habitat for lynx by creating forage and cover for snowshoe hares. Dense conifer seedlings and saplings provide snowshoe hare browse and escape and thermal cover. Vegetation characteristics making up good snowshoe hare habitat include a dense, multi-layered understory that maximizes cover and browse at both the ground level and at varying snow depths throughout the winter (crown continuous from ground level to approximately 6 feet high at maximum snow depths). Some older forests can provide habitat for snowshoe hares and lynx for longer periods of time than disturbance-created habitats (Ibid).

Survivorship, productivity and population dynamics are closely related to snowshoe hare densities throughout the range of the lynx. A minimum density of hares (>1.2/acre) (Ruggiero et al. 2000) distributed across a large landscape is necessary to support survival of young and recruitment into and maintenance of a population. In northern Canada, populations fluctuate in response to snowshoe hare cycles. Although hare populations in the southern portion of their range may fluctuate, they don't show the strong, regular population cycles of the north. Average lynx home ranges in southern populations are generally

substantially larger than those in the north (Aubry et al. 1999), likely because southern hare populations exist at lower densities than northern populations. Red squirrels are an important secondary prey item, particularly when hare populations are low (Ruediger et al. 2000). Summer diets are not as well known but are probably more varied. In Montana lynx may prey on a wider variety of species throughout the year because of generally lower snowshoe hare densities and the availability of alternate prey (Ibid). Alternate prey items include cottontails, jack rabbits, grouse, flying squirrels, ground squirrels, porcupines, beavers, mice, voles, shrews and occasionally ungulates as prey or carrion.

Breeding occurs in March and April, and gestation lasts 62 to 74 days with 3 or 4 in an average litter. Adult females produce one litter every 1 to 2 years, and the young stay with the female at least through the next mating season. During snowshoe hare population highs, reproduction increases and some females give birth as yearlings. Prey scarcity suppresses breeding and may result in mortality of nearly all young (Brand and Keith 1979). In Alberta, reproduction fell 38 percent (ovulation rates, pregnancy rates and litter size) and mortality of kittens reached 95 percent during cyclic hare population lows (Ibid). Denning habitat is highly associated with large amounts of coarse woody debris. Dens are typically in hollow trees, under stumps, or in thick brush in mature or old-growth stands of spruce, subalpine fir, and lodgepole pine with a high density of logs. Denning habitat must be near or adjacent to foraging habitat as the foraging distance of the female is reduced during this time (Ruediger et al. 2000).

Many high elevation and deep snow areas have traditionally received little human activity in late winter with the exception of downhill ski areas. The recent popularity of backcountry snowmobiling and the advent of more powerful snowmobiles have resulted in substantially increased late winter disturbance into areas previously receiving little use. With increased horsepower, improved traction, and improved suspension, snowmobilers are able to access more areas. Backcountry snowmobiles cover a vastly greater area, and have a greater zone of influence than nonmotorized uses as the speed, distance covered, noise, and exhaust are greater. Areas accessible to snowmobiles are vastly greater in size than lands occupied by downhill ski areas, and substantially more miles of snowmobile trails occur in the analysis area than cross country ski trails. Designated routes through area closures likely have less of an impact than dispersed use, as wild animals generally have a higher tolerance for predictable human activities.

The lynx's adaptations for foraging in deep snow provide an advantage against competitors such as coyotes or bobcats. Snow compacted routes caused by snowmobiling or ski trails may improve the ability of competitors to use deep snow habitat.

ATVs and motorcycles are similar enough in speed, noise, and exhaust to automobiles that motorized trails would likely have similar effects to roads. Effects are primarily related to disturbance.

Disturbance can affect lynx in multiple ways. Disturbance may displace potential mates from each other, or separate young from mothers, thereby influencing reproductive and survival rates. Elevated heart rate and respiration, increased blood sugar levels, increased flow to skeletal muscles and a corresponding decrease of blood flow to the skin and digestive organs (Knight and Gutzwiller 1995) result as part of a fight or flight response, and have a high energetic cost. Adult females are capable of annual reproduction, but often do not. Poor nutritional status of females, coupled with high energetic demands of fetal development and lactation are likely primary causes of reproductive failure. In late spring and early summer, females are in the last part of their pregnancy, giving birth, and lactating, all while continuing

to forage. Moving kittens in response to disturbance could result in relocation to less suitable sites, increased risk to exposure, predation, and other threats. Disturbance can also result from nonmotorized access in the immediate vicinity of a den.

Sensitive Species

Wolverine

Within Montana, the wolverine is not a federally listed or candidate species with the USFWS, or currently petitioned for listing. The wolverine has been petitioned twice for listing under the federal endangered species act in the conterminous United States (U.S.). The most recent petition was denied citing lack of information on distribution, habitat requirements, and threats (USFWS 2003). The wolverine has an S3 status with the MT FWP. An S3 status is defined as "Potentially at risk because of limited and potentially declining numbers, extent and/or habitat, even though it may be abundant in some areas." The Forest identifies the wolverine as both a Sensitive and Management Indicator Species.

In North America, this species range once included the vast majority of Alaska and Canada, the northern tier of the conterminous U.S., and mountains as far south as the Sierra Nevada's in California and the Rocky Mountains of northern New Mexico. As a result of habitat loss and human caused mortality, the current range in North America has been reduced to Alaska, northern and western Canada, and limited areas of Idaho, Montana, Washington, and Wyoming (Banci 1994). They have been documented in all three mountain ranges in the analysis area. Location and distribution information included Forest and District records of both sightings and track surveys, and MT FWP track survey and trapping records.

Individual home ranges are large with males having larger home ranges than females. From studies in Alaska, the Yukon, Montana, and Idaho home ranges vary from less than 37 mi^2 to greater than 932 mi^2 (Banci 1987; Copeland 1996; Gardner 1985; Magoun 1985). Wolverine use a wide range of habitats and in summer generally prefer higher elevation areas of forest, talus/rock, and alpine. In winter and spring they may follow big game ungulates to scavenge on winter kill, and use higher elevation areas where adequate prey and carrion are available. Wolverine habitat normally encompasses large areas of remote and rugged terrain. Wolverines are considered to be sensitive to human development, especially with respect to selection of denning sites (Banci 1994).

Isolation from human impacts and activities, a diverse prey base, ungulate carrion, and natal den site security seem to be the primary factors associated with effective wolverine habitat. They appear to not tolerate land-use activities that permanently alter habitats, such as agriculture, and urban and industrial development (Banci 1994). Wolverines have large home ranges, low reproductive potential, and are more ecologically similar to large carnivores than other species of similar size (Weaver et al. 1996). Even in areas that have not been impacted by human activities, they have naturally very low population densities. This increases the risk that local extirpations will isolate populations. Life history characteristics of the wolverine result in low population resiliency (Banci and Proulx 1999; Weaver et al. 1996).

Despite the wolverine's capacity for long-range dispersal, studies investigating the phylogeography and conservation genetics of wolverines have found varying levels of geographic partitioning. Northern North American wolverine populations experienced higher levels of gene flow and less genetic structure than more southerly (including Montana) populations. Higher levels of genetic structuring are likely associated with more limited gene flow (Kyle and Strobeck 2001 and 2002). A study of population structure and gene flow in

Montana (Cegelski et al. 2003) found a high degree of population substructure and low levels of gene flow in contrast to results from other studies in less fragmented landscapes of Alaska and Canada. Despite the geographical proximity of the subpopulations and the dispersal capabilities of this species, Montana wolverines are clearly not a single population. The study supported the hypothesis that populations of Montana are becoming increasingly fragmented due to human development and disturbance. Of the three subpopulations identified by the study in Montana, the population in the Crazy and Little Belt Mountains (the population found in the analysis area) was the most isolated for number of migrants and gene flow. The apparent isolation of this population suggests that the population will not be "bolstered" by migrants from other areas, and that it may not be recolonized as easily as other regions in Montana. Appropriate management plans and conservation strategies should include provisions for conserving connectivity among populations, and conserving remaining genetic diversity of this species (Tomasik and Cook, 2005).

The broad diet of the wolverine varies with region and season. It is an excellent scavenger of carrion, with a robust skull, musculature, and dentition capable of crushing large ungulate bones and rendering frozen carcasses. Wolverine do not hibernate and thus need to forage year around. Movement to lower elevations in winter may result from increased presence of carrion attributable to the fall big game hunting seasons (Copeland 1996) and winter kill. Big game carrion throughout the year is provided by all causes of mortality such as human hunting, vehicle accidents, winter kill, old age, disease, and predation by other predators (primarily mountain lions in this area). Wolverine have occasionally been documented killing large ungulates, primarily in deep snow. More commonly they prey on a wide range of smaller species such as snowshoe hares, cottontails, voles, ground squirrels, porcupines, marmots, skunks, and weasels. They also opportunistically consume berries, insects, fish, birds, and eggs.

Breeding season is primarily early summer, but ranges through late spring and early fall. Delayed implantation of embryos results in birthing between January and April. Very few den sites have actually been found and documented. The majority of these were in areas of deep snow accumulation where snow was retained into spring and early summer. Snow tunnels often form part of the den infrastructure, along with large rocks and large down wood. Denning habitat in the northern Rockies is strongly tied to secluded, high elevation, glaciated landscapes (Copeland 1996; Hillis and Kennedy 2002; Hornocker and Hash 1981;Magoun and Copeland 1998), often with cirque (deep, steep-walled) basins. The Jefferson Division offers little in the way of cirque basins with few exceptions, most notably Big Baldy Mountain. They have also been found in high elevation talus slopes or avalanche chutes, and have been located in large woody debris within subalpine forest (Copeland et al. 2003). In this area denning habitat is likely in high elevation areas where snow remains relatively late in the year, and where talus slopes, other rocky areas, and large down wood are present. Denning habitat is limited on the Jefferson Division and low availability of natal dens may limit reproduction (Banci 1994).

Denning habitat was modeled for the Jefferson Division using GIS. The model was a combination of three queries of different data sources. The first included elevation greater than 6,499 ft, azimuth between 315 and 135 degrees, concave curvature, slope less than 101 percent, and cover types of rock and ice (from the SILC 1 data). The second query used the same parameters as the first (utilizing the SILC 3 data), except that the rock vegetation type was excluded from the data set, and curvature was set to equal all but convex. The third query included the same parameters as the second except that the rock vegetation type was derived from the TSMRS data base, and the ice component was excluded. Results from all

three queries were added to get the modeled wolverine denning habitat. The modeled denning habitat was then buffered by 1km to capture disturbance influences and also to capture additional denning sites in conifer vegetation types.

Many high elevation areas have traditionally received little human activity in late winter with the exception of downhill ski areas. The recent popularity of backcountry snowmobiling and the advent of more powerful snowmobiles have resulted in substantially increased late winter disturbance into areas suitable for denning (Hillis and Kennedy 2002). With increased horsepower, improved traction, and improved suspension, snowmobilers are able to access more remote and rugged areas. Copeland (1996) believed that over-snow vehicles and increased interest in winter recreation has likely displaced wolverines from potential denning habitat in central Idaho. Copeland (1996) found that when denning females were exposed to even low levels of human disturbance, those females immediately relocated their dens, often miles away from the original location. Several researchers have speculated that such behavior to avoid humans could result in reduced young survival or total den failure (Copeland 1996; Ruggiero et al. 1994). Krebs corroborated this assumption in British Columbia by demonstrating that wolverine populations had the highest levels of juvenile recruitment within areas where there was no human disturbance in late winter (Krebs, et al. 2004). Backcountry snowmobiles cover a vastly greater area, and have a greater zone of influence than nonmotorized use as the speed, distance covered, noise, and exhaust are greater. Areas accessible to snowmobiles are vastly greater in size than lands occupied by downhill ski areas. There is more snowmobile use and many more miles of snowmobile trails than cross country skiing or snowshoeing use and trails in the analysis area. Backcountry snowmobiling has been identified as a possible limiting factor to wolverines in Region One, and is the factor managed by National Forests that is likely the most limiting for wolverine. Wild animals generally have a higher tolerance for predictable human activities, and designated routes through area closures likely have less of an impact than dispersed use. Snowmobile use even on designated routes through denning habitat would likely still have adverse impacts.

Wolverines are well adapted to deep snow conditions through characteristics such as low weight loading (proportionately large, furred feet). This results in a potential foraging advantage in deep snow against predators such as coyotes or bobcats. Snow compacted routes caused by activities such as snowmobiles may improve the ability of competitors such as coyotes and bobcats to use deep snow habitat.

Rowland et al. (2003) evaluated models for wolverine habitat in the northwestern U.S. and concluded that road densities were a reasonable proxy for human disturbance relative to wolverine occurrence on the landscape. A model developed for the Interior Columbia River Basin found wolverine occurrences to be distinguishable between low road densities (<=0.7 $mi/mi^{2)}$ and moderate road densities (0.8 to 1.7 mi/mi^2). The model did not indicate a distinction between moderate and high (>1.7mi/mi^2) road densities (Rowland et al. 2003). Carroll found that wolverine occurrences in the Rocky Mountain region declined when road densities exceeded 2.7 mi/mi^2. ATVs and motorcycles are similar enough in speed, noise, distance traveled, and exhaust to automobiles that motorized trails would likely have similar effects.

Disturbance can affect wolverine in multiple ways. Disturbance may displace potential mates from each other, or separate young from mothers, thereby influencing reproductive and survival rates. Elevated heart rate and respiration, increased blood sugar levels, increased flow to skeletal muscles and a corresponding decrease of blood flow to the skin and digestive organs (Knight and Gutzwiller 1995) result as part of a fight or flight response. This poses a

high energetic cost at times of energy deficiencies. In winter, weather conditions can be extreme, food sources limited, and thermoregulatory demands high.

Also in winter and spring, females are in the last part of their pregnancy, creating dens, giving birth, and lactating, all while continuing to forage. Adult females are capable of annual reproduction, but often do not (Banci 1987; Hornocker and Hash 1981; Magoun 1985;, Persson 2003; Inman et al. 2003). Poor nutritional status of females, coupled with high energetic demands of fetal development and lactation are likely primary causes of reproductive failure. Female wolverines may be extraordinarily sensitive to human disturbance, and have been found to abandon maternal den sites and move kits in response to disturbance (Copeland 1996). Moving kits increases kit mortality through relocation to less suitable sites, increases risk to exposure and predation, and other threats. Given the wolverine's low reproductive capacity, any reproductive losses could be significant.

Nonmotorized travel may also impact den sites. Snowshoeing, cross country and back country skiing may cause disturbance, particularly where they occur in denning habitat. Motorized use generally has a greater zone of influence as the area used; speed, distance covered, sound, and exhaust are greater than nonmotorized use. In the analysis area there are more miles of snowmobile trails than nonmotorized winter trails.

The MT FWP currently manages the wolverine as a furbearer. The Jefferson Division falls within Wolverine Management Unit 2, which has an annual harvest limit of two individuals. Montana is the only state in the conterminous U.S. that currently allows the legal harvest of wolverines. Habitat loss and human caused mortality (primarily trapping) are likely the most important factors affecting conservation of the wolverine (Gittleman et al. 2001, Hornocker and Hash 1981). Survival is substantially lower in trapped populations of wolverines, and human caused mortality is largely additive to natural mortality (Krebs et al. 2004). Trapping and hunting account for most of known wolverine mortalities (Banci 1994:108). With their dependence on carrion and wide ranging habits, wolverine are susceptible to bait trapping, and trapping may be a threat given their low realized biological potential (Ruggiero et al. 1994). Travel management can have an effect on harvest as roads and trails are often used for trapping access.

Big Game Species

Ungulates provide a large percentage of the recreational opportunities for wildlife enthusiasts in the State of Montana. Hunting, wildlife viewing, and photography generate economic benefits in excess of $450 million annually (Canfield et al. 1999). Recreational activities have the potential not only to displace ungulates to private land where they may cause damage, but also to have negative direct and indirect effects to the populations themselves (Ibid). Various types of Forest travel can cause disturbance and displacement of some big game species from important seasonal habitats, resulting in lower big game populations and reduced wildlife related recreational opportunities. Displacement from public lands can erode habitat quality, and result in under-utilization of otherwise suitable big game habitats. Displacement to private ranges can increase damage to private properties, reduce hunting opportunities for the general public, and limit the ability to manage populations and meet population management objectives. While displacement from public lands can result from an array of different types of human disturbances, including timber management, livestock grazing, and recreational pursuits, this analysis will focus on disturbances associated with travel planning, especially motorized travel.

The Jefferson Travel Planning Analysis Area (Little Belt, Castle, and Crazy Mountain Ranges) provides habitat for many big game mammals. The Lewis and Clark National Forest is responsible for managing habitat for big game ungulates, while the Montana Department of Fish, Wildlife and Parks (MT FWP) is responsible for managing the animals themselves. Primary big game species within the planning area include elk, mule deer, white-tail deer, and moose. Of these, the Lewis and Clark Forest Plan identifies elk, mule deer and white-tail deer as Management Indicator Species (MIS) for commonly hunted species.

Mule Deer

Mule deer are found throughout the planning area during one or more seasons of the year. All forest lands are considered summer range, and lower elevations within the forest/grassland interface provide winter range and fawning habitat. As is the case with elk, Forest Service and MT FWP biologists have mapped and spatially designated mule deer winter ranges (Forest GIS library). There is a large amount of overlap between mule deer and elk habitat, and travel management impacts are expected to be very similar. Therefore, travel planning effects on mule deer will not be analyzed in detail, except for mule deer winter range.

White-tail deer

This species utilizes primarily private lands during winter, but migrates to the Forest in spring/early summer. There is considerable overlap in habitat between elk, mule deer and white-tail deer (especially during summer/fall seasons); travel management impacts on elk during the summer (June 1 to September 1) and fall hunting seasons (September 1 to December 1) would be similar to anticipated effects on white-tail deer; therefore, travel planning effects on white-tail deer will not be analyzed in detail.

Moose

Moose occur throughout the planning area, although at much lower population densities than the other big game ungulates. Moose are most likely to be found in willow dominated riparian areas, aspen stands and subalpine fir forests. As is the case with other big game ungulates, they utilize higher elevation habitats in summer, and lower elevations with low snow packs during winter. There is little research available to adequately measure travel planning effects on moose, but effects are likely to be similar to those described for elk. Elk are widely distributed across the planning area, and habitat use overlaps those habitats most preferred by moose. Since both species utilize similar habitats, and travel management impacts on elk would be expected to have similar effects on moose, this species will not be analyzed in detail is this document. Travel planning effects on moose were not identified as a significant issue during scoping, and moose are not identified as a Management Indicator Species in the Forest Plan.

Elk

Elk are found throughout the planning area during one or more seasons of the year. All forested lands are considered summer range. Lower elevations within and adjacent to the forest /grassland interface provide winter range and calving habitat. Important winter range and calving habitat have been identified and mapped by LCNF and MT FWP biologists, and important winter range and calving habitats are spatially designated in the Forest GIS library and on Map 11 in the DEIS. The planning area provides a large amount of quality elk habitat and significant recreational hunting opportunities to hunt elk. Current elk populations meet or exceed population objectives set by MT FWP in most Hunting Districts within the planning area. The Forest Plan identifies elk as a Management Indicator Species (MIS) for commonly

hunted species. Forest Plan standard C-1 and Forest Plan appendices E, F, G, and O describe the need and means to manage open route densities, habitat effectiveness and security. The analysis that follows defines and describes in detail how the different travel alternatives would be expected to affect elk habitat, and whether or not Forest Plan standards and objectives would be met.

Summer Travel Period (June 30 to Sept 1)

The summer period is critical, in that elk must have access to adequate forage to build fat stores sufficient to allow them to survive the next winter. Summer nutrition plays an important role in the ability of cows to produce healthy calves, and in the ability for bulls to build fat reserves for the fall breeding season while meeting energy demands for antler growth (Canfield et al. 1999). Disturbance from human activities has the potential to displace elk from preferred habitats during the critical summer period, thus compromising their ability to survive and reproduce, potentially affecting populations (Ibid).

Many studies have shown that motorized access influences elk habitat use (Canfield et al. 1999; Christensen et al. 1993; Lyon 1983; Roland et al. 2005). Elk have repeatedly been shown to avoid habitat adjacent to open roads and declines in habitat use have been reported within 0.25-1.8 miles of open roads (Lyon and Christensen 2002). Substantial reductions in habitat use are normally confined to <0.5 miles of an open road. Although many variables influence elk habitat use relative to open roads, avoidance of open roads was greatest when less cover was present, during the hunting season when use of Forest roads peaks, and on high-standard primary roads (Lyon et al. 1985).

Observed declines in habitat use adjacent to roads have led to the development of elk habitat effectiveness models. Habitat effectiveness refers to the percentage of available habitat that is usable by elk outside the hunting season (Lyon and Christensen 1992). A variety of elk habitat effectiveness models have been produced for different habitats in the western United States, but a common variable is open road density. Although restricted roads (those roads which are gated or otherwise physically blocked to prevent public motorized use during all or portions of the year) may still cause an avoidance response by elk, avoidance is normally much lower when compared to open roads (Lyon et al. 1985). This is why open road densities are normally used rather than total road densities (which include both open and restricted roads) in habitat effectiveness models.

Using Lyon's model for habitat effectiveness based entirely on road density (Lyon 1983), Christensen and others (1993) recommended that habitat effectiveness should be 70 % or greater (open road density <0.7 mi/sq mi) for areas intended to benefit elk summer habitat and retain high use. Areas where elk are one of the primary resource considerations should have habitat effectiveness of 50% or greater (open road density <1.9 mi/sq mi). Areas with <50% habitat effectiveness (>1.9 mi/sq mi) were expected to make only minimal contributions to elk management goals (Christensen et al. 1993).

Most past studies involving the effects of motorized uses on elk involved roads with passenger vehicle use rather than motorized trails where ATVs and/or motorcycles are used. However, recent studies indicate that ATVs and motorcycles cause similar elk flight responses to that caused by full-sized motor vehicles (Wisdom et al. 2005). Findings from a controlled experimental study evaluating the effects of ATVs, mountain bikes, hiking, and horseback riding on elk and mule deer indicate that elk exhibited much higher rates of movement (or greater displacement) and probability of flight response from ATVs and

mountain bikes compared to horses and hikers. Canfield and others (1999), and Toweill and Thomas (2002) also indicate that the effects of open motorized trail uses are likely similar to those resulting from open roads. The two uses are similar in that both allow easier access to areas that would otherwise be inaccessible without considerable effort using non-motorized transportation.

This analysis incorporates the habitat effectiveness model developed by Lyon (1983), and described by Christensen and others (1993) for defining elk habitat effectiveness and comparing differences between alternatives. Based on recent findings of Wisdom et al. (2005), personal communications with current researchers (Wisdom, personal communication 2006; Rowland, personal communication 2006), and recommendations from MT FWP area biologists (Grove personal communication 2006; Loecker, personal communication 2006; Newell, personal communication 2006) all motorized routes (including ATV and motorbike trails) will be used in estimating habitat effectiveness and habitat security for alternative comparison.

As shown in Table III-79, 7 of the 11 hunting districts in the travel planning analysis area currently provide slightly more than 50% habitat effectiveness, and none meet or exceed the 70% effectiveness guideline. Alternative 1 depicts current habitat effectiveness conditions.

Fall Hunting Season – (Sept 1 to Dec 1)

Elk security has been defined by Lyon and Christensen (1992) as "the protection inherent in any situation that allows elk to remain in a defined area despite an increase in stress or disturbance associated with the hunting season or other human activities." When security is inadequate, elk become increasingly more vulnerable to harvest. As open road densities increase, otherwise secure habitats become more accessible and elk more vulnerable to harvest. This is especially true for bulls because hunting regulations have traditionally allowed greater opportunity for bull harvest as compared to cows. In response to reduced security and additional hunting pressure, elk will seek "safe" areas if they are available. In the case of small "island mountain ranges" such as the Little Belts, Castles, and Crazy Mountains, adjoining private lands where hunting is either not allowed or limited offer "sanctuaries" for elk, which may or may not be acceptable to some private property owners. Through cooperative meetings, USFS and MT FWP biologists have identified areas on the Forest where they believe security is inadequate, and where adjoining private ranches have become refuge areas for displaced elk. Such displacement can result in crop damage, loss of private livestock forage, fence damage, a loss of public recreational hunting opportunities, and/or the inability for MT FWP to effectively manage elk population numbers. Managing motorized access is one of the few factors affecting elk vulnerability that the Forest Service has management authority for (Christensen et al. 1992). Most other methods of managing elk populations are under the control of MT FWP.

Hillis and others (1991) provided guidelines for managing elk security and limiting elk vulnerability. The key concept was to provide security areas for elk during the hunting season where they are less vulnerable to harvest. They defined secure areas as >250 acres in size and >0.5 miles from an open road, and recommended that they comprise >30% of analysis units. The 30% secure habitat level should be viewed as the minimum necessary during the hunting season, realizing that more may be necessary in some districts, due to variables such as topography, vegetation cover and hunting pressure. Although Hillis's model is based on open roads, as described above in the **Summer Season** section, recent studies indicate that ATVs and motorcycles cause similar elk flight responses to that caused by full-sized motor vehicles

(Wisdom et al. 2005). And, for the same reasons stated above for defining habitat effectiveness, motorized ATV and motorcycle trails were included in security calculations for comparing amounts of security by alternative.

Currently, during the bow hunting season (September 1 to October 15) only hunting district 448 in the Little Belts and hunting district 580 in the Crazies meet or exceed the recommended 30% security level for elk habitat within the Forest Boundary **(**Alt. 1 in Table III-81**).** During the rifle hunting season (October 15 to December 1), only hunting district 413 and hunting district 448 in the Little Belts and hunting district 580 in the Crazies meet the minimum guideline. Existing elk security areas are displayed by hunting district on Map 17.

Winter Travel Period – Dec 1 to May 15

Traditionally, winter ranges have been viewed as geographic sites on which animals concentrate seasonally because of snow depths. Heavy utilization of available forage, and animal die-off in severe winters, have been commonly recorded (Christensen et al. 1993). Forage availability is important, but in severe weather big game ungulates substitute an energy-conservation strategy for forage intake. Thus, management of winter range to improve thermal cover and prevent harassment may be as important as anything done to change forage quantity or quality (Ibid). Winter is the time of year when energy expenditure invariably exceeds intake, due to increased metabolic demands and energetic costs of locomotion, coupled with decreased forage quality and availability. Under such conditions, ungulates typically lose a substantial percentage of their body weight. Severe weight loss leads to increased risk of mortality through starvation and predation, and lower production and survival of calves the following spring. Humans can exacerbate these impacts through winter travel. Disturbance can cause animals to run through deep snow, which is very energetically demanding (Clark 1999; Gates and Hudson 1979) found that activity by elk in cold temperatures results in a thermoregulatory penalty: in other words, it takes more energy to move during winter than it does in fall or summer. Thus, while inactivity provides an energetic advantage for animals exposed to cold, forced activity caused by human disturbance exacts an energetic disadvantage. Animals that do not flee often exhibit an increased heart rate, which may elevate energy expenditures that result in illness, decreased reproduction, and even death. Lastly, animals may be displaced from important wintering areas to lower quality habitats, thus reducing their chances of survival and successful reproduction (Canfield et al. 1999).

All types of human activity, including both motorized and non-motorized travel, can cause disturbance and displacement of wintering big game. Elk rely on fairly restricted winter ranges in which food and cover may be limited or of marginal quality; consequently, any activity preventing them from using all or part of that range could have negative impacts on their ability to survive or to successfully reproduce (Clark 1999). The literature shows a broad range of conclusions regarding the impacts of different types of uses (Canfield et al. 1999:6.7). The type of use may be less important than the frequency and predictability of the use. Generally, big game are most affected by unpredictable activities such as off-trail snowmobiling or skiing, and light use of snowmobile or ski trails (Clark 1999; Cassirer 1992; Parker 1984). They tend to habituate to predictable activities occurring on well-used routes at regular intervals, because this is energetically less costly than fleeing. Off-trail travel was deemed potentially the most detrimental because it occurs over larger areas and is less predictable than use of designated routes (Clark 1999). However, off-trail use may have

limited impact on wintering animals if use levels are low enough simply because they are rarely disturbed.

Wildlife biologists on the LCNF and local biologists from MT FWP have collaboratively identified and mapped big game winter ranges within the planning area. The latest mapping update of elk and mule deer winter ranges occurred in 1997 based on local knowledge of area biologists. Areas identified as winter range were delineated, and are spatially designated and filed in the Forest GIS library. Winter range designations included adjoining private lands – as shown on Map 11**,** there is relatively fewer acres of winter ranges on USFS lands as compared to winter range on private lands. In general, winter range on USFS lands are restricted to Forest edges within the forest/grassland interface. Table III-82 summarizes elk and mule deer winter range area (square miles) within the Forest boundary by hunting district; there are 173.7 and 163.9 square miles of elk and mule deer winter range respectively on USFS lands.

The current travel plan (existing condition) restricts off-route motorized uses (including snowmobiles) within travel areas A, E, G, C, R, F, and H (Map 6) during the winter period. Some of these restricted areas are within mapped elk and mule deer winter ranges, but many are not. Tables III-86 and III-87 summarize the total amount of mapped winter range where off-route motorized uses are allowed. Currently, of the 173.7 square miles of elk winter range on the Forest, off-route motorized uses are allowed on 53.8 square miles (or 30%) of mapped elk winter range area, ranging from a low of .2 square miles in hunting district 454 to a high of 16.9 square miles in hunting district 580. Of the 163.9 square miles of mule deer winter range on the Forest, off-route motorized uses are allowed on 63.1 square miles (or 38%) of mapped mule deer winter, ranging from a low of 0.9 square miles in hunting district 420 to a high of 17.3 square miles in hunting district 432.

Spring Calving Period – May 1 to June 30

As the spring months approach in late April/early May, forbs and grasses begin the new growth period. Elk use is usually confined to winter ranges during early spring, but progresses upward in elevation as the season advances. Although south exposures are used more frequently during April, all exposures are important during June (Leege 1984). Elk often move from one seasonal range to another, following traditional routes along ridges and other areas of gentle terrain. Crossings from one drainage to another commonly occur in low saddles.

Actual calving normally occurs between May 15 and June 15, and frequently occurs on secluded, gentle slopes. Typical calving habitat commonly contains open foraging areas adjacent to dense forest or other dense woody vegetation (such as willow carrs or high sagebrush) that can serve as hiding cover for newborn calves. Most cows appear to have traditional areas they return to each year at calving time (Leege 1984), although calving grounds can vary year to year depending on the rate of snowmelt and plant development.

Even though winter weight loss may be severe, serious demands on cow elk do not occur during the first 170 days of gestation. Nearly 70% of weight gain in a developing fetus occurs during the last 80 days of pregnancy (Bubenik 1982), thus spring green-up may be the most important winter forage resource for pregnant elk. Canfield (1999) cautions that the importance of spring range in assuring recovery from winter weight loss has not been appropriately emphasized in the literature. Even with warming temperatures and reduced snow depths, early spring reveals many ungulates at the absolute lowest physical condition of

the year. Until new, green forage restores lost weight and energy, these animals may succumb to stresses that would be considered minor at other times of the year (Ibid).

As described above in the Winter Range Affected Environment, all types of human activity, including both motorized and non-motorized travel, can cause disturbance and displacement of big game. As was the case on winter range, elk rely on fairly restricted spring ranges in which forage and cover may be limited or of marginal quality; consequently, any activity preventing them from using all or part of that range could have negative impacts on their ability to successfully raise calves (Canfield et al. 1999). In Colorado, Phillips (1998) was able to show that repeated displacement during the calving season resulted in major declines in survival of elk calves. Although there are no specific travel route density or closure area guidelines for managing calving habitat on the Forest, there is an abundance of research that recommends restricting human disturbances in known calving ranges (Canfield et al. 1999; Christensen et al. 1993; Phillips 1998; Clark 1999; Leege 1984; Lyon, et al. 1985; Wisdom et al. 2005).

Wildlife biologists on the LCNF and local biologists from MT FWP have collaboratively identified and mapped elk calving ranges within the planning area. The latest mapping update of elk calving ranges occurred in 1997 based on local knowledge of area biologists. Areas identified as calving habitat were delineated, spatially designated and filed in the Forest GIS library. Map 11 displays those areas suspected of being primary calving range. As shown on the map, some calving areas include adjoining private lands, but the predominance of calving area is on the Forest. Table III-81 summarizes elk calving range area (square miles) within the Forest boundary by Hunting District. There is a total of 134.9 square miles of calving habitat on USFS lands. Table III-81 also displays existing route densities open to motorized uses (all motorized types) during the May 1 to June 30 time period by hunting district (depicted as Alternative 1). As shown in the table, hunting district 540 currently has the highest open road density at over three miles of open route per square mile, and hunting district 416 has the lowest at less than 0.8 miles per square mile.

b. Forest Plan Direction

General

Forestwide Management Standards for wildlife include a number of general statements about management of wildlife and habitats, including compliance with the Endangered Species Act and other laws, regulations, and policies. Standards with specific relevance to travel management include:

- C-1(6): Manage motorized use through the Forest Travel Plan, in cooperation with the public, state of Montana, and other federal agencies to reduce effects on wildlife during periods of high stress (hunting seasons and wintering periods). Also see Chapter III and Appendix O of the Forest Plan.

The Forest Plan provides specific direction for Management Areas (MAs) on the Forest as shown in Appendix O of the Forest Plan and in Chapter III for each Management Area. The standards for Management Areas found in the Project Area are as follows:

Management Area	Public Access Level	Road density (miles/sq mile)
A	Moderate	1.5 - 3.0
B	Moderate	1.5 - 3.0
C	Low	0.5 - 1.5
D	Low	<2.5
E	Low	0.5 - 1.5
F	Minimize	
G	Minimize	
H	High	3.0+
I	Low	0.5 - 1.5
J	No construction	
K	Minimize	
L	High	3.0+
M	No construction	
S	High	3.0+

Three Management Areas are specific to wildlife: MA-C includes important elk and deer habitat, MA-E includes important big game winter range, and MA-I includes important wildlife habitat for big game and other species, generally occurring near the Forest boundary and adjacent to state Wildlife Management Areas. Direction for road and trail management in all three Management Areas states:

- Achieve low (defined as 0.5-1.5 miles open road/square mile area) public access through permitting motorized use on all arterial and most collector roads. Although local roads could remain open, collectively the access provided would be restricted. Closures or restrictions may be used to: (1) resolve user conflict; (2) promote user safety; or (3) protect resources.
- Open all areas and trails to ORVs except where use is restricted by season, type of vehicle, or type of activity. Closures or restrictions may be used to: (1) resolve user conflict; (2) promote user safety; or (3) protect resources. Important identified wildlife habitat will be protected.

Threatened and Endangered Species

The Lewis and Clark National Forest Plan states that: "Standards have been established to further the recovery efforts on behalf of T&E (threatened and endangered) species. These standards are a continuation of present methods, policies, and direction" (Forest-wide Management Standard C-2). The Forest Plan also requires compliance with the Endangered Species Act and other laws, policies, and regulations with respect to management of T&E species and their habitats (Forest-wide Management Standard C-2(1)).

Canada Lynx

The USDA Forest Service Region 1 is a signatory to the Lynx Conservation Agreement (USFS #00-MU-11015600-013), applicable through December 31, 2005. Signatories have agreed to take actions to reduce or eliminate adverse effects or risks to the species and its habitat and to maintain the ecosystems on which lynx depend. This agreement will eventually be superceded by the Northern Rockies Lynx Amendment, which will add specific management direction to Forest Plans, including the LCNF Forest Plan. Specific

recommendations and guidelines to be followed under the current agreement are contained in the Lynx Conservation and Assessment Strategy (Reudiger et al. 2000).

The Lynx Conservation Assessment Strategy (LCAS) objectives call for using specific criteria to map lynx habitat on federal lands, and for establishing LAUs as the analysis area for project planning purposes. Lynx Analysis Units are to be the approximate size of a female lynx home range and contain a sufficient quantity of denning and foraging habitat, as well as connections between those habitats, to sustain a female lynx throughout the year (Ruediger et al. 2000).

The LCAS acknowledges that lynx can "adapt to the presence of regular and concentrated recreational use", but that to do so "it is essential that an interconnected network of foraging habitat be maintained that is not subjected to widespread human intervention or competition from other predator species" (Ruediger et al. 2000).

Concern regarding potential competition from other predator species provides the basis for the LCAS standard for programmatic planning in recreation management. This standard is to "allow no net increase in groomed or designated over-the-snow routes and snowmobile play areas by LAU unless the designation serves to consolidate unregulated use and improves lynx habitat" (Modifications of Lynx Conservation Assessment and Strategy, August 2000 Edition – Clarifying Language; Memo from Deputy Regional Forester, August 28, 2003).

Designated over-the-snow routes are defined as "over-the-snow routes (such as trails) and snowmobile play areas (usually large, open areas) that are 'designated', that is specifically marked on a map, described in the resource or forest plan, described in the travel plan, or signed. This definition does not apply to ski areas" (Modifications of Lynx Conservation Assessment and Strategy, August 2000 Edition – Clarifying Language; Memo from Deputy Regional Forester, August 28, 2003).

LCAS guidelines for recreation and travel management planning efforts include:

> Provide a landscape with interconnected blocks of foraging habitat where snowmobile, cross-country skiing, snowshoeing, or other snow compacting activities are minimized or discouraged.
>
> Determine where high road densities (>2 miles per square mile) coincide with lynx habitat, and prioritize roads for seasonal restrictions or reclamation in those areas (Reudiger et al. 2000).

Sensitive Species

Sensitive species, as defined in the Forest Service Manual (FSM) are those identified by the Regional Forester, Northern Region, USDA Forest Service, for which population viability is a concern as evidenced by "significant current or predicted downward trend" in population numbers or density and/or in habitat capability that would reduce a species' existing distribution (FSM 2670.5). Sensitive species must receive special management emphasis to ensure their viability and to preclude trends toward endangerment that would result in the need for Federal listing (FSM 2672.1).

Big Game Species

The primary Forest Plan direction for big game species is stated above (Forest-wide Management Standards C-1(6)) and directs the Forest to manage motorized travel to reduce impacts to wildlife during seasons or periods of stress.

The LCNF Forest Plan also states that the Montana Fish and Game Commission Road Management Policy (1982) will guide Forest road management planning (LCNF Forest Plan Forest-wide Management Guideline L-2; LCNF Forest Plan Appendix G). The objective of the Montana Fish and Game Commission policy is to "maintain current hunting opportunities associated with elk in forested areas of Montana as other resources are developed". The policy recommends limits on open road densities during hunting season. It also recommends that:

> Calving grounds and nursery areas having concentrated elk use should be closed to motorized public use during periods of peak use by elk. These should be identified with land managers.
>
> All winter range should be closed to motorized public use between December 1 and May 15. Exceptions may be established through consultation with land managers.

Montana Elk Management Plan Objectives

Montana Fish, Wildlife and Parks (MT FWP) adopted a new comprehensive elk management plan in 2005. The plan, referred to as the Montana Elk Management Plan (MEMP) provides a comprehensive analysis of elk habitat, elk populations and goals/objectives for managing elk throughout Montana, including the Jefferson Travel planning area. The plan presents specific objectives for 44 individual Elk Management Units (EMUs). Specifically, the plan (Montana Elk Management Plan, 2005) identifies six statewide objectives relevant to the travel planning process as follows:

1. Maintain elk population numbers at levels producing a healthy and productive condition of elk, vegetation, soil, and water and that also reduces elk conflicts on private and public lands.
2. Promote conservation and improvement of habitats that support the state's elk populations.
3. Provide for a diverse elk hunting opportunity within, as much as possible, a 5-week general season and a 5 to 6 week archery season. Further, provide for quality viewing experiences and general enjoyment of elk by the public.
4. Maintain or improve public hunting access such that hunting is an effective population management tool that will maintain elk populations below levels causing damage to their habitat (vegetation, soil, and water) or excessive economic harm to the landowners that allow public hunting. For areas where elk security problems exist, promote access management that will reduce excessive harvests or movement of elk from public to private lands.
5. Manage elk populations at levels commensurate with other land uses and, to the extent possible, prevent game damage from occurring.

This travel planning area includes three EMUs described in the MEMP: the Little Belt EMU includes 8 hunting districts (HD) within the project area (HDs 413, 416, 418, 420, 432, 445, 448, 454, and 540); the Castle Mountains EMU includes 2 hunting districts (HDs 449 and 452) within the project area; and the Crazy Mountains EMU includes two hunting districts (315 and 580), with only HD 580 located within the project area. National Forest lands within HD 315 are located on the Gallatin National Forest.

Little Belts EMU – This EMU encompasses the area in and around the Little Belt Mountain Range and is 3,585 square miles in size, 1,407 square miles of which are on the Forest and within the project area. Existing elk population status, distribution and objectives within this EMU are well described in the MEMP (pages 311-319).

Castle Mountains EMU – This EMU encompasses the area in and around the Castle Mountain Range and is 341 square miles in size, 125 square miles of which are on the LCNF and within the project area. Existing elk population status, distribution and objectives are well described in the MEMP (pages 304-310).

Crazy Mountains EMU - This EMU encompasses the area in and around the Crazy Mountain Range and is 1,708 square miles in size, 108 square miles of which are on the LCNF and within the project area. Existing elk population status, distribution and objectives are well described in the MEMP (pages 291-297).

Specific MEMP goals and objectives common to both the Little Belt and Castle Mountains EMUs (and directly related to travel planning efforts in the project area) include:

1. Continue to cooperate with public and private land managers to provide optimum elk habitat, and manage for a diversity of elk hunting experiences.
2. Maintain or enhance elk security levels, so that the elk harvest is distributed throughout the general hunting season, and more elk remain on National Forest land during the general hunting season. Maintain or enhance elk security levels so that no more than 40% of the bull harvest occurs during the first week of the season.
3. Provide technical assistance to the LCNF to help develop a comprehensive road management plan that maintain or enhance elk security on National Forest land during hunting season, while still allowing adequate access for hunters. The goal is to keep more elk on USFS land so that elk do not seek out private land "refuge" areas, and thereby improve opportunities for hunters to harvest elk on National Forest lands within the EMU.

MEMP goals and objectives specific to the Crazy Mountains EMU (and directly related to travel planning efforts) include:

1. Manage elk populations within the range of habitat availability and social tolerance while providing diverse hunting and non-hunting elk-related recreational opportunities.
2. Work cooperatively with public and private land managers to maintain quality elk habitat on presently occupied lands and maintain elk security so that elk harvest is distributed throughout the hunting season.
3. Work with the Gallatin and Lewis and Clark National Forests to maintain forest road densities at levels that balance concerns with elk security and hunter access.

Existing Hunting District Habitat Conditions

Several meetings and telephone conversations between wildlife biologists on the LCNF and area wildlife biologists from MT FWP occurred to identify areas on the Forest where existing motorized uses may be significantly impacting elk habitat use, elk population management, and recreational hunting opportunities. Specific concerns and potential means to reduce effects (route closures, seasonal restrictions, etc.) were identified for each HD – memos

describing specific concerns were prepared and are located in the project file. In general, concerns can be grouped into the following categories:

1. Areas where high motorized route densities may be adversely affecting elk habitat effectiveness during summer and security during hunting seasons. In most cases where these conditions exist, MT FWP biologists are witnessing higher levels of use on adjacent/adjoining private lands that elk have learned is more secure. These private "refuge areas" can be problematic for private land owners, and result in reduced recreational hunting opportunities on public Forest lands.
2. Areas where illegal motorized uses are adversely affecting elk and elk habitat.
3. Winter range and calving habitats where excessive motorized uses of all types (including snowmobiles) are displacing elk and/or causing stress during critical winter and spring periods.

2. ENVIRONMENTAL CONSEQUENCES

As described under the heading "Wildlife Affected Environment" above, potential impacts of the alternatives on wildlife were analyzed and will be discussed by issue. Potential impacts to individual species are discussed within each issue as appropriate.

Analysis Considerations

There are three basic differences among the travel management alternatives under consideration:

- the total mileage of routes (particularly trails) open to wheeled motorized travel or non-motorized travel
- the total acreage of area open to snowmobile travel
- the pattern in which those uses would occur

Therefore our analysis will be based on comparisons of the different mileage, acreage, and pattern of motorized use among alternatives with respect to wildlife habitats.

Both the summer alternative 1 and the winter alternative 1 are the existing conditions and will be used as an environmental baseline for comparison to the action alternatives. The three summer action alternatives (3, 4, and 5), and the two winter action alternatives (2 and 3) will also be compared relative to each other.

POTENTIAL FOR DISPLACEMENT OF WILDLIFE.

The amount and types of access may affect wildlife habitats by displacing wildlife from roads, trails and adjacent areas due to the presence of humans and machines and/or the noise associated with the use. This displacement erodes habitat value of areas near roads and trails and results in overall declines in habitat availability. Disturbance may lead to stress, resulting in over-all declines in health and reproduction. These declines would be additive to existing habitat declines resulting from development of private lands, timber sales, fires, etc.

FOREST PLAN OPEN ROAD DENSITY STANDARDS

Analysis Methodology

The Lewis and Clark National Forest Plan includes a standard for open road density by Management Area, as described in Forest Plan Appendix O, and displayed previously under Forest Plan Direction. Management areas specific to wildlife include C, E, and I. The standards are applicable to open roads on USFS lands, and do not apply to trails open to OHV vehicles (ATVs and motorbikes).

Management Areas (MAs) were intersected with roads and miles of open road by Management Area was determined using the travel codes for each alternative. Densities were calculated using Management Area size and miles of open road.

Calculated open road densities by MA for all alternatives are displayed in Table III-77. The standard does not specify a specific season of use, and so all roads open at any time of the year were selected for this calculation.

Table III-77. Open Road Density by Alternative (for all roads on NFS lands)

Management Area			Summer Alternative 1	Summer Alternative 3	Summer Alternative 4	Summer Alternative 5
Area	Access Standard	(mi/mi^2)				
A	Moderate	1.5-3.0	2.16	1.31	1.34	1.21
B	Moderate	1.5-3.0	1.49	0.99	0.96	0.91
C	Low	0.5-1.5	1.53	1.08	1.04	1.00
D	Low*	< 2.5	2.61	2.12	2.12	2.14
E	Low	0.5-1.5	1.86	1.20	1.19	1.05
F	Minimize		0.19	0.18	0.10	0.14
G	Minimize		0.59	0.38	0.33	0.30
H	High	3.0 +	1.62	1.20	1.22	1.25
I	Low	0.5-1.5	1.82	1.67	1.11	1.08
J	No construction		0.57	0.25	0.25	0.25
K	Minimize		0.65	0.35	0.35	0.58
L	High	3.0 +	1.75	1.15	1.15	1.05
M	No construction		0.42	0.41	0.36	0.33
S	High	3.0 +	9.15	7.87	7.87	8.09

* Forest Plan Amendment 19 established an open road density of 2.5 miles per square miles in the Castle Mountains in Management Area D

a. Summer Alternative 1 – No Action (Existing Condition) Alternative

1. Direct and Indirect Effects

As shown in Table III-151, Alternative 1 Open Road Density is exceeded in Management Areas C, D, E, and I. For the wildlife specific MAs open road density should not be more than 1.5 miles per square mile. The existing condition (Alternative 1) is MA C equals 1.53 miles per square miles, MA E equals 1.86 miles per square miles, and MA I equals 1.82 miles per square mile.

b. Summer Action Alternatives 3, 4 and 5

1. Direct and Indirect Effects

In all three of these alternatives, differing mileages of open roads are proposed for yearlong closure. Per Table III-151, open road density by Management Area would be reduced, and the maximum miles per square mile standard would be met in all alternatives, with one exception; MA I in Alternative 3 would still slightly exceed the standard by 0.17 miles per square mile. In all MAs, Alternative 5 would result in the lowest open road densities of the 4 alternatives, and result in a significant decrease in open road density disturbance effect on wildlife in general and big game specifically over the existing condition.

ELK SUMMER AND FALL RANGES (ELK HABITAT EFFECTIVENESS AND ELK SECURITY)

Analysis Methodology

Habitat Effectiveness refers to the percentage of available habitat that is usable by elk outside the hunting season (Lyon and Christensen 1992). This analysis incorporates the habitat effectiveness model developed by Lyon (1983) based upon open road densities. Christensen and others (1993) described Lyon's model for defining elk habitat effectiveness and comparing differences between alternatives. Based on recent findings of Wisdom et al. (2005), personal communications with current researchers (Wisdom, personal communication 2006; Rowland personal communication 2006), and recommendations from MT FWP area biologists (Grove, personal communication 2006; Loecker, personal communication 2006; Newell, personal communication 2006) all motorized routes (including ATV and motorbike trails) open during the summer time period of June 30 to September 1 were used to estimate

and compare habitat effectiveness by alternative. Thus, densities of all open routes (Table III-78) were incorporated into Lyons (1983) regression curve to estimate habitat effectiveness by alternative. Table III-79 displays results by alternative for each affected hunting district.

Table III-78. Density (miles per square mile) of Open Motorized Routes (roads and trails) by Hunting Districts

Hunting District	Summer Alternative 1		Summer Alternative 3		Summer Alternative 4		Summer Alternative 5	
	FS routes	All routes	FS routes	All routes	FS routes	All routes	FS routes	All routes
413	1.16	1.18	0.93	0.95	0.36	0.37	0.66	0.67
416	1.87	1.88	1.33	1.33	1.19	1.20	1.13	1.13
418	1.65	1.65	1.48	1.48	1.29	1.29	1.15	1.16
420	1.77	1.77	1.33	1.33	1.33	1.33	0.77	0.78
432	1.55	1.56	1.18	1.19	0.85	0.86	1.04	1.04
448	1.20	1.20	1.16	1.17	0.66	0.67	0.86	0.87
449	2.42	2.43	1.90	1.90	1.90	1.90	1.81	1.81
452	1.29	1.29	1.23	1.23	0.40	0.41	0.48	0.49
454	2.03	2.03	1.46	1.46	1.46	1.46	1.40	1.40
540	1.93	1.93	1.69	1.69	1.39	1.39	1.62	1.63
580	1.36	1.36	1.20	1.20	0.48	0.48	0.66	0.66
TOTAL	**1.56**	**1.57**	**1.28**	**1.29**	**0.92**	**0.92**	**1.03**	**1.03**

(For summer motorized travel, calculated for Forest Service (FS) routes only and for all routes.)

Christensen and others (1993) recommended that habitat effectiveness should be 70% or greater (open road density <0.7 mi/sq mi) for areas intended to benefit elk summer habitat and retain high use. Areas where elk are one of the primary resource considerations should have habitat effectiveness of 50% or greater (open road density <1.9 mi/sq mi). Areas with <50% habitat effectiveness (>1.9 mi/sq mi) are expected to make only minimal contributions to elk management goals.

Table III-79. Elk Summer Habitat Effectiveness

Hunting District	Summer Alternative 1	Summer Alternative 3	Summer Alternative 4	Summer Alternative 5
413	57 %	60 %	80 %	69 %
416	49 %	55 %	57 %	57 %
418	52 %	53 %	56 %	57 %
420	51 %	55 %	55 %	68 %
432	53 %	57 %	64 %	59 %
448	57 %	57 %	69 %	64 %
449	43 %	49 %	49 %	50 %
452	56 %	56 %	78 %	74 %
454	48 %	53 %	53 %	54 %
540	48 %	52 %	54 %	52 %
580	54 %	57 %	74 %	69 %
TOTAL	**52 %**	**56 %**	**60 %**	**59 %**

Elk Security is defined by Lyon and Christensen (1992) as "the protection inherent in any situation that allows elk to remain in a defined area despite an increase in stress or disturbance associated with the hunting season or other human activities." When security is inadequate, elk become increasingly more vulnerable to harvest. Hillis and others (1991) provided guidelines for managing elk security and limiting elk vulnerability. The key concept was to provide security areas for elk during the hunting season where they are less vulnerable to harvest. Secure habitats are defined as areas >250 acres in size and >0.5 miles from an open road. Hillis recommended that they comprise >30% of analysis units. The 30% secure habitat level should be viewed as the minimum necessary during the hunting season, realizing that more may be necessary in some districts, due to variables such as topography, vegetation cover and hunting pressure. Although Hillis's model is based on open roads, as described above, recent studies indicate, and many biologists agree, that ATVs and motorcycles cause similar elk flight responses to that caused by full-sized motor vehicles (Wisdom et al. 2005). And, for the same reasons stated above for defining habitat effectiveness, motorized ATV and motorcycle trails were included in security calculations for comparing amounts of security by alternative.

In general, elk populations within the analysis area and within MT FWP Little Belts, Castles, and Crazies Elk Management Units meet or exceed population goals (MT FWP 2005); however, in some hunting districts elk tend to "sanctuary" on private lands near the FS boundary. In some specific areas on the Forest, biologists feel that available elk habitat is not being fully utilized, which may be contributing to "sanctuary" effects on adjacent private lands. In meetings held between LCNF and MT FWP biologists to discuss travel planning, specific areas were identified where reduced route densities could be beneficial to improving elk habitat effectiveness and security objectives. Specific areas of concern identified by MT FWP area biologists are summarized in Table III-80, but in general, they address the need to reduce motorized route densities in the following areas during the summer and/or fall hunting seasons:

1. Southern periphery Castle Mountain Range in hunting districts 449 and 452.
2. Northern periphery Castle Mountain Range south of Checkerboard in hunting district 449.
3. Miller Creek drainage in southern portion of hunting district 416.
4. Calf Creek Area north of Sheep Creek Road in hunting district 416.
5. Hoover Ridge Area in hunting district 432.
6. Fisher Creek/Rugby Creek area SE of Monument Peak in hunting district 413.
7. Round Grove, Nevada Creek, Morrisy Coulee, and Hopley Creek along the southern periphery of the Musselshell Ranger District in hunting district 540.
8. Manger Park Area of SW Castles in hunting district 452 – especially during hunting seasons.
9. Mass Creek/Sawmill Creek and Area South of Higgins Park in hunting district 454 - especially during hunting seasons.
10. Decker/Cox Combe Butte – especially during hunting seasons.
11. Long Canyon/Alkalli Creek in hunting district 540 – especially during hunting season.
12. Running Wolf Creek in hunting district 448 – especially during hunting seasons.

Table III-80. Special Areas of Concern Identified by MT FWP Area Biologists

Hunting District	Season of Concern	Specific Area of Concern
Castles – 449 & 452	Summer & Hunting Seasons	Private lands along the entire southern Forest boundary of the Castle Mtn Range, from Whetsone Ridge west to Cottonwood Creek on the SW corner of the Range, tends to harbor elk during summer and especially fall hunting seasons. Elk habitat on the Forest in these areas of the Castles tends to be under-utilized, and high motorized route densities (especially in HD 449 - E. Castles) may be the primary reason.
Castles – 452	Hunting Season	Elk tend to move from the Manger Park and W. Cottonwood area (HD 452) onto adjoining PVT lands at the beginning of bow hunting season (early Sept.) – legal public, motorized access (bikes) to these areas is possible thru motorized trail systems from the North and West, and illegal use by ATVs is thought to occur. Motorized access through adjoining PVT lands to the west may also be a factor
Castles – 449	Summer & Hunting Seasons	During summer and fall months, greater numbers of elk (than would be expected) tend to "keg" up on PVT lands south of Checkerboard and north of the Forest Boundary. The E. Castles have a very high open route density.
Musselshell – 540	Summer & Hunting Seasons	In the NW portion of this HD (vicinity of Long Canyon and Alkalli Creek, elk are "kegging up" on PVT land, especially during hunting season.
Mass/ Higgins – 454	Hunting Season	Elk are "kegging up" on PVT lands south of the Forest Boundary in the Mass Cr/Sawmill Cr areas, and along the Forest Boundary immediately N of Bair Reservoir and E of N.Fork Musselshell, especially during hunting seasons. Hunting pressure and easy access are likely reasons.
Miller CK –416	Summer & Hunting Seasons	During summer and fall hunting seasons, elk tend to underutilize available Forest habitats in the Miller Creek drainage and tend to hang on PVT lands North and South of the drainage. Two possible reasons are high route densities and displacement by livestock grazing.
Sheep CK/Calf CR –416	Summer & Hunting Seasons	During summer and fall hunting seasons, elk tend to under-utilize available Forest habitats North of the Sheep Creek Road and in the vicinity Eagle Creek, and tend to utilized PVT lands West of the Forest boundary in the Eagle Creek drainage and PVT checkerboarded lands on Forest south of the Sheep Creek Road. Much of this PVT "sanctuary" is not available to public access. This concern could be mitigated by reducing motorized routes densities within adjacent Forest habitats.
Running Wolf –448	Hunting Season	Elk tend to leave Forest habitats in the Running Wolf Creek Drainages during hunting seasons (bow and rifle) and tend to "sanctuary" on boarding PVT lands North and East of County Roads 102 & 104. Hunting pressure and easy access are the likely reasons
Decker – Coxcombe –416	Summer & Hunting Seasons	Elk are leaving the Forest for adjacent Checkerboarded PVT lands North and South of Decker Gulch. Adam speculates that road densities and /or livestock grazing may be reason why.
Morrisy Hopley – 549	Summer & Hunting Seasons	Elk being pushed of the Forest in late summer and beginning of Archery Season. Excessive OHV use may be a factor, including illegal OHV use.
SE Moument – 413	Summer & Hunting Seasons	The area immediately South of Monument Peak to Pilgrim Peak (Taylor Hills, Rugsby, Fisher, Packsaddle) appears to be quality summer/fall range for elk, but existing elk use levels are low – number of animals there during hunting seasons (bow and rifle) are especially concerning. Elk that would traditionally utilize this range appear to be displacing to adjacent habitats on the Forest and on PVT lands South and West of the Forest boundary. High motorized route densities in this area (most of which are undetermined ATV and Bike routes) may be a factor, and motorized route restrictions would improve habitat effectiveness and security.

a. Summer Alternative 1 – No Action (Existing Condition) Alternative

1. Direct and Indirect Effects

Habitat Effectiveness - Under this alternative, 4 of the 11 hunting districts in the project area currently provide less than 50% habitat effectiveness (Table III-79), 7 hunting districts would slightly exceed 50%, and none meet or exceed the 70% effectiveness guideline for summer habitat. Under this alternative, contributions to habitat effectiveness would not be improved, and MT FWP specific concerns (listed above) for improving summer range utilization and reducing elk use on private land "sanctuary" areas would not be addressed.

Elk Security – Alternative 1 would not improve existing security conditions. As shown in Table III-81 (and spatially displayed on Map 17), only hunting district 448 (Middle Fork of Judith) and hunting district 580 (Crazy Mountains) would exceed the 30% security recommendation during archery hunting season. Only three others (HDs 413, 432, and 452) would exceed the 20% security level. During the general hunting season (October 15 to December 1), this alternative seasonally closes some roads and trails to motorized use. As a result, security increases such that hunting district 413 (Deep Creek) would join hunting districts 448 and 580 in meeting the 30% security recommendation, and 5 others: HD 418, 420, 432, 452, and 454 would exceed 20%. But none of the specific concern areas (listed above) identified by biologists for improving hunting season security and reducing elk use on private land "sanctuary" areas would be addressed by this alternative. Hunting district 449 in the East Castles contains many miles of open motorized routes and several open parks (with no hiding cover); as a result, this hunting district only provides 2% secure area during archery season and 5 % during rifle season.

Table III-81. Percentage of Secure Elk Habitat* by Hunting Districts

Hunting District	Percent Secure Elk Habitat							
	Summer Alternative 1		Summer Alternative 3		Summer Alternative 4		Summer Alternative 5	
	Bow Season	Rifle Season	Bow Season	Rifle Season	Bow Season	Rifle Season	Bow Season	Rifle Season
413	26	31	35	35	61	61	46	56
416	14	15	19	19	23	23	29	35
418	17	22	25	36	29	40	29	46
420	15	27	16	30	16	31	33	36
432	28	29	35	36	41	42	43	44
448	34	36	30	31	45	46	41	42
449	2	5	8	8	8	8	10	10
452	22	22	29	29	56	56	42	42
454	14	20	20	23	25	28	27	30
540	15	17	28	28	34	36	32	35
580	32	40	33	33	44	44	44	44
Total	**22**	**26**	**28**	**30**	**39**	**41**	**37**	**42**

* (For summer motorized travel. Secure habitat values were calculated using all routes open to motorized travel within the Forest boundary.)

Air Craft Landing Strips – This alternative does not propose the development and use of aircraft landing strips in the project area.

b. Summer Action Alternatives 3, 4 and 5

1. Direct and Indirect Effects Common to Alternative 3

Habitat Effectiveness - Under this alternative many undetermined routes would be closed yearlong. Elk habitat effectiveness and security methods assume that closed routes are effectively closed. As a result, all hunting districts except 449 would provide more than 50% habitat effectiveness (Table III-79), but none would exceed 60%. Under this alternative, contributions to habitat effectiveness would be improved to some degree, but MT FWP specific concerns (Table III-80) for improving summer range utilization and reducing elk use on private land "sanctuary" areas would not be addressed.

Elk Security – Because a number of undetermined motorized routes would be closed under this alternative, secure area would increase slightly during the archery season in10 of the11 hunting districts (assuming routes are effectively closed), and one (hunting district 448 in Middle Fork Judith) would lose 1% secure area as a result of providing new ATV recreational opportunities during this time period. Overall, only 4 hunting districts (hunting district 413, 432, 448, and 580) would meet the 30% security recommendation (Table III-81 and Map 18). During the general hunting season (October 15 to December 1), additional motorized routes would be seasonally closed in hunting districts 418, 420, 432, and 454 to provide slight increases in secure area. As a result, 6 of the 11 hunting districts would meet the 30% security recommendation, and all but 2 would exceed 20% during the rifle hunting season. Hunting district 449 would remain very low at 8%. This alternative would seasonally close motorized routes in the Miller Creek, Coxcombe Butte, and Decker Gulch areas in hunting district 416, which addresses one of the specific concern areas identified by MT FWP biologists for improving hunting season security and reducing elk use on private land "sanctuary" areas.

Air Craft Landing Strips - This alternative also authorizes the development of small air craft landing strips in Deep Creek Park (hunting district 413), Middle Fork of the Judith (hunting district 448), Lost Fork of the Judith (hunting district 448), and Holiday Camp (hunting district 418). There is little research available to assess this type of activity on elk, but avoidance, disturbance, and displacement effects would likely be commensurate with frequency of use, similar to that which would be expected with other modes of motorized disturbances. Assuming each airstrip is approximately ½- mile long, the addition of all four airstrips increases the road density in hunting district 413 by one one-hundredth miles per square mile. The airstrips do not change the habitat effectiveness in these four hunting districts.

Two of the proposed air craft landing strips are located within security habitat in hunting districts 448 (completely within security habitat) and 413 (partially within security habitat). Under this alternative, security habitat would be reduced by a total of 626 acres. This does

not change the percentage of security habitat under the bow or rifle season in these hunting districts.

Although there are no numerical changes to habitat effectiveness and security with the inclusion of the air craft landing strips, displacement of elk is probable with this activity. This effect can be mitigated during the hunting season by placing timing restrictions on any landing strips (I.E. closing the landing strip from September 1 to December 1). The effect of the landing strip on elk is not quantifiable, nor is the effect of potential mitigation.

2. Direct and Indirect Effects Common to Alternative 4

Habitat Effectiveness - Under this alternative many undetermined routes would be closed yearlong. In addition, this alternative would establish quiet areas by closing most motorized routes in the Deep Creek, Rugby Creek, and Pilgrim Creek areas of hunting district 413, Butcher Knife Mountain, Hoover Ridge, and Middle Fork Judith Basin Areas in hunting districts 432 and 448, Morrisy Coulee/Spring Creek Areas in hunting district 540, and several miscellaneous routes in hunting district 580 (Crazy Mountains). As a result, habitat effectiveness in all hunting districts would exceed 50%; 6 hunting districts would exceed 60%; 3 hunting districts would exceed 70%; and hunting district 413 would exceed 80% habitat effectiveness (Table III-79). This alterative would also increase habitat effectiveness in site specific areas of concern raised by MT FWP biologists by significantly reducing motorized route densities in the following areas:

1. Hoover Ridge Area in hunting district 432.
2. Fisher Creek/Rugby Creek area SE of Monument Peak in hunting district 413.
3. Round Grove, Nevada Creek, Morrisy Coulee, and Hopley Creek along the southern periphery of the Musselshell Ranger District in hunting district 540

Elk Security - Because this alternative closes a number of undetermined motorized routes and establishes quiet areas by closing additional routes as described in habitat effectiveness above, elk security area would be significantly increased during both the archery and rifle hunting seasons in Alternative 4, especially in hunting district 413, 452, and 580. During the archery season, 6 of the 11 hunting districts would meet the 30% security recommendation, and during rifle season, hunting district 418 and 420 would also meet the recommendation. During rifle season, all but hunting district 449 (East Castles) would exceed 20% (Table III-81 and Map 19). In addition to those specific concern areas listed above for habitat effectiveness effects, this alternative would also improve hunting season security in:

1. SW periphery Castle Mountain Range in hunting district 452.
2. Miller Creek drainage in southern portion of hunting district 416
3. Manger Park Area of SW Castles in hunting district 452.
4. Decker/Cox Combe Butte – especially during hunting seasons.
5. Long Canyon/Alkali Creek in hunting district 540 – especially during hunting season.

Over-all, this Alternative would be expected to significantly improve elk summer range utilization and security during the hunting season, especially in hunting districts 413, 452, and 580.

Air Craft Landing Strips – This alternative does not propose the development and use of aircraft landing strips in the travel planning area.

3. Direct and Indirect Effects Common to Alternative 5

Habitat Effectiveness - Under this alternative many undetermined routes would be closed yearlong. These routes are scattered across the planning area, and were identified and selected for closure for a variety of reasons. In many cases, routes were selected for closure by Travel Plan IDT resource specialists to meet specific resource needs and reduce environmental impacts. Several routes within the 7 areas of concern identified by MT FWP (Table III-80) were selected for closure in an attempt to increase elk summer use on the Forest in those specific areas. As a result, habitat effectiveness in all hunting districts would exceed 50%, 5 hunting districts would exceed 60%, and 1 hunting district would exceed 70% (Table III-79). Overall, this Alternative would be expected to benefit elk summer habitat and higher elk use would be expected, especially in the following areas of concern:

1. Southern periphery Castle Mountain Range in hunting districts 449 and 452.
2. Calf Creek Area north of Sheep Creek Road in hunting district 416.
3. Hoover Ridge Area in hunting district 432.
4. Fisher Creek/Rugby Creek area SE of Monument Peak in hunting district 413.

Elk Security – As was described above for habitat effectiveness, many undetermined routes would be closed yearlong under Alternative 5. In addition, this alternative identified and selected several additional routes for yearlong or seasonal closure to meet specific resource needs and reduce environmental impacts. Several routes within the 11 areas of concern identified by MT FWP biologists (Table III-80) were selected for closure in an attempt to increase elk security, especially along the Forest/Private land interface. As a result, security within 7 of the 11 hunting districts would meet the 30% security recommendation during archery season, and all but one (HD 449 in the East Castles) would meet the recommendation during rifle season (Table III-81 and Map 20). As described earlier, hunting district 449 is heavily roaded, is rather narrow in shape, and contains several openings – these factors in combination make it difficult to develop a road management plan that meets minimum security requirements.

In addition to meeting security recommendations in all but one hunting district, this alternative addresses all but two of the specific concern areas identified by biologists for improving hunting season security and reducing elk use on private land "sanctuary" areas. For reasons described above, this alternative does not significantly reduce motorized route densities in the Southern or Northern periphery of the East Castle Mountain Range in hunting district 449. Some routes were closed on the south-west edge, however.

Overall, Alternative 5 would be expected to significantly improve elk summer range utilization and security during the hunting season. It comes closer than the other alternatives to meeting security objectives in all hunting districts, and addresses most of the MT FWP biologist's special concern areas.

This alternative includes a long ATV route into Deep Creek Park. The route would be open June 30 to Dec 1 and would provide good access into the Park during hunting season. Existing motorcycle trails in the same general area would be closed to motorized traffic during the rifle season under this alternative in an attempt to hold elk on the Forest during the hunting season. The route proposed entirely "loops" around the large private parcel in the middle of the park. The north side of this loop would be located on an existing single-track route; the south side of the loop route does not currently exist, and would be constructed at some date in the future. The new construction route would be located in a relatively secure area for elk. Terrain is steep and tough for hunters to access. Construction of this route would provide new access for ATV and motorcycles, increase hunting pressure that is currently considered relatively light, and impact an elk security area. ***NOTE:*** *Security Map 20 was made in error - the proposed ATV trail 301, 311, and new construction loop trail around the private property in Deep Creek would traverse an existing security block. Map 20 did not deduct security area associated with this impact. Thus, the security block as shown on Map 20 would be divided and numbers of total security reduced in Hunting District 413 for Alt. 5.*

Air Craft Landing Strips **-** This alternative also authorizes the development of small air craft landing strips at two sites; one would be located in Middle Fork of the Judith (HD 448) and the other at Russian Flat (HD 418). There is little research available to assess this type of activity on elk, but avoidance, disturbance, and displacement effects would likely be commensurate with frequency of use, similar to that which would be expected with other modes of motorized disturbances. Assuming each airstrip is approximately ½-mile long, the addition of both airstrips does not increase the road density or change the habitat effectiveness in these hunting districts.

One of the proposed air craft landing strips is located within security habitat in hunting districts 418. Under this alternative, security habitat would be reduced by a total of 390 acres. This does not change the percentage of security habitat under the bow or rifle season in this hunting district.

Although there are no numerical changes to habitat effectiveness and security with the inclusion of the air craft landing strips, displacement of elk is probable with this activity. This effect can be mitigated during the hunting season by placing timing restrictions on any landing strips. The effect of the landing strip on elk is not quantifiable, nor is the effect of potential mitigation.

EFFECTS ON SEASONALLY IMPORTANT RANGES FOR WILDLIFE.

The amount and types of access may reduce the value of important seasonal ranges (e.g. winter range, calving/fawning habitat, denning habitat) by displacing wildlife from those areas.

ROUTE DENSITY IN ELK AND MULE DEER WINTER RANGE AND IN ELK CALVING AREAS

Analysis Methodology

Two important travel variables affecting elk and mule deer are the density of winter routes within winter range or calving areas, and the amount of winter range or calving area relatively free of disturbance available to each species. Unlike for elk habitat effectiveness or security, there are no recommended guidelines for travel route densities or closure areas within winter range or calving areas. The Lewis and Clark National Forest Plan states that the Montana Fish and Game Commission Road Management Policy (1982) will guide Forest road management planning (Lewis and Clark Forest Plan, Forest-wide Management Guideline L-2; Forest Plan Appendix G). The policy recommends that:

> Calving grounds and nursery areas having concentrated elk use should be closed to motorized public use during periods of peak use by elk. These should be identified with land managers.
>
> All winter range should be closed to motorized public use between December 1 and May 15. Exceptions may be established through consultation with land managers.

In order to compare alternatives route densities were calculated by hunting district for elk winter range, mule deer winter range, and elk calving areas. In addition, the percentage of un-restricted winter range area open to over-the-snow motorized use was determined. The area of winter and calving ranges is displayed in Table III-82. Because calving typically occurs during spring (May 1 to June 30) and outside the winter period, effects on calving habitat was compared between Summer Alternatives 1, 3, 4, and 5. Winter range effects will be compared between Winter Alternatives 1, 2, and 3. For the winter alternatives, area closures are proposed, with routes designated through these closed areas. Routes in the open areas were not specifically addressed in the winter alternatives. Therefore, in areas open under the winter alternatives, the summer alternative designations of open or closed by route must be used to determine route mileages and densities.

Table III-82. Area* of Big Game Ranges on NFS Lands in the Little Belt, Castle and north half Crazy Mountains

Hunting District	Elk Calving Areas ($mile^2$)	Elk Winter Range ($mile^2$)	Mule Deer Winter Range ($mile^2$)
413	18.5	35.5	59.2
416	20.6	7.5	1.8
418	27.4	8.9	10.2
420	0	9.2	2.3
432	0	8.3	18.4
448	22.1	7.4	9.1
449	19.6	18.0	0
452	5.5	5.8	0

Hunting District	Elk Calving Areas (mile^2)	Elk Winter Range (mile^2)	Mule Deer Winter Range (mile^2)
454	9.1	8.2	9.6
540	12.1	32.3	33.8
580	0	32.5	19.5
Total	**134.9**	**173.7**	**163.9**

* Square miles within Hunting Districts on the Lewis and Clark National Forest.

Effects on Elk Calving Habitat

Wildlife biologists on the LCNF and local biologists from MT FWP collaboratively identified and mapped elk calving ranges within the project area. The latest mapping update of elk calving ranges occurred in 1997 based on local knowledge of area biologists. Areas identified as calving habitat were delineated, spatially designated and filed in the Forest GIS library. Map 11 displays those areas designated as primary calving range. Table III-83 summarizes elk calving range area (square miles) within the Forest boundary by hunting district, and also displays existing route densities open to motorized uses (all motorized types) during the May 1 to June 30 time period by hunting district. There are a total of 8 hunting districts which support mapped calving habitats within the Forest Boundary.

Table III-83. Open Route Density in Elk Calving Habitat

Hunting District	Calving Habitat (mi^2)	Summer Alt. 1 Density (mi/mi^2)	Summer Alt. 3 Density (mi/mi^2)	Summer Alt. 4 Density (mi/mi^2)	Summer Alt. 5 Density (mi/mi^2)
413	18.5	1.29	1.65	0	0.03
416	20.6	0.77	0.54	0.54	0.40
418	27.4	2.42	1.70	1.87	0.81
448	22.1	1.49	1.54	0.56	0.68
449	19.6	2.14	1.73	1.73	1.63
452	5.5	1.66	1.81	1.11	1.13
454	9.1	2.81	2.01	2.01	1.16
540	12.1	3.06	2.65	1.93	2.15

a. Summer Alternative 1 – No Action (Existing Condition) Alternative

1. Direct and Indirect Effects

As shown in Table III-83, existing open motorized route densities on calving areas is currently relatively high in all hunting districts. Hunting district 540 (Musselshell) currently has the highest open motorized route density at over 3 miles of open route per square mile, and hunting district 416 (Moose/Sheep Creek) has the lowest at less than 0.8 miles per square mile.

b. Summer Action Alternatives 3, 4 and 5

1. Direct and Indirect Effects Common to Alternative 3

As shown in Table III-83, open motorized routes densities on calving areas would be relatively high in all hunting districts under Alternative 3 as well, although the route densities

are reduced over the existing condition. Hunting district 540 again would have the highest open route density at 2.65 miles per square mile, and hunting district 416 would have the lowest at less than 0.6 miles per square mile.

2. Direct and Indirect Effects Common to Alternative 4

If this alternative were implemented, open motorized route densities on most calving areas would remain relatively high in most hunting districts, except that in hunting district 413 (Deep Creek) no motorized routes would be open on calving range during the calving season. Hunting District 454 (Newlan/Spring Creek) would have the highest open route density at 2.65 miles of open route per square mile.

3. Direct and Indirect Effects Common to Alternative 5

If this alternative were implemented, open motorized route densities on most calving areas would be lowest of all alternatives, but would remain relatively high in some hunting districts. The lowest open road density on calving range would be in hunting district 413 at less than 0.1 miles per square mile, and the highest would be in hunting district 540 at 2.15 miles per square mile. The higher than expected open road density values in this alternative are due to several roads in the mapped calving range being a primary system route or County route outside Forest Service jurisdiction.

4. Direct and Indirect Effects Common to Alternatives 3 and 5

Both of these alternatives include development and use of light aircraft landing strips. Alternative 3 would approve four such strips and Alternative 5 would approve two. Two of these strips would be located on mapped calving ranges.

Russian Flat Strip – This landing strip is located in calving range in hunting district 418, and would be approved under Alternative 3.

Middlle Fork Judith Strip - This landing strip is located in calving range in hunting district 448, and would be approved under both Alternative 3 and 5.

There is little research available to assess this type of activity on elk calving, but avoidance, disturbance, and displacement effects would likely be commensurate with frequency of use, similar to that which would be expected with other modes of motorized disturbances. Potential for avoidance and displacement effects would likely increase as the level of aircraft use increases. Use of either landing site during the calving season (May 1 to June 30) would likely displace cows and calves and may adversely affect elk recruitment in the long term. Limiting use of these airstrips by closing them from May 1 to June 30 would limit the disturbance during the calving season, thereby mitigating the effects.

<u>Effects on Elk & Mule Deer Winter Range</u>

Wildlife biologists on the LC NF and local biologists from MT FWP collaboratively identified and mapped big game winter ranges within the planning area. The latest mapping update of elk and mule deer winter ranges occurred in 1997 based on local knowledge of area biologists. Areas identified as winter range were delineated, and are spatially designated and filed in the Forest GIS library (Map 11). Winter range designations included adjacent private lands. As can be seen from Map 11**,** there is relatively fewer acres of winter ranges on USFS lands as compared to winter range on private lands. In general, winter range on USFS lands is restricted to Forest edges within the forest/grassland interface. Table III-82 summarizes elk and mule deer winter range area (square miles) within the Forest boundary by Hunting

District. There are 173.7 and 163.9 square miles of elk and mule deer winter range respectively on National Forest System lands.

c. Winter Alternative 1 – No Action (Existing Condition) Alternative

1. Direct and Indirect Effects

The current travel plan imposed off-route travel restrictions on some winter ranges designated at the time the plan was developed (1987). New mapping efforts by biologists in 1997 has changed winter range designations; as a result 30% (53.8 sq miles) of existing elk winter range, and 38% (63.1 sq miles) of existing mule deer winter range is not currently protected by off-route travel restrictions (Tables III-86 and III-87). Of the three winter alternatives, Alternative 1 places winter travel restrictions on the least amount of mule deer winter range.

On elk winter range, hunting district 413 has the least amount of winter range area unprotected (819 acres), and hunting district 580 has the most winter range area unprotected (10,132 acres). Hunting districts 416, 418, and 540 also have large amounts of unprotected winter range; in excess of 4000 acres each. In Winter Alternative 1, there are several roads and trails that allow snowmobile travel. Additionally, there are roads and trails within open (unprotected) areas that are available during the winter months. Table III-84 displays the total miles of routes where snowmobile use would be allowed. For Winter Alternative 1 this would vary from a high of 112 miles for Summer Alternative 1 to a low of 57 miles for Summer Alternative 5.

Table III-84. Elk Winter Range, Miles of Open Road and Trail

Summer Alternative		Winter Alt. 1	Winter Alt. 2	Winter Alt. 3
1	roads	91.6	120.4	26.6
	trails	20.6	14.3	5.9
	Sub-total	112.2	134.7	32.5
3	roads	64.6	103.8	27.2
	trails	22.0	10.7	3.7
	Sub-total	86.6	114.5	30.9
4	roads	52.2	84.9	19.4
	trails	4.0	3.8	1.0
	Sub-total	56.2	88.7	20.4
5	roads	52.2	87.0	21.7
	trails	4.5	7.0	2.8
	Sub-total	56.7	94.0	24.5

On mule deer winter range, hunting district 416 has the least amount of winter range area unprotected (728 acres), and hunting district 432 has the most winter range area unprotected (11,121 acres). Hunting districts 418, 540, and 580 also have large amounts of unprotected winter range; in excess of 5000 acres each. In Alternative 1, there are several roads and trails that allow snowmobile travel. As is the case for elk, there are roads and trails within open (unprotected) areas that are available during the winter months. Per Table III-85, the total miles of routes where snowmobile use would be allowed on winter range in Alternative 1

would vary from a high of 129 miles for Summer Alternative 1 to a low of 66 miles for Summer Alternative 5.

Table III-85. Mule Deer Winter Range, Miles of Open Road and Trail

Summer Alternative		Winter Alt. 1	Winter Alt. 2	Winter Alt. 3
1	roads	103.3	113.8	33.9
	trails	25.4	10.1	5.4
	Sub-total	128.7	123.9	39.3
3	roads	78.5	95.6	31.0
	trails	19.9	7.0	2.4
	Sub-total	98.4	102.6	33.4
4	roads	68.9	79.2	24.7
	trails	3.3	3.1	1.0
	Sub-total	72.2	82.3	25.7
5	roads	62.7	81.2	25.0
	trails	3.6	6.1	2.0
	Sub-total	66.3	87.3	27.0

d. Winter Action Alternatives 2 and 3

1. Direct and Indirect Effects Common to Winter Alternative 2

Of the three winter alternative, Alternative 2 places off-route travel restrictions on the least amount of elk winter range. Under Alternative 2, 33% (58.2 sq miles) of existing elk winter range, and 26% (63.1 sq miles) of existing mule deer winter range would not be protected by off-route travel restrictions (Tables III-86 and III-87).

Table III-86. Percentage of Elk Winter Range Open to Snowmobiling

Hunting District	Winter Alt. 1 (Existing)	Winter Alt. 2	Winter Alt. 3
413	4 % (819 Ac.)	0 %	0 %
416	92 % (4408 Ac.)	92 % (4408 Ac.)	0 %
418	79 % (4522 Ac.)	0 %	3 % (184 Ac.)
420	24 % (1416 Ac.)	11 % (634 Ac.)	2 % (124 Ac.)
432	27 % (1433 Ac.)	3 % (169 Ac.)	1 % (45 Ac.)
448	18 % (834 Ac.)	5 % (232 Ac.)	13 % (619 Ac.)
449	31 % (3554 Ac.)	31 % (3541 Ac.)	8 % (975 Ac.)
452	53 % (1951 Ac.)	100 % (3715 Ac.)	8 % (296 Ac.)
454	2 % (123 Ac.)	52 % (2720 Ac.)	5 % (250 Ac.)
540	22 % (4562 Ac.)	39 % (7969 Ac.)	6 % (1285 Ac.)
580	49 % (10132 Ac.)	67 % (13840 Ac.)	11 % (2379 Ac.)
Total	**30 % (53.8 sq mi)**	**33% (58.2 sq mi)**	**6% (9.6 sq mi)**

Table III-87. Percentage of Mule Deer Winter Range Open to Snowmobiling

Hunting District	Winter Alt. 1 Existing	Winter Alt. 2	Winter Alt. 3
413	23 % (8560 Ac.)	6 % (2085 Ac.)	1 % (208 Ac.)
416	62 % (728 Ac.)	62 % (728 Ac.)	0 %
418	82 % (5323 Ac.)	0 %	3 % (188 Ac.)
420	39 % (572 Ac.)	9 % (137 Ac.)	12 % (179 Ac.)
432	94 % (11121 Ac.)	17 % (2056 Ac.)	11 % (1356 Ac.)
448	33 % (1897 Ac.)	3 % (190 Ac.)	29 % (1682 Ac.)
454	17 % (1043 Ac.)	59 % (3638 Ac.)	4 % (253 Ac.)
540	26 % (5526 Ac.)	38 % (8323 Ac.)	7 % (1458 Ac.)
580	43 % (5359 Ac.)	78 % (9695 Ac.)	12 % (1508 Ac.)
Total	**38 % (63.1 sq mi)**	**26% (42.0 sq mi)**	**<1% (10.7 sq mi)**

On elk winter range in this alternative, hunting district 413 and hunting district 416 would both be fully restricted for off-route motorized travel, and hunting district 580 would have the most winter range area unprotected (13,840 acres). Hunting district 540 would also have large amounts of unprotected winter range (7,969 acres). In Alternative 2 there are several roads and trails that allow snowmobile travel.

Mileages of routes allowing snowmobile use in Winter Alternative 2 would vary depending on which summer alternative is implemented. As shown in Table III-84, the total miles of routes where snowmobile use would be allowed in winter Alternative 2 would vary from a high of 135 miles for Summer Alternative 1 to a low of 94 miles for Summer Alternative 5.

On mule deer winter range under this alternative, hunting district 418 would be fully restricted for off-route motorized travel, and hunting district 580 would have the most winter range area unprotected (9,695 acres). Hunting district 540 would also have a large amount of unprotected winter range (8,323 acres).

In Alternative 2 there are several roads and trails that allow snowmobile travel. As is the case for elk, mileages of routes allowing snowmobile use in Winter Alternative 2 would vary depending on which summer alternative is implemented. Per Table III-85, the total miles of routes where snowmobile use would be allowed on winter range in winter Alternative 2 would vary from a high of 124 miles for Summer Alternative 1 to a low of 82 miles for Summer Alternative 5.

2. Direct and Indirect Effects Common to Winter Alternative 3

This winter alternative was developed specifically to address natural resource issues. As a result it restricts winter motorized travel to the greatest extent of all winter alternatives. Under winter Alternative 3, 6% (9.6 sq miles) of existing elk winter range, and <1% (10.7 sq miles) of existing mule deer winter range would not be protected by off-route travel restrictions (Tables III-86 and III-87).

On elk winter range in this alternative, hunting district 413 and hunting district 416 would both be fully restricted for off-route motorized travel, and hunting district 580 would have the most winter range area unprotected (2,379 acres). Hunting district 540 would have 1285 acres

unprotected, and the remaining hunting districts would have less than 1000 acres each. In winter Alternative 3, there are several roads and trails that allow snowmobile travel. Mileages of routes allowing snowmobile use in Winter Alternative 3 would vary depending on which summer alternative is implemented. Per Table III-84, the total miles of routes where snowmobile use would be allowed in winter Alternative 3 would vary from a high of 39 miles for Summer Alternative 1 to a low of 20.4 miles for Summer Alternative 4.

On mule deer winter range under this alternative, hunting district 416 would be fully restricted for off-route motorized travel, and hunting district 448 would have the most winter range area unprotected (1682 acres). Unprotected area in hunting district 540 and 580 would be significantly reduced in Alternative 3 as compared to the other alternatives. In Alternative 3 there are several roads and trails that allow snowmobile travel. As is the case for elk, mileages of routes allowing snowmobile use in Winter Alternative 3 would vary depending on which summer alternative is implemented. Per Table III-85, the total miles of routes where snowmobile use would be allowed on winter range in Alternative 3 would vary from a high of 39 miles for Summer Alternative 1 to a low of 26 miles for Summer Alternative 4.

By far, winter Alternative 3 restricts winter motorized travel to the greatest extent, and comes closest to meeting Montana Fish and Game Commission Road management Policy (1982) recommendations of allowing no motorized use on big game winter range.

ROUTE DENSITY NEAR WOLVERINE DENNING HABITAT

Motorized and non-motorized activities and associated recreation can affect wolverine mortality, distribution, and reproduction. The greatest potential for negative impacts result from disturbance to den sites and access for trapping. Other effects associated with travel planning include displacement and disturbance, and the distribution and availability of big game carrion. The high mobility of this species and the nature of the Jefferson Division make it likely that any individual's wanderings would overlap roadless areas, roads, motorized trails, and nonmotorized trails. With all other factors the same, remote and unroaded areas (with little backcountry winter use) are likely more effective wolverine habitat than roaded and high use areas. Greater motorized access increases disturbance and in the winter increases access for trapping. Activities that enhance the ungulate populations within habitat used by wolverines are better than those that reduce ungulate populations.

Disturbance is the primary mechanism by which travel management decisions are likely to have impacts on wolverines. The fact that wolverines are habitat generalists with the theme of remoteness from humans and human development (Banci 1994:100), implies that wolverines are highly sensitive to human disturbance. Disturbance from human activities can affect wolverines in a number of ways. Potential biological responses include elevated heart rate and respiration, increased blood sugar levels, increased blood flow to skeletal muscles and a corresponding decrease of blood flow to the skin and digestive organs (Knight and Gutzwiller 1995). These responses all occur in preparation for the "fight or flight response." These reactions pose an energetic cost to individuals which, in times of critical energy deficiencies could affect survival and reproductive rates.

Behavioral reactions to disturbance from humans could result in displacement from familiar territories, security cover and foraging opportunities. Wolverines choosing to flee from human intrusions may become more vulnerable to altercations with other predators. This situation should be rare, since wolverines typically occupy large home ranges and should be able find familiar and secure areas for retreat within their home range. Displacement effects

due to human disturbance would likely have the greatest impacts on juvenile and subadult animals that have not yet established secure home range territories.

Disturbance effects are most likely to have adverse impacts on wolverines during winter; a critical time period since weather conditions are more extreme, food sources may be limited, thermoregulatory demands are high and reproductive females have the added energetic demands of developing fetuses, giving birth and nursing kits (Inman et al. 2003:1). Human disturbance during this challenging time could result in increased energy expenditures due to unnecessary movement to avoid the disturbance, and/or decreased energy intake if foraging is interrupted. These conditions could have negative impacts on wolverine survival and reproductive rates, which could affect the population.

Denning habitat was modeled for the Jefferson Division using GIS. The model was a combination of three queries of different data sources. The first included elevation greater than 6,499 ft, azimuth between 315 and 135 degrees, concave curvature, slope less than 101%, and cover types of rock and ice (from the SILC 1 data). The second query used the same parameters as the first (utilizing the SILC 3 data), except that the rock vegetation type was excluded from the data set, and curvature was set to equal all but convex. The third query included the same parameters as the second except that the rock vegetation type was derived from the TSMRS data base, and the ice component was excluded. Results from all three queries were added to get the modeled wolverine denning habitat. The modeled denning habitat was then buffered by 1km to capture disturbance influences and also to capture additional denning sites in conifer vegetation types. Within the buffered area, route densities for winter and summer were calculated, as was the percentage of the area open to over snow travel. This gives the extreme value of area potentially compacted by snowmobiles near denning habitat.

Wolverines have tremendous dispersal capabilities, and considerable movement and exchange may occur between the island ranges included in this analysis and adjacent areas (Cegelski et al. 2003; Inman et al. 2003). With this said, Cegelski (2003) found that of the three subpopulations identified by the study in Montana, the population in the Crazy and Little Belt Mountains (the population found in the analysis area) was the most isolated for number of migrants and gene flow.

All travel management decisions made through this process would be specific to routes and areas within the analysis area. Analysis areas used for evaluating effects of travel management on wolverines include mountain ranges for direct and indirect impacts, and the entire analysis area for cumulative effects. These spatial scales were chosen because they represent logical units for evaluating route-by-route travel uses and seasonal restrictions by alternative. Further, mountain ranges are of an adequate size to include the large home ranges of wolverines.

For all three mountain ranges (Castles, Crazies, and Little Belts) both winter alternatives 2 and 3 provide substantial decreases from the current situation in the amount of area open to snowmobiling in denning habitat (Table III-88). Currently 100% of denning habitat in the Castles is open for snowmobiling. Alternative 2 reduces this to 67%, and Alternative 3 reduces this to 66%. Currently 91% of denning habitat in the Crazies is open for snowmobiling. Alternative 2 reduces this to 24%, and Alternative 3 reduces this to 14%. Currently 70% of denning habitat in the Little Belts is open to snowmobiling. Alternative 2 reduces this to 39%, and Alternative 3 reduces this to 45%. In addition to percentages the quality of denning habitat should also be considered. While in the Little Belts Alternative 3

appears to have less secure denning habitat than Alternative 2, several areas of higher denning potential are closed to snowmobiling in Alternative 3 that are not in Alternative 2.

The miles of snowmobile routes open to winter travel within denning habitat were summarized across the three mountain ranges. Only designated routes were used in this analysis, and there are additional legal routes that are undesignated but which can be used. The amount of seldom groomed snowmobile routes was the same across the three alternatives and was insubstantial (0.3 miles). Currently 50 miles of regularly groomed snowmobile routes (including 16.6 miles closed from 10/15 to 12/01) are open. There are 59.1 miles of regularly groomed snowmobile routes proposed to be open in both Alternatives 2 and 3. Of this, 59.1 miles of regularly groomed routes, Alternative 2 provides 3.2 miles within area closures while Alternative 3 provides 21.9 miles within area closures (Tables III-89 and III-90).

For cross county skiing there are a total of approximately 14 miles of groomed and ungroomed miles of routes in denning habitat across the three mountain ranges. The only substantial change across the three alternatives is the number of miles of ungroomed routes within areas closed to snowmobiles increases in Alternatives 2 and 3, with a proportional decrease in the number of miles of ungroomed routes in areas open to snowmobiling (Tables III-89 and III-90).

A varying portion of the roads and other motorized routes in denning habitat that are open from 12/01 to 5/15 will be passable by wheeled vehicles during this time. The number of miles of roads and trails in this category were calculated by mountain range (Table III-91). For the Castles the miles of roads in denning habitat open from 12/01 to 5/15 drops from the existing 4.5 miles to 2.4 miles across the three proposed alternatives. Motorized trails in denning habitat open from 12/01 to 5/15 remain the same (9.1 miles) for Alternative 3 and decrease to 4.6 miles for Alternative 5 and a low of 0.6 miles for Alternative 4.

For the Crazies the value for roads open from 12/01 to 5/15 decreases slightly from existing to Alternative 3 (from 10.5 to 9.9 miles), drops to 8.6 miles in Alternative 5, and drops to a low of 6.6 miles in Alternative 4. The pattern is similar but more pronounced for motorized trails. The value for motorized trails open from 12/01 to 5/15 decreases slightly from existing in Alternative 3 (from 24.6 to 23.0 miles), drops to 1.5 miles in Alternative 5, and drops to a low of 0.0 miles in Alternative 4.

For the Little Belts the value for roads open from 12/01 to 5/15 drops from the existing 288.2 miles to 204.5 miles in Alternative 3, 187.8 miles in Alternative 4, and a low of 177.9 miles in Alternative 5. Motorized trails open from 12/01 to 5/15 increase slightly from the existing 152.8 to 158.7 in Alternative 3. The amount of motorized trails open from 12/01 to 5/15 decreases substantially in Alternatives 4 (low of 61.6 miles) and 5 (96.9 miles).

Table III-88. Percentage of Area within 1 km of Modeled Wolverine Denning Habitat Open to Snowmobile Use by Winter Alternative

Mountain Range	Winter Alt. 1 Existing	Winter Alt. 2	Winter Alt. 3
Castles	100 %	67 %	66 %
Crazies	91 %	24 %	14 %
Little Belts	70 %	39 %	45 %

Table III-89. Miles of Existing Routes Within 1 km of Modeled Wolverine Denning Habitat

Type	Miles	Description of Activity
Snowmobile	30.0	Regularly groomed routes open yearlong
	0.3	Seldomly groomed routes open yearlong
	0.4	Regularly groomed routes to parking lot in closed area
	16.6	Regularly groomed routes closed from 10/15 to 12/1
X-C skiing	0.4	Regularly groomed routes open yearlong
	10.8	Ungroomed routes open yearlong
	2.0	Regularly groomed routes within area closed to snowmobiles
	1.0	Ungroomed routes within area closed to snowmobiles

Table III-90. Miles of Proposed Routes Within 1 km of Modeled Wolverine Denning Habitat

Type	Winter Alt. 2 miles	Winter Alt. 3 miles	Decscription of Activity
snowmobile	55.9	37.2	Regularly groomed routes open yearlong
	0.3	0.3	Seldomly groomed routes open yearlong
	3.2	21.9	Regularly groomed routes through area closures
X-C skiing	0.2	0	Regularly groomed routes open yearlong
	2.7	0.1	Ungroomed routes open yearlong
	2.3	2.4	Regularly groomed routes within area closed to snowmobiles
	9.1	11.8	Ungroomed routes within area closed to snowmobiles

Table III-91. Miles of Routes Open from 12/1 to 5/15 Within 1 km of Wolverine Denning Habitat by Mountain Range and by Summer Alternative

Summer Alternative		Castle Mtns.	Crazy Mtns. (north half)	Little Belt Mtns.
Alt 1	Roads	4.5	10.5	288.2
	Trails	9.1	24.6	152.8
Alt 3	Roads	2.4	9.9	204.5
	Trails	9.1	23.0	158.7
Alt 4	Roads	2.4	6.6	187.8
	Trails	0.6	0	61.6
Alt 5	Roads	2.4	8.6	177.9
	Trails	4.6	1.5	96.9

POTENTIAL EFFECTS OF SNOW COMPACTION.

Winter recreational uses can result in compaction of snow, which may decrease habitat availability for wildlife species or their prey, and may increase access for competitors and predators less well adapted to deep snow.

ROUTE DENSITY NEAR WOLVERINE DENNING HABITAT

Snow compaction caused by human travel could provide better access to wolverine winter foraging habitat for potential competitors such as coyotes and bobcats. This theory has been postulated for potential impacts to Canada lynx resulting from snow compaction (Buskirk et al. 2000:94). Snow compaction resulting from human travel could also indirectly affect wolverines through impacts to prey species. Many small mammals utilize the subnivian (under the snow) environment for security cover and thermal regulation in winter. Several authors (Jarvinen and Schmid 1971, Neumann and Merriam 1972, Boyle and Samson 1985) have reported adverse impacts to small mammal populations resulting from snow compaction associated with snowmobile use. Wolverines depend to varying extents on big game carrion and big game distribution may be affected by snowmobile use. For a comparison of alternatives see the discussion under the preceding issue.

MILES OF DESIGNATED ROUTES & ACRES OPEN IN LYNX ANALYSIS UNITS

Analysis Methodology

The LCAS (Ruediger et al. 2000) is the primary basis for determining effects to lynx. There are no specific methodologies for determining effects to lynx other than guidelines and standards identified in the LCAS. A Conservation Agreement between the US Forest Service and the US Fish and Wildlife Service committed the Forest Service to use the LCAS in determining the effects of actions on lynx until the Forest Plans are amended (USDI 2003). To address compliance with LCAS habitat standards, effects to Canada lynx were evaluated by assessing the travel planning proposal and alternative(s) subsequent effects to those guidelines and standards that apply to these specific actions. Standards and guidelines were developed based on risk factors and credible scientific evidence. Those risk factors are described in Chapter 2 of the LCAS. Those that apply to the travel planning alternatives include those factors affecting lynx productivity (recreation, Forest/ backcountry roads and trails), factors affecting lynx mortality (legal and non-target trapping, incidental or illegal shooting, competition and predation as influenced by human activities), and other large-scale risk factors (lynx movement and dispersal across shrub-steppe habitats).

The proportion of unsuitable lynx habitat and lynx denning (and foraging) habitat would not be changed with any of the travel planning alternatives as no vegetation treatment is proposed. Therefore, the habitat components are displayed for baseline information in the Biological Assessment, but are not appropriate for analysis to compare alternatives.

As stated above, direction for habitat management for lynx is found in the LCAS (Ruediger et al. 2000), which outlines guidelines and standards at the programmatic and project level of planning. In regards to travel management, key information is found in Conservation

Measures, Chapter 7 in two sections; Recreation Management and Forest/Backcountry Roads and Trails. Most objectives, standards and guidelines in these two sections are aimed at addressing areas of primary concern. One concern relates to landscape scale connectivity of lynx habitat. This is a basic habitat characteristic that is important to the conservation of many species, including many wide-ranging mid-size and larger carnivores. Another habitat concern is unique to lynx and revolves around potential competing predators who may utilize packed snow routes for access into areas normally only accessible to lynx. The standards and guidelines incorporate recommendations on location and use of public roads and motorized trails, particularly during periods of winter use. Table III-92 through Table III-94 below outline the conservation measures applicable to the Travel Plan alternatives and pertinent discussion relative to those conservation measures.

Previously established analysis units, in accordance with the Lynx Conservation and Assessment Strategy (Ruediger, et al 2000), were used to assess the effects of proposed actions on lynx and lynx habitat. These Lynx Analysis Units (LAUs) approximate the size of a female's home range and encompass all seasonal habitats (Ruediger et al. 2000).

Breeding season and a limited prey base contribute to winter and early spring being a critical time for lynx. Effects were evaluated by assessing alternatives effects to those guidelines and standards that apply in the LCAS. For travel planning those are; factors affecting lynx productivity (recreation, Forest/backcountry roads and trails), factors affecting lynx mortality (legal and non-target trapping, incidental or illegal shooting, competition and predation as influenced by human activities), and other large scale risk factors (lynx movement and dispersal across shrub-steppe habitats). Forest/Backcountry roads and trails are a risk factor identified as potentially affecting lynx productivity. Landscape level connectivity of lynx habitat and competitors such as coyote and mountain lion accessing lynx habitat via plowed roads and groomed trails are primary concerns. Parameters used to measure effects include roads and motorized trails open from 12/1 to 5/15, miles of marked or groomed (designated) snowmobile and ski routes, and percentage of LAU open to snowmobiling. There are a considerable number of consistently used snowmobile play areas which result in varying polygons of compacted snow. The majority occur within LAUs and will be further analyzed in the Biological Assessment.

Table III-92. Lynx Conservation Measures Applicable to All Programs and Activities.

Programmatic Planning (7-3)	
Standards	**Discussion**
S1 - Conservation measures will generally apply only to lynx habitat on federal lands within LAUs.	Standards were only measured against existing conditions on federal lands in lynx habitat for direct and indirect effects with three exceptions: 1) summer motorized routes and over-the-snow routes were measured in total even if they transverse private lands; 2) areas of non-habitat were included in calculations of over-the-snow accessible area changes; and 3) private lands within the LAUs were qualitatively discussed in the cumulative effects section.

S2 - Lynx habitat will be mapped using criteria specific to each geographic area to identify appropriate vegetation and environmental conditions	In compliance with LCAS Project Planning Standards regarding habitat delineation, a map identifying primary lynx foraging and denning habitat is located in the electronic files in the Gallatin GIS library.
S3 - To facilitate project planning, delineate LAUs; LAUs should be at least the size of area used by a resident lynx and contain sufficient year-round habitat	See section below on LAUs on the Gallatin National Forest
S4 - LAU boundaries will not be adjusted for individual projects, but must remain constant	See section below on LAUs on the Gallatin National Forest
Programmatic Planning (7-3)	
Standards	**Discussion**
S5 - Limit disturbance within each LAU: if more than 30% of lynx habitat within a LAU is currently in unsuitable condition, no further reduction of suitable conditions shall occur as a result of vegetation management by Federal agencies	Baseline habitat standards will be addressed in the Biological Assessment but not analyzed in detail by alternative. The proportion of unsuitable lynx habitat and lynx denning (and foraging) habitat would not be changed with any of the travel planning alternatives as no vegetation treatment is proposed.
Project Planning (7-4)	
Standards	**Discussion**
S1 - Within each LAU, map lynx habitat; identify potential denning and foraging habitat (hares, squirrels, etc.), and topographic features important for lynx movement (major ridge systems, prominent saddles, and riparian corridors); identify non-forest vegetation (meadows, shrublands, grasslands, etc.) adjacent to and intermixed with forested lynx habitat providing habitat for alternate lynx prey species.	Not applicable for this analysis at programmatic level. Primary lynx foraging and denning habitat is located in the electronic files in the Gallatin GIS library. Willow, aspen, and sagebrush habitats adjacent to conifer habitats mapped as lynx habitat have also been identified. Further NEPA analysis would be required for implementation of the selected travel plan alternative.
S3 - Maintain habitat connectivity within and between LAUs.	It is essential that landscape connectivity between lynx habitats and populations in Canada and the contiguous United States be maintained (USDI 2003).

Table III-93. Conservation Measures to Address Risk Factors Affecting Lynx Productivity.

Recreation Management (7-9) - Programmatic Level	
Standards and Guidelines	**Discussion**
S1 - On federal lands in lynx habitat, allow no net increase in groomed or designated over-the-snow routes and designated snowmobile play areas by LAU unless the designation serves to consolidate unregulated use and improves lynx habitat though a net reduction of compacted snow area (Ruediger et al. 2000, Mcallister 2003).	This standard was developed to meet the programmatic planning objective listed under Recreation Management (LCAS:7-8, Ruediger et al. 2000): "plan for and manage recreational activities to protect the integrity of lynx habitat." The focus is to minimize snow compaction in lynx habitat.

S2 - Map and monitor the location and intensity of snow compacting activities… that coincide with lynx habitat, to facilitate future evaluation of effects on lynx as information becomes available.	This analysis considered known over-the-snow winter recreation and identified those areas of lynx habitat accessible with over-the-snow winter recreation as it related to LCAS standards and guidelines.
G1 - Provide a landscape with interconnecting blocks of foraging habitat where snowmobile, cross-country skiing, snowshoeing, and other snow compacting activities are minimized or discouraged.	Not applicable for this analysis. Foraging habitat is well distributed across the Forest and generally precludes over-the-snow activities. In addition, over-the-snow activities are limited due to wilderness designation, topography, accessibility, or other restrictions.
G2 - As information becomes available on the impact of snow-compacting activities and disturbance on lynx, limit or discourage this use in areas where it is shown to compromise lynx habitat.	Existing and ongoing literature and research used to conduct analysis. Also included as monitoring item.
Forest/Backcountry Roads and Trails (7-10) – Programmatic Level	
Standards and Guidelines	**Discussion**
S1 - On federal lands in lynx habitat, allow no net increase in groomed or designated over-the-snow routes and snowmobile play areas by LAU. (This standard is similar to S1 – Recreation Management.)	Plowed roads and groomed over-the-snow routes may allow competing carnivores such as coyotes and mountain lions to access lynx habitat in the winter, increasing competition for prey (Ruediger et al. 2000).
G1 - Determine where high total road densities (>2 miles per square mile) coincide with lynx habitat, and prioritize roads for seasonal restrictions or reclamation in those areas.	Further research directed at elucidating the effects of road density on lynx is needed (Ruediger et al. 2000).
G2 - Minimize roadside brushing in order to provide snowshoe hare habitat.	Not applicable for this analysis but may be an indirect effect of implementation of the selected travel plan alternative if it includes reconstruction, rerouting, etc. of selected roads and/or trail routes for which further NEPA analysis would be required.
G3 - Locate trails and roads away from forested stringers.	Not applicable for this analysis. See G2. Landscape connectivity may be provided by narrow forested mountain ridges, plateaus, or forest stringers that link more extensive areas of lynx habitat (Ruediger et al. 2000).
G5 - Minimize building of roads directly on ridgetops or areas identified as important for lynx habitat connectivity.	

Table III-94. Lynx Conservation Measures to Address Mortality Risk Factors: Movement / Dispersal.

Mortality Risk Factors - Programmatic Level Standards and Guidelines (LCAS, 7-12 to 16)	
Trapping (7-12)	**Discussion**
G1 - Federal agencies should work cooperatively with States and Tribes to reduce incidental take of lynx related to trapping.	Lynx are known to be vulnerable to trapping. Lynx may be more vulnerable to trapping near open roads (Ruediger et al. 2000).
Shooting (7-12)	**Discussion**
G1 - Initiate interagency information and education efforts throughout the range of lynx in the contiguous states. Utilize trailhead posters, magazine articles, news releases state hunting and trapping regulation booklets, etc., to inform the public of the possible presence of lynx, field identification, and their status.	Lynx may be mistakenly shot by legal predator hunters seeking bobcats, or illegally by poachers. Prey species may also be affected by legal shooting (Ruediger et al. 2000).
Competition and Predation as Influenced by Human Activities (7-13)	**Discussion**
S1 - On federal lands in lynx habitat, allow no net increase in groomed or designated over-the-snow routes and designated snowmobile play areas by LAU unless the designation serves to consolidate unregulated use and improves lynx habitat though a net reduction of compacted snow area.	Habitat changes that benefit competitor/ predator species, including providing packed snow travel ways, may lead to increased starvation or direct mortality of lynx (Ruediger et al. 2000).
Movement and Dispersal - Programmatic Level Standards and Guidelines (LCAS, 7-12 to 16)	
Highways (7-14)	**Discussion**
G1 - Dirt and gravel roads traversing lynx habitat (particularly those that could become highways) should not be paved or otherwise upgraded … in a manner that is likely to lead to significant increases in traffic volumes, traffic speeds, increased width of the cleared ROW, or would foreseeably contribute to development or increases in human activity in lynx habitat.	Highways impact lynx by fragmenting habitat and impeding movements. Special concern must be given to the development of new highways including gravel roads being paved (Ruediger et al. 2000).

a. Winter Alternative 1 (No Action) and Action Alternatives 2 and 3

1. Direct and Indirect Effects by LAU

Table III-95 provides percentages of all 25 LAUs open to snowmobiling by winter alternative. Table III-96 provides miles of winter routes with no restrictions for the 12 LAUs that have those routes. Table III-97 provides the miles of existing winter routes in areas closed to snowmobiles for the 2 LAUs with that situation. Table III-98 provides the miles of winter routes closed 10/15 to 12/1 for the 12 LAUs where this occurs.

CA1 – Currently this entire LAU is open to snowmobiling. Alternative 2 reduces this to 79%, and Alternative 3 reduces this to 75%.

CA2 – Currently 95% of this LAU is open to snowmobiling. Alternative 2 increases this to 99%, and Alternative 3 maintains the current use level of 95%.

CR1 – Currently 74% of this LAU is open to snowmobiling. Alternative 2 reduces this to 69%, and Alternative 3 reduces this to 52%.

CR2 – Currently this entire LAU is open to snowmobiling. Alternatives 2 and 3 reduce this to 0%.

LB1 – Currently none of this LAU is open to snowmobiling. Alternative 2 increases this to 13%, and Alternative 3 increases this to 93%.

LB2 – Currently 72% of this LAU is open to snowmobiling. Alternative 2 reduces this to 19%, and Alternative 3 reduces this to 61%.

LB3 – Currently this entire LAU is open to snowmobiling. Alternative 2 reduces this to 26%, and Alternative 3 reduces this to 97%.

LB4 – Currently this entire LAU is open to snowmobiling. Alternative 2 reduces this to 19%, and Alternative 3 reduces this to 46%.

LB5 – Currently 87% of this LAU is open to snowmobiling. Alternative 2 reduces this to 21%, and Alternative 3 reduces this to 33%.

LB6 – Currently 28% of this LAU is open to snowmobiling. Alternative 2 reduces this to 13%, and Alternative 3 increases this to 100%. Currently there are 0.7 miles of unrestricted snowmobile routes in this LAU. Alternative 2 reduces this to 0%, and Alternative 3 would maintain the current value. Alternatives 1 and 3 have no miles of snowmobile routes closed 10/15 to 12/1, Alternative 2 has 0.7 miles.

LB7 – Currently 20% of this LAU is open to snowmobiling. Alternative 2 increases this to 73%, and Alternative 3 increases this to 97%. Currently there are 0.5 miles of unrestricted snowmobile routes in this LAU. Alternative 2 increases this to 9.3 miles, and Alternative 3 increases this to 6.2 miles. Currently there are 5.8 miles of snowmobile routes closed 10/15 to 12/1. Alternative 2 decreases this to 0 miles, and Alternative 3 decreases this to 3.1 miles.

LB8 – Currently 96% of this LAU is open to snowmobiling. Alternative 2 reduces this to 93%, and Alternative 3 reduces this to 29%. Currently there are 9.6 miles of unrestricted snowmobile routes in this LAU. Alternative 2 increases this to 13.7 miles, and Alternative 3 reduces this to 7.5 miles. Currently there are 4.7 miles of unrestricted cross country ski routes in this LAU. Alternative 2 reduces this to 2.4 miles, and Alternative 3 reduces this to 0.2 miles. Currently there are 1.8 miles of snowmobile routes closed 10/15 to 12/1. Alternative 2 reduces this to 0 miles, and Alternative 3 increases this to 6.2 miles. Currently there are no cross country ski routes closed 10/15 to 12/1. Alternative 2 increases this to 2.5 miles, and Alternative 3 increases this to 2.1 miles.

LB9 – Currently 97% of this LAU is open to snowmobiling. Alternative 2 reduces this to 79%, and Alternative 3 reduces this to 8%. Currently there are 14.3 miles of unrestricted snowmobile routes in this LAU. Alternative 2 increases this to 16.5 miles, and alternative 3 reduces this to 8.9 miles. Currently there are 12.8 miles of unrestricted cross country ski routes in this LAU. Alternative 2 reduces this to 0.7, and Alternative 3 reduces this to 0.2 miles. There are currently 0.2 miles of snowmobile routes to access parking areas in areas closed to snowmobiles. There are 5.5 miles of cross country ski routes in areas closed to snowmobiles. Currently there are 0.1 miles of snowmobile routes closed 10/15 to 12/1. Alternative 2 increases this to 0.2 miles, and Alternative 3 increases this to 7.7 miles. Currently there are no cross country ski routes closed 10/15 to 12/1. Alternative 2 increases this to 12.2 miles, and Alternative 3 increases this to 9.2 miles.

LB10 – Currently 83% of this LAU is open to snowmobiling. Alternative 2 reduces this to 6%, and Alternative 3 reduces this to 55%.

LB11 – Currently 83% of this LAU is open to snowmobiling. Alternative 2 reduces this to 8%, and Alternative 3 reduces this to 80%.

LB12 – Currently 25% of this LAU is open to snowmobiling. Alternative 2 increases this to 92%, and Alternative 3 increases this to 95%. Currently there are 4.0 miles of unrestricted snowmobile routes in this LAU. Alternatives 2 and 3 increase this to 10.4 miles. Currently there are 6.4 miles of snowmobile routes closed 10/15 to 12/1. Alternatives 2 and 3 would reduce this to 0.6 miles.

LB13 – Currently 92% of this LAU is open to snowmobiling. Alternative 2 increases this to 100%, and Alternative 3 reduces this to 88%. Currently there are 36.6 miles of unrestricted snowmobile routes in this LAU. Alternative 2 increases this to 44.4 miles, and Alternative 3 increases this to 38.0 miles. Currently there are 0.2 miles of unrestricted cross country ski routes in this LAU. Alternatives 2 and 3 reduce this to 0. Currently there are 4.8 miles of snowmobile routes closed 10/15 to 12/1. Alternative 2 would decrease this to 0 miles, and Alternative 3 would increase this to 6.5 miles. Currently there are no cross country ski routes closed 10/15 to 12/1. Alternative 2 would increase this to 0.2 miles, and Alternative 3 would increase this to 0.1 miles.

LB14 – Currently 97% of this LAU is open to snowmobiling. Alternative 2 reduces this to 65%, and Alternative 3 reduces this to 64%. Currently there are 34.4 miles of unrestricted snowmobile routes in this LAU. Alternative 2 increases this to 34.8 miles, and Alternative 3 decreases this to 33.0 miles. Currently there are 21.3 miles of unrestricted cross country ski routes in this LAU. Alternative 2 reduces this to 3.0 miles, and Alternative 3 reduces this to 2.4 miles. There are currently 0.4 miles of snowmobile routes to access parking areas in areas closed to snowmobiles. There are currently 0.7 miles of cross country ski routes in areas closed to snowmobiles. Currently there are 0.4 miles of snowmobile routes closed 10/15 to 12/1. Alternative 2 would decrease this to 0.1 miles, and Alternative 3 would increase this to 1.9 miles. Currently there are no cross country ski routes closed 10/15 to 12/1. Alternative 2 would increase this to 18.3 miles, and Alternative 3 would increase this to 6.4 miles.

LB15 – Currently none of this LAU is open to snowmobiling. Alternative 2 increases this to 38%, and Alternative 3 increases this to 63%. Currently there are 0.4 miles of unrestricted snowmobile routes in this LAU. Alternatives 2 and 3 increase this to 8.9 miles. Currently there are 8.5 miles of snowmobile routes closed 10/15 to 12/1. Alternatives 2 and 3 decrease this to 0 miles.

LB16 – Currently 34% of this LAU is open to snowmobiling. Alternatives 2 and 3 increase this to 100%. Currently there are 11.7 miles of unrestricted snowmobile routes in this LAU. Alternative 2 increases this to 29.1 miles, and Alternative 3 increases this to 27.8 miles. Currently there are 17.4 miles of snowmobile routes closed 10/15 to 12/1. Alternatives 2 and 3 decrease this to 0 miles.

LB17 – Currently none of this LAU is open to snowmobiling. Alternative 2 increases this to 20%, and Alternative 3 increases this to 100%. Currently there are no unrestricted snowmobile routes in this LAU. Alternative 2 increases this to 9.6 miles, and Alternative 3 increases this to 9.9 miles. Currently there are 9.9 miles of snowmobile routes closed 10/15 to 12/1. Alternative 2 would decrease this to 0.3 miles, and Alternative 3 would decrease this to 0 miles.

LB18 – Currently 58% of this LAU is open to snowmobiling. Alternative 2 increases this to 96%, and Alternative 3 increases this to 97%. Currently there are 8.1 miles of unrestricted snowmobile routes in this LAU. Alternative 2 increases this to 69.2 miles, and Alternative 3 increases this to 70.1 miles. Currently there are 45.7 miles of snowmobile routes closed 10/15 to 12/1. Alternative 2 would decrease this to 4.9 miles, and Alternative 3 would decrease this to 4.1 miles.

LB19 – Currently 12% of this LAU is open to snowmobiling. Alternative 2 increases this to 90%, and Alternative 3 increases this to 99%. Currently there are no unrestricted snowmobile routes in this LAU. Alternatives 2 and 3 increase this to 9.8 miles. Currently there are 7.1 miles of snowmobile routes closed 10/15 to 12/1. Alternatives 2 and 3 would decrease this to 0 miles.

LB20 – Currently this entire LAU is open to snowmobiling. Alternative 2 reduces this to 0%, and Alternative 3 reduces this to 21%.

LB21 – Currently this entire LAU is open to snowmobiling. Alternative 2 reduces this to 92%, and Alternative 3 reduces this to 53%.

Table III-99 provides miles of open motorized routes from summer alternatives open from 12/1 to 5/15. The following statements address routes meeting this criteria. The miles of road decreases for LAUs in the Castles and Crazies for all 3 action alternatives. The miles of motorized trail decreases for all but CA2 which has a slight increase in Alternative 3. The miles of road decreases for 18/21 of the LAUs in the Little Belts with the exceptions being LB3, LB10, and LB21. The miles of motorized trails increases in 12/21 of the LAUs in the Little Belts, these being LB1, LB2, LB4, LB5, LB8, LB9, LB13, LB14, LB15, LB16, LB18, and LB20. The greatest gains in miles of motorized trails are generally in Alternative 3 (Table III-99).

Table III-95. Percentage of LAU Open to Snowmobiling by Winter Alternative

LAU	Winter Alt. 1	Winter Alt. 2	Winter Alt. 3
CA1	100	79	75
CA2	95	99	95
CR1	74	69	52
CR2	100	0	0
LB1	0	13	93
LB2	72	19	61
LB3	100	26	97
LB4	100	19	46
LB5	87	21	33
LB6	28	13	100
LB7	20	73	97
LB8	96	93	29
LB9	97	79	8
LB10	83	6	55
LB11	83	8	80
LB12	25	92	95
LB13	92	100	88
LB14	97	65	64
LB15	0	38	63
LB16	34	100	100
LB17	0	20	100
LB18	58	96	97
LB19	12	90	99
LB20	100	0	21
LB21	100	92	53

Table III-96. Miles of Winter Routes With No Restrictions by LAU

LAU	Route Type	Winter Alt. 1	Winter Alt. 2	Winter Alt. 3
LB6	Snowmobile	0.7	0	0.7
LB7	Snowmobile	0.5	9.3	6.2
LB8	Snowmobile	9.6	13.7	7.5
	XC ski	4.7	2.4	0.2
LB9	Snowmobile	14.3	16.5	8.9
	XC ski	12.8	0.7	0.2
LB12	snowmobile	4.0	10.4	10.4
LB13	snowmobile	36.6	44.4	38.0
	XC ski	0.2	0	0
LB14	Snowmobile	34.4	34.8	33.0
	XC ski	21.3	3.0	2.4
LB15	Snowmobile	0.4	8.9	8.9
LB16	Snowmobile	11.7	29.1	27.8
LB17	Snowmobile	0	9.6	9.9
LB18	Snowmobile	8.1	69.2	70.1
LB19	Snowmobile	0	9.8	9.8

Table III-97. Miles of Winter Routes under Existing Condition in Areas Closed to Snowmobiles (snowmobile routes access parking areas) by LAU

LAU	Type	Miles
LB9	Snowmobile	0.2
	X-C ski	5.5
LB14	Snowmobile	0.4
	X-C ski	0.7

Table III-98. Miles of Winter Routes Closed 10/15 to 12/1 by LAU

LAU	Route Type	Winter Alt. 1	Winter Alt. 2	Winter Alt. 3
LB6	Snowmobile	0	0.7	0
LB7	Snowmobile	5.8	0	3.1
LB8	Snowmobile	1.8	0	6.2
	XC ski	0	2.5	2.1
LB9	Snowmobile	0.1	0.2	7.7
	XC ski	0	12.2	9.2
LB12	snowmobile	6.4	0.6	0.6
LB13	snowmobile	4.8	0	6.5
	XC ski	0	0.2	0.1
LB14	Snowmobile	0.4	0.1	1.9
	XC ski	0	18.3	6.4
LB15	Snowmobile	8.5	0	0
LB16	Snowmobile	17.4	0	0
LB17	Snowmobile	9.9	0.3	0
LB18	Snowmobile	45.7	4.9	4.1
LB19	Snowmobile	7.1	0	0

Table III-99. Miles of Routes Open 12/1 to 5/15 by LAU and by Summer Alternative

LAU	Summer Alt. 1		Summer Alt. 3		Summer Alt. 4		Summer Alt. 5	
	Roads	Trails	Roads	Trails	Roads	Trails	Roads	Trails
CA1	12.6	30.7	9.0	28.6	9.0	0	8.1	7.9
CA2	29.6	13.0	19.2	13.2	19.3	1.3	11.5	3.1
CR1	51.2	47.1	45.7	41.9	38.6	0	48.0	7.1
CR2	5.7	15.9	4.1	16.2	2.8	0	3.3	0
LB1	31.5	38.3	13.1	40.0	14.0	8.7	8.3	7.0
LB2	20.7	17.9	6.3	19.5	5.9	7.3	11.4	0
LB3	13.9	27.9	15.9	21.8	15.9	0.1	16.3	16.2
LB4	47.0	28.6	31.7	36.2	31.1	8.3	32.1	29.0
LB5	16.4	0.1	11.3	0.6	11.3	0.6	8.6	0.6
LB6	10.5	18.8	7.2	17.9	2.9	0.4	7.0	8.0
LB7	59.0	19.4	26.8	13.2	26.6	3.3	29.4	8.8
LB8	60.2	14.8	28.7	28.5	25.0	12.6	26.7	16.6

LAU	Summer Alt. 1		Summer Alt. 3		Summer Alt. 4		Summer Alt. 5	
	Roads	Trails	Roads	Trails	Roads	Trails	Roads	Trails
LB9	88.4	10.9	62.2	20.8	61.7	15.7	54.1	18.5
LB10	30.2	28.1	37.6	26.2	37.6	15.4	37.6	27.7
LB11	31.4	30.0	28.7	28.9	26.3	10.9	21.4	22.4
LB12	29.9	22.0	16.2	18.4	16.2	18.4	13.7	0
LB13	115.0	5.4	42.8	12.4	34.9	5.5	40.2	7.3
LB14	109.2	7.3	60.4	22.9	59.7	22.8	52.9	7.5
LB15	44.0	23.1	23.9	31.2	18.5	4.9	18.4	19.8
LB16	56.2	2.8	38.9	8.8	28.5	7.0	27.8	7.0
LB17	25.4	31.3	13.6	16.0	9.6	0	9.2	6.9
LB18	102.1	16.6	93.1	20.7	83.3	17.7	55.6	8.9
LB19	36.1	26.1	30.1	25.2	28.1	10.9	27.3	24.2
LB20	19.2	17.4	17.0	23.4	17.0	11.5	9.2	1.9
LB21	37.1	12.5	47.7	11.8	44.3	2.2	44.7	4.6

CUMULATIVE EFFECTS FOR LYNX AND WOLVERINE

Substantial timber harvest has occurred in the past in the analysis area. For approximately 10-15 years harvest areas are generally unsuitable for foraging or denning.

After about 15 years harvest areas provide snowshoe hare habitat and thus lynx foraging habitat. Until the lynx was listed in April 2000, thinning reforested timber harvest units at about the age (10-15 years) they became suitable for snowshoe hares was routine. This decreased habitat suitability as densely stocked early successional forests are optimum snowshoe hare foraging habitat. Fire suppression substantially reduced the presence of early successional, regenerating forest vegetation, favorable for snowshoe hares, and timber harvest tended to be the surrogate for creating landscape level forest age class diversity.

Road construction generally associated with timber harvest has created extensive motorized access routes into lynx habitat. This has both fragmented lynx and prey habitat, and provided increased access for past trapping. Roads may also provide increased access for generalist predator competitors such as coyote and bobcat.

Snowmobile use during the winter season is becoming increasingly popular. Snowmobile numbers are increasing. A substantial area on the Jefferson Division with the greatest snowfall and retention has had snowmobile and nonmotorized winter use for decades, which may have had negative effects on lynx.

Human developments such as campgrounds, hiking trails, and road development probably had more far reaching effects by increasing human presence in once remote areas. In recent decades the Forest has closed a number of roads.

Human access and motorized travel may have resulted in changing habitat conditions that favors other predators, resulting in greater interspecific competition and possible predation. If the effective range of the wolverine or lynx has shrunk on the Jefferson Division, then intraspecific competition for denning habitat, mates, and other factors may have increased.

Highways likely form barriers and cause occasional mortalities for this wide ranging and high mobile species.

Highways likely form barriers and cause occasional mortalities particularly for wide ranging and high mobile species. Highway 89 runs through the Little Belt Mountains on the Forest. Transportation systems and other development between these island mountain ranges likely increase fragmentation and pose further risk of vehicle collisions.

The Showdown Ski Area is located on the Forest in the middle of the Little Belt mountains. Habitat that would have occurred within the ski area and adjacent habitat is largely no longer suitable.

Future road building, snowmobile use, timber harvest, and other human activities in the area will have cumulative effects on the effectiveness of habitat.

Snowmobile use during the winter season is becoming increasingly popular. As snowmobiles become more powerful riders are increasingly leaving the trails, which further impacts wolverine use of an area and natal denning success. In much of the wolverines range in the conterminous U.S. substantial areas are designated wilderness or National Parks, providing protection for natal denning habitat from motorized use. The Jefferson Division has no designated wilderness, and has no adjacent wilderness or National Parks.

A substantial number of areas with the greatest potential for denning have had motorized access at high elevations for decades (e.g. Big Baldy Mountain, Yogo Peak, Quartzite Ridge) having an unknown, but likely negative effect on wolverine denning and reproductive productivity.

Before management actions such as road building and timber harvest, wolverine had unlimited access to the variety of habitats available and likely traveled from high elevation summer habitats to low elevation winter big game ranges. These actions and others have fragmented wolverine habitat and influenced the prey carrying capacity of large areas. Fire suppression has affected habitat types and vegetative structure in the greater area. Roads and snowmobiles have provided increased access for trapping and associated mortality. Future road building, snowmobile use, timber harvest, and other human activities in the area will have cumulative effects on the effectiveness of wolverine habitat.

Wolverine experienced a great range reduction in the conterminous U.S. in modern times, and have twice been petitioned for listing in this portion of their range. Many view these populations as precarious and possibly declining.

Survival is substantially lower in trapped populations, and human caused mortality is largely additive to natural mortality (Krebs et al. 2004). Trapping may be a threat to wolverines as they have a low realized biological potential and are easily trapped (Ruggiero et al. 1994). The analysis area is part of MT FWP's Wolverine Management Unit 2, which allows an annual harvest of two wolverines.

Past and current activities have and are affecting ungulate winter ranges and populations in the greater area. Big game hunting regulations in the area are liberal. In some areas motorized access may be contributing to big game being pushed off the Forest seasonally, or becoming resident off the Forest throughout the year.

Global warming will gradually push lynx and wolverine habitat northward, and southern portions of their range such as the analysis area would be among the first affected.

CUMULATIVE EFFECTS COMMON TO BIG GAME UNGULATES ADDRESSED IN PREVIOUS ISSUES.

Human Influences

Although elk populations within the planning area are stable or increasing and meeting or above population goals, populations are dynamic and fluctuate based on many factors beyond the control of land management agencies' control. Human populations in Montana are expected to continue to increase, and increased recreational uses will likely follow. Increasing demands for motorized opportunities, especially OHV opportunities, is also expected, and such demand will affect big game and big game habitats.

The recent trend of local ranches being purchased and developed for uses other than livestock management will likely continue and could complicate big game population management goals if/when public hunting opportunities become more limiting on private ranches.

Natural Fire Events

For the past several decades, fire suppression actions have resulted in a build up of forest fuels, increased canopy closures, and resulted in conifer encroachment into natural meadows. The result has been a net loss of grassland forage for wildlife ungulates (especially elk). These trends are likely to continue since private residences occur throughout the travel planning area wildland/urban interface where fire suppression actions will continue to be necessary to protect private property.

Livestock Grazing

Many studies have shown that elk avoid or decrease their use of areas with the onset of cattle grazing. Because elk and cattle often share the same ranges and have similar diets, they are among the most likely of ungulate competitors on rangelands of North America. Wisdom and Thomas (1996) have developed several generalizations from the studies of interactions between elk and cattle; those most applicable to this analysis are summarized below.

- The potential for competition between elk and cattle is highest on winter and spring-fall ranges where either forage quantity or quality is limited and where both ungulates commonly share "ecologically compressed habitats" on low-elevation bottomlands or foothills. On winter ranges, elk can reduce forage availability for cattle or vice versa. If such areas are grazed heavily by cattle in the fall, insufficient forage may remain for elk during winter; on the other hand, heavy grazing by elk

during winter may reduce the forage available to cattle during spring and early summer.

- Competition between elk and cattle is usually low on high elevation summer ranges where forage of moderate to high quality is readily available during late spring and summer and where animals have a more expansive land base from which to make optimal grazing choices.

- The potential for competition between elk and cattle is high on unproductive rangelands, especially in arid ecosystems. Potential for competition also is high on rangelands grazed to full or maximum use by elk or cattle, and on rangelands experiencing a declining trend.

- Elk show an aversion to the presence of cattle that may or may not restrict their grazing choices. Avoidance is not total, however, and some studies observed both ungulates grazing near each other on numerous occasions. But in most cases after cattle were introduced, most elk moved to adjacent areas without cattle. The elk that remained, however, were observed grazing near cattle. Some researchers believe that elk move away in response to changes in vegetation in the grazed pasture rather than from a social intolerance. Others believe that elk avoidance may be related to increased human activities associated with livestock management, rather than the cattle themselves.

- On productive rangelands that were grazed historically by native herbivores, systems of cattle grazing can be designed to enhance forage or foraging conditions for elk. Likewise, grazing by elk can enhance conditions for cattle. Systems of rest-rotation grazing by cattle can be used during spring and summer to "condition" grasses (ie., improve forage quality or foraging access) for later use by elk in winter.

In general, elk displacement within the analysis area due to livestock grazing would not be considered a significant issue on traditional elk summer range in the Little Belt Mountains when forage of moderate to high quality is readily available outside of suitable range for livestock (primary and secondary range).

The travel planning area contains many grazing allotments where elk must compete with livestock for space and forage. Currently, there are 6 Range Management Plans that guide livestock management within the travel planning area: 5 of these plans (Sheep Creek, Castles, Musselshell, Judith, and Belt Creek) have all been revised within the past 7 years and include rotation grazing systems intended to leave adequate winter and summer forage for elk and other wildlife ungulates. But, these plans are relatively new, and forage utilization monitoring sufficient to determine if grazing systems are meeting objectives has not yet been completed. The Crazy Mountains Grazing Management Plan is over 20 years old, and in need of new grazing system planning.

Thus, livestock grazing is likely a cumulative factor for elk not fully utilizing available summer ranges within the travel planning area, and may be partially responsible for elk "refuging" on private lands adjacent to the forest. Likely, the reasons are complex, but cumulative to travel issues addressed in this analysis.