RE: Petition Contents §294.14 (a) (6)

A description of how the recommended management requirements identified in §294.14 (a) (2) would affect the fish and wildlife that utilize the particular land in question and their habitat;

Note: There should be information for each inventoried roadless area in the existing land management plan and EIS concerning wildlife species, populations, and management needs. Existing planning documents should also discuss management alternatives considered for each inventoried roadless area and the effects of these alternatives on various resources and the wilderness attributes of the area. The discussion in this petition requirement should address the possible effects of the proposed changes in management requirements on the fish and wildlife resource. Much of this discussion should be able to come directly from information in existing planning documents that has already been estimated and disclosed

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Summary Response:

In short, the proposal explained in this document would result only in beneficial impacts to the diversity of Colorado's fish and wildlife species and their habitats.

In both Part 1 of this document and in the accompanying Forest specific comments (Part 2) there is a consistent recommendation that Inventoried Roadless Areas in Colorado be protected, preserved (sustained/ maintained), enhanced and managed to benefit wildlife and wildlife habitat. Viritually every comment or point made throughout this document supports or elaborates on that central point. Management for the benefit of wildlife may also consider the use, benefit and enjoyment of wildlife by the people of Colorado and its visitors. Further, management of Inventoried Roadless Areas should be based on sound findings and practices supported by relevant scientific literature. Such management will result in significant long term benefits to a diversity of interests held by current and future Colorado citizens and Forest visitors (including but not limited to wildlife related recreation opportunities; ecologic benefits such as biological diversity and watershed protection; and statewide economic benefits).

Because this document outlines a proposal to manage Inventoried Roadless Areas ***for the benefit of wildlife*** *(or to minimize negative impacts when managing for other multiple uses)* our response to this section . . . [36CFR] *§294.14 (a) (6)* . . . could reasonably be far shorter and more direct than those proposing non-wildlife related recommendations/changes to the Forest Inventoried Roadless Areas protections. However, to provide additional useful information for Task Force members and other reviewers, it is helpful to expand on the information provided in Part 1 §294.14 (a) (2), and to provide Task Force members with a review of some scientific findings relevant to the relationship between roads, road-related recreation and wildlife and wildlife habitat. By providing an introduction to the research available, this section aims not only to answer the query posed (see black type above) in *§294.14 (a) (6)*, but also the question of what may be the impacts of *not* implementing the recommendations of this document - of not maintaining the current values and 2001 protections of Inventoried Roadless Areas.

The following is a sampling of research findings that pertain to the relationship between roads/road – related recreation and wildlife species. This list is necessarily abridged but suggests a volume of research available to decision makers.

Note: Two primary sources for these citations/findings are listed below. An additional bibliography is attached at the end of this section.

In addition, according to the USFS formal instruction notes (see in red type above), there normally should be information for each inventoried roadless area in the existing land management plan and EIS concerning wildlife species, populations, and management needs.

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Detail of Response / Part 1 / General Comments

Following are general comments including references to several scientific wildlife studies that directly, or indirectly, relate the potential impacts of roads and road related recreation to wildlife. Some suggest management actions to avoid or mitigate for impacts. Note that in many instances, it is the *use* of the road that causes the most undesirable overall impacts.

Ideally, resource managers could provide research specific to each Inventoried Roadless Area in Colorado. But the resources for such detailed research will never be available; nor should they be necessary. Resource managers can rely on peer reviewed research that can be applied to other like situations. Using relevant research combined with anecdotal information and on-the-ground observations, managers and biologists can draw inferences regarding potential impacts to wildlife – and plan to avoid or mitigate for such impacts.

For this section *§294.14 (a) (6)* there are **two primary resource reference source and two other secondary source materials** referred to and/ or used extensively for development of this section; significant portions of material are derived directly from them. Please refer directly to these resource materials for additional background as needed or warranted. These two primary sources and two secondary sources are:

A. **Forest Roads: A Synthesis of Scientific Information by USDA Forest Service, General Technical Report PNW-GTR 509 May 2001, Editors H. Gucinski, M.H. Brookes, M.J. Furniss, R.R. Ziemer, May 2001, 65pp.**
(http://www.fs.fed.us/pnw/pubs/gtr509.pdf)

B. **Effects of Recreation on Rocky Mountain Wildlife A Review for Montana by the Montana Chapter of the Wildlife Society, 1999, 307pp.**
The on-line report and annotated bibliography of Recreation in Wildlife Habitat can be accessed at:
http://www.montanatws.org/chapters/mt/index.cfm?tname=recreationreport

C. **Colorado Division of Wildlife Research Center Library located at 317 West Prospect Road Fort Collins, CO 80526**.

D. **The United States Forest Service Region 2 Species Conservation Project, which is producing species assessment reports for the majority of the sensitive species and management indicator species for the region. Ultimately, they expect to post over 200 peer reviewed reports on thieir web site. This United States Forest Service site includes a number of Colorado's native wildlife (amphibians, reptiles, birds, fish, and mammals, crustaceans, mollusks), insects and plants (dicots, monocots, ferns).** The on-line reports can be accessed at:
http://www.fs.fed.us/r2/projects/scp/assessments/

General Note on USFS lands containing montaine, subalpine and alpine habitats:

Many of Colorado's forests (montaine, subalpine and alpine habitats) are ecologically sensitive and show significant impacts after minor use (HaySmith and Hunt 1995). The dry, cold climate; short growing season; and slow formation of new soil affect the time required for plant regeneration, making these habitats particularly fragile and susceptible to disturbance (Fitzgerald et al. 1994).

To complement information in existing US Forest Service planning documents, the Colorado Division of Wildlife hereby lists various potential impacts that can occur to wildlife as follows:

1. Amphibians And Reptiles

(Consulting CDOW Specialist – Tina Jackson, Wildlife Conservation Amphibian and Reptile Coordinator)

a. Limited Knowledge: There is limited knowledge about the distribution, biology and status of many of Colorado's amphibians and reptiles. This single element highlights the need to be conservative and to properly manage activities, including roads and recreation, that may negatively impact them.

b. Worldwide Declines: Evidence indicates dramatic worldwide amphibian declines at rates higher than other taxonomic groups (Houlahan et al. 2000, Campbell 1999, Lips 1999, Young et al. 2001, Blaustein and Wake 1990, Phillips 1990, Wyman 1990, Wake and Morowitz 1991, Drost and Fellers 1996 Pechmann and Wilbur 1994). In North America, amphibian declines have been most numerous in the Western United States and have occurred among species that occupy a variety of elevations, habitat types, and disturbance regimes (Corn 1994). Many reptiles have also declined (e.g., Dodd 1988, Garber and Burger 1995, Grover and DeFalco 1995, and Greene 1997). The conspicuous decline of amphibian populations may indeed be a good indication of the declining health of our environment.

i. Seven major factors and their interactions have been implicated as causative agents of amphibian declines. These include:

1. Loss, deterioration, and fragmentation of aquatic and terrestrial habitat (see Bury et al. 1980, Schwalbe 1993, Van Rooy and Stumpel 1995, Lind et al. 1996 and Beebee 1997)

2. Introduction of nonindigenous species(see Bradford 1989, Fisher and Schaffer 1996, Gamradt and Kats 1996, Kupferberg 1996, Adams 1997, Hecnar and M`Closkey 1997, and Kiesecker and Blaustein 1997*a*)

3. Environmental pollutants (see Beebee et al. 1990, and Dunson et al. 1992);

4. Increased ambient UV-B radiation (see Blaustein et al. 1994a, Blaustein et al. 1995, Kiesecker and Blaustein 1995, and Nagl and Hofer 1997)

5. Climate change (see Pounds and Crump 1994, Stewart 1995, and Pounds et al. 1999);

6. Pathogens (see Carey 1993, Kiesecker and Blaustein 1997*b*, Berger et al. 1998, and Lips 1999); and

7. Human commerce (see Nace and Rosen 1979, Jennings and Hayes 1985, Buck 1997, and Pough et al. 1998).

ii. Similarly these factors have also been implicated as causative agents of reptile declines and the overall decline in biodiversity (e.g., Dodd 1988, Wilson and Peters 1988, Henderson 1992, Weir 1992, Guillete et al. 1994, Ballinger and Watts 1995, and Wilkinson 1996*b*)

iii. Direct and indirect impacts from roads and activity on roads (e.g., traffic) may contribute to localized declines. The scientific literature provides several examples of factors often associated with roads that affect herptile populations. Road traffic and off-road vehicle use directly kill herpetofauna and indirectly impact populations by creating migration barriers, destroying habitats, and increasing sedimentation and chemical contamination.

c. Habitat: Relative to Colorado's Inventoried Roadless Areas and native amphibians and reptiles, the most important feature that management plans need to address is habitat use and migration corridors. At higher latitudes all herpetofauna require suitable breeding/rearing, foraging and over-wintering habitats in order to survive. The general loss of habitat may lead to fragmentation and disruption of that population dynamic. (see, Turner 1957, Dole 1965, Ewert 1969, McAuliffe 1978, and King 1990).

d. A review of the scientific literature identified six major impacts that recreational travel activities are likely to have on Colorado's herpetofauna. They are:
   i. Nonindigenous species (plant and animal) introduction and management
   ii. Road and trail development and on- and off-road vehicle use
   iii. Development and management of recreational facilities and water impoundments
   iv. Species harvest and commerce
   v. Habitat fragmentation and metapopulation impacts
   vi. Lack of information / research needs

e. Harmful noxious weeds may be spread by the use of off-road vehicles. There is relatively little information about the impact weeds have on amphibian and reptile communities; however, nonindigenous aquatic and terrestrial weeds often form dense stands which are likely to exclude amphibian and reptile species that are sensitive to microhabitat changes (Germano and Hungerford 1981; Scott 1996).

f. Due to their unique biology, amphibian species may be more susceptibility to chemical contamination (e.g., treatment of noxious weeds and insect pests. (Stebbins and Cohen 1995)).

g. Mortalities from vehicle collisions have been extensively documented for herpetofauna species (e.g., Campbell 1956, Van Gelder 1973, Dodd et al. 1989, Bernardino and Dalrymple 1992, Fahrig et al. 1995, and Rosen and Lowe 1994). Many amphibian and reptile species undergo mass migrations to and from breeding habitats and may be killed while crossing roads. (Koch and Peterson 1995; Langton 1989.)

   i. Density of roads within 750 meters of a pond site was negatively associated with the probability that the pond would be occupied at all.
   ii. Van Gelder (1973) estimated that 30% of the females from a local breeding population of the common toad (*Bufo bufo*) succumbed to road kill and an equivalent percentage for males was likely.
   iii. At least one study indicated that road density within 250 meters of a pond site negatively impacted amphibians. (Vos and Chardon 1998).
   iv. A study of frogs and toads (Fahrig et al. 1995) found the proportion of dead-to-live animals increased and the total density of animals decreased with increasing traffic intensity.

h. Although less studied, herpetofauna may also suffer from indirect impacts of motorized activities. Reduced habitat quality, habitat fragmentation and vehicle noise may all be important indirect impacts. In addition, many predators may use roads and trails to access sites with amphibian and reptile prey.

i. Although far less studied, impacts of OHVs have limited documentation. For instance, direct mortality resulting from collisions, may disrupt habitat to the point that it becomes unusable by herpetofauna. Indirect mortality was studied and measured light, moderate and heavy vegetation damaged by OHVs. The results indicated 31%, 72% and 85% fewer reptiles respectively then the control plots which indicated little damage by OHVs (Busack and Bury 1974) That study also found a number of birds and mammals, potential prey for herpetofauna reduced in OHV use areas.

j. Noise from off-road vehicles is also likely to have negative indirect impacts on herpetofauna. For example (Nash et al. 1970) found the leopard frogs exposed to loud noises (120 decibels) remained immobilized for much longer periods of time than a similarly handled control group. Although no studies were found that document impacts of noise on breeding choruses of amphibians, it is possible that vehicle noise may not allow amphibians to properly hear and move toward breeding aggregations.

k. Soil disturbance, sedimentation from roads, and chemical contamination by runoff from roads may affect amphibians. Lead concentration in frog tadpoles living in roadside ponds and ditches were correlated with daily traffic volumes (Birdsall et al. 1986)

l. Roads, trails, and OHV use can fragment or destroy natural habitat leading to displacement or loss of herpetofauna populations (Bury et al. 1980; Dodd 1990, Lind et al. 1996; and Beebee 1997).

m. Habitat patch size, shape, isolation, and quality all influence the persistence of regional collections of populations or metapopulations. The size of a habitat patch is often associated with the probability that a patch is occupied by amphibian or reptile species (Laan and Verboom 1990; Branch et al. 1996; Marsh and Pearman 1997; Fahrig 1998; and Hokit et al. 1999). Patch distribution across a landscape may also greatly influence whether a patch is occupied or not. The degree of patch isolation is often negatively associated with patch occupancy (Sjögren 1991, Vos and Stumpel 1995, Branch et al. 1996, Sjögren-Gulve and Ray 1996, and Hokit et al. 1999). Even manipulating the matrix habitat in between habitat patches can influence patch occupancy. For example, Sjögren-Gulve and Ray (1996) found that ditches meant to drain forest areas between frog ponds effectively isolated them even though the distance between ponds had not been altered.

n. **Colorado Division of Wildlife recommendation to Colorado Inventoried Roadless Area Task Force**

   i. Potential changes from the 2000 roadless rule should be thoroughly reviewed for amphibian and reptiles in order to minimize the impacts of road or motorized trail construction and vehicle use,

   ii. Avoid sensitive habitats such as wetlands, water bodies, and key denning and breeding habitats,

   iii. OHVs use should be restricted to US Forest Service designated classified roads, and some roads may need seasonal closures,

   iv. When new roads and trails must be constructed near water bodies or wetlands, care should be taken to avoid increased sedimentation, maintain the essential hydrographics, and continue the low natural processes such as changes in river courses.

   v. Areas identified as key migration routes should be closed to vehicle use during peak migration or adequate structures installed.

      1. **Culverts** have been shown to be effective in minimizing amphibian road mortality (Langton 1989, Bush et al. 1991, Bernardino and Dalrymple 1992, Yanes et al. 1995, and Boarman and Sazaki 1996).

   vi. Road and trail development and off-road vehicle use in areas with soils that contain mine tailings should be prevented. If road and travel construction is absolutely necessary in these areas then reclamation activities should be undertaken prior to road and/or trail construction.

   vii. The limited knowledge of distribution status of many reptile and amphibian species makes it important to properly manage activities that may impact them. This point is highlighted in scientific literature that indicates amphibian and reptile species are relatively less protected by public lands than other terrestrial vertebrates (Hart et al. 1998; Redmond et al. 1998).

2. **Birds**
(Consulting CDOW Specialist : Dave Klute, Wildlife Conservation All Bird Species Coordinator)

a. The presence of people and roads in forested habitats may affect a variety of outcomes for bird species, impacting habitat suitability, behavior, and reproductive outcomes. Some bird spcies may habituate to the presence of people and roads, and other species may not occupy previously-suitable areas or be otherwise negatively affected. Specific reactions can vary within and among species depending on breeding status, activity (e.g., foraging, roosting), species size, location (interior species versus concomitant edge species), and group sizes (Berger et al. 1995).

b. **Waterfowl**
i. Human disturbance may have three basic effects on hatching success: (1) flushing of hens off nests may expose eggs to heat or cold and kill embryos; (2) flushing of hens off nests may increase egg depredation and (3) creating trails or leaving markers near nests may increase predator density and subsequent egg and hen depredation.

ii. Disturbance by humans during the brood-rearing season can break up and scatter broods or frighten parents into running ahead of their ducklings or goslings. Young waterfowl briefly separated from the hen are vulnerable to predators and susceptible to death from severe weather or lack of experience in obtaining food.

iii. Prolonged and extensive disturbances may cause large numbers of waterfowl to leave disturbed wetlands and migrate elsewhere.

c. **Colonial Waterbirds**
i. Because of their colonial breeding habits, large numbers of individuals and young may be impacted by activity during the breeding season. Increased human activity may result increased levels of nest and colony abandonment. Specific response to disturbance may vary between sites and time of breeding season. Colonies are typically most easily disturbed early in the breeding season, with birds becoming less-easily flushed from nests later in the nesting phase (Anderson 1978, Parker 1980, Vos et al. 1995).

ii. Werschkul et al. (1978) found increased levels of nest and colony abandonment in Great Blue Herons with road building and logging activity within 0.5 km.

iii. To minimize disturbance, most studies recommend no activity during the courtship and nesting seasons within at least 300 m of colonies. (Buckley and Buckley 1978, Butler 1992).

iv. International and regional waterbird conservation plans have identified disturbance to colonies as an important conservation issue (Kushlan et al. 2002, Ivey and Herziger 2005).

d. **Upland game** –
i. **Greater and Gunnison Sage-Grouse**

1. Sage-grouse have been the focus of substantial recent conservation attention. Rangewide population declines, significant habitat loss, and petitions for ESA listing have contributed to increased conservation planning, implementation and research on these species.

2. For Greater Sage-grouse in Colorado, the average distance between a lek site and nest was 4.0 km (Hausleitner 2003), although this distance varies substantially over the range of the species (Connelly et al. 2004). Human disturbance should be minimized in the vicinity of lek sites to minimize disturbance to nesting grouse.
3. Lyon and Anderson (2003) found in western Wyoming, the average distance moved by hens from undisturbed nests was 2.1 km, while hens moved 4.1 km on average from disturbed nests.

4. Species conservation plans recommend that disturbance to sage grouse be minimized to benefit regional populations. When possible, roads and associated structures should avoid sage-grouse habitats and any timing of any acitivity should avoid critical periods (Gunnison Sage-Grouse Rangewide Steering Committee 2005, Connelly et al. 2004).

ii. **Columbian Sharp-tailed Grouse**

1. Disturbance of leks may limit reproductive opportunities and result in regional declines in populations (Baydack and Hein 1987). Male Sharp-tailed grouse are tolerant of some acitivites, but are displaced by human presence. Females are less tolerant to various types of disturbance (Connelly et al. 1998).

2. Nests are placed, on average, 0.4-1.8 km for leks sites (Kohn 1978, Bergerud and Gratson 1988, Meints 1991, Connelly et al. 1998). Thus, disturbance at or near nest sites may impact significant numbers of nesting females. Human disturbance at and near leks sites should be minimized.

iii. **Wild turkey**

1. Response of wild turkeys to roads and road activity varies but (Wright and Speake 1977) noted range abandonment with increased human use of areas, disturbance and harassment.

e. **Raptors**

i. "Birds of prey" are high trophic global predators, and because of their sensitivity to environmental perturbations are aptly called "indicators" of ecosystem quality. Management to benefit raptors often will protect a diversity of habitats and therefore provides benefits to a wide spectrum of other wildlife species" (Hair 1987).

ii. Some raptor species (e.g., Northern Goshawk) are completely dependent on forested habitats. Degredation of habitat and disturbance may result in population declines in some raptor species.

iii. There is abundant evidence that habitat modifications resulting from land-management activities, such as logging, grazing, and development have a direct impact on raptors. The type of disturbance, time of year the disturbance occurs, and length of time of the disturbance can determine the impact on an individual or breeding pair of raptors. There also may be differences between species when reacting to a particular type of disturbance (Holmes et al. 1993).

iv. Human activities, including recreation, are known to impact raptors in at least 3 ways: (1) by physically harming or killing eggs, young, or adults; (2) by altering habitats; and (3) by disrupting normal behavior (Postovit and Postovit 1987, Richardson and Miller 1997).

v. Recreational shooting causes direct mortalities and indirect poisoning from carrion containing lead shot. Recreational trapping causes raptor injuries and deaths from accidental take (Redig et al. 1983).

vi. Recreational disturbance may disrupt raptor behavior. For instance, flushing raptors from foraging perches and from day and night roosts have been recorded in the scientific literature for some raptor species relative to pedestrians and vehicles (Fraser et al. 1985; White and Thurow 1985; Holmes et al. 1993).

vii. Disturbance can alter normal raptor activity patterns, therefore managers have two choices: (1) completely deny human access to important raptor habitat, (2) develop a management plan for coexistence with spatial and/or temporal restrictions on recreational disturbance (Knight and Skagan 1988).

1. Debois and Hazelwood (1987 recommended the following spatial buffer zones for particular human disturbances in the Rocky Mountain Front during sensitive nesting phases
    a. off-road vehicle use: 0.4 -1.2 km

2. Avoid all human disturbance of nesting territories and sensitive nesting phases (Steenhof 1987; Stalmaster 1987).

3. Manage travel corridors so that vehicles and pedestrians approach perched raptors tangentially and do not stop or remain in the immediate area of the perched birds.

4. Maintain low road density to minimize disturbance of raptors by promoting conservative human use of raptor areas where raptors forage and nest and maintain 1600 meter buffer zone. (Jones 1979; Clark et al. 1989; Richardson and Miller 1997; Snow 1972;).

f. **Nocturnal raptors (Owls)**

i. Direct and indirect impacts to owls may be similar to diurnal raptors. Indirect impacts and habitat loss may be most critical for owls.

ii. Hiking, off-road vehicle use, camping, and firewood gathering may potentially affect owls through alteration of habitat or because owls will avoid these areas of activity. Several researchers have recommended limiting human activity around nesting owls (Haug and Oliphant 1990; Forsman and Bull 1994). Some species of owl (e.g., Northern Pygmy-owl, Great Horned Ow) are relatively insensitive to human disturbance, although nesting birds of other species may desert if disturbed (e.g., Northern Saw-whet Owl (Canning 1993)).

iii. Owls are attracted to forest road sides for several reasons. The edge effect may attract prey species and afford easier hunting opportunities. Hunting perches occur at the interface between open road and adjacent forest. Direct mortality to owls from vehicle collisions is well documented and may be a significant mortality factor (e.g., Loos and Kerlinger 1993). Additionally roads and vehicle traffic and high noise levels may result in decreased productivity (Plumpton and Lutz 1993). Haug and Oliphant 1990, actually recommended buffer zones around burrowing owl nests that were near primary and secondary roads for protection.

iv. The mere presence of roads represents a loss of habitat for owls. This may be inconsequential in open areas with sparse human populations and low road densities, but it may be significant in forested areas where dense logging road systems are present in intensively harvested areas. Roads also may lead to fragmentation effects that may be negative or positive depending upon the species of concern. Roads and the high associated number of road kills may act as population sinks when animals are attracted to the edges to utilize an abundant food source such as insects, small mammals, and birds (Forman 1995).

g. **Woodpeckers and cavity nesting birds**

i. Some woodpecker species are relatively tolerant of human disturbance (Dobbs et al. 1987, Walters et al. 2002). Indirect impacts, loss of snags and direct habitat loss may be most critical.

ii. Snags are important to cavity nesting wildlife (Raphael and White 1976; Milnel and Hejl 1989; Bull and Holthausen 1993, Hutto 195b, Hitchcox, 1996). Logging, harvesting of firewood, and other activities that may result in a reduction in snag availability may be detrimental to many species of woodpeckers.

h. **Songbirds**

i. Management of songbird habitat where recreation and travel activities occur is essential to prevent reductions in populations of some songbird species and, in some situations, overall bird species diversity. Travel corridors created for motorized travel and recreation may fragment songbird habitat, and human activity within songbird habitat may disrupt breeding activity and displace birds.

ii. Fragmentation and Roads: (There is significant scientific literature to indicate that activity on roads impact songbirds in forested areas.

1. Where forest roads fragment habitat, the number of avian songbird species may be affected. Hutto (1996) reported that some forest songbirds may not occur as commonly in small as in larger forest patches, including the Townsend's warbler (*Dendroica townsendii*), varied thrush (*Ixoreus naevius*), golden-crowned kinglet, chestnut-backed chickadee (*Parus rufescens*), winter wren (*Troglodytes troglodytes*), red-breasted nuthatch (*Sitta canadensis*), and Swainson's thrush (*Catharus ustulatus*). In Wyoming, Keller and Anderson (1992) found that the brown creeper, hermit thrush (*Catharus guttatus*) and red-breasted nuthatch were associated with larger forest patches.

2. Fragmentation of limited, high-value habitats may cause some of the most severe impacts to songbirds. Many songbird species are largely or primarily restricted to riparian habitats (Hutto 1995*a*). Fragmentation of riparian habitats with corridors (e.g., trails, roads) will create greater impacts to songbirds on a landscape perspective than fragmentation of adjacent forests.

3. Fragmentation of habitats may not only reduce patch size for interior species, but may separate important associations between two adjacent habitats. Riparian habitat in conjunction with upslope habitat may be more effective in meeting habitat needs of the entire songbird community in western coniferous forests. McGarigal and McComb (1992) found that while riparian forests in Oregon supported many songbird species, upslope areas were more important in contributing to the avifauna of mature, unmanaged forest stands.

4. The breakup of continuous forest habitat with roads may increase predation rates on songbirds by increasing the ratio of edge to interior habitats. This has been observed in heavily forested areas of Connecticut and Maine (Askins et al. 1987, Small and Hunter 1988). Small fragments may be easier for predators to penetrate, while the adjacent roads will provide predators a travel corridor into forested habitat from nearby areas (Small and Hunter 1988, Askins 1994). Predation rates on eggs were also found to be significantly higher along 100 m of minor roads through otherwise continuous forests in Belize (Burkey 1993). Increases of both cowbirds and nest predators have been observed along unpaved and paved roads in New Jersey (Rich et al. 1994). Increases of cowbirds and nest predators have even been noted along 2-3 m-wide nature trails in Illinois (Hickman 1990), while in Colorado, predation of songbirds was greater closer to forested hiking trails (Miller et al. 1998).

5. The phenomenon of reduced songbird productivity along edges was reviewed by Paton (1994). Nest success varied near edges, with both depredation rates and parasitism rates increasing near edges; in addition, there was a positive relationship between nest success and patch size. The most conclusive studies suggest that edge effects usually occur within 50 m of an edge. Paton (1994) concluded that strong evidence exists that avian nest success declines near edges, and his review corresponds with management recommendations provided by Askins (1994) that if diversity of neotropical migratory songbirds is a management goal, large blocks of continuous forest should not be segmented with roads.

6. In addition to fragmentation effects, roads and trails in forests likely disrupt songbirds breeding activities and/or displace birds from the zone of disturbance. Even non-motorized activity has documented disturbance impacts to songbirds. Miller et al. (1998) studied bird species density in forest habitat in Colorado and found that generalist species were more abundant near hiking trails, whereas specialist species were less common. The zone of influence averaged about 75 m, but extended to more than 100 m some sensitive species. Similar disturbance impacts were noted for 8 of 13 songbird species along wooded trails in the Netherlands (van der Zande et al. 1984). Because of the noted sensitivity of even common songbirds to disturbance, van der Zande et al. (1984) recommended that recreational disturbance impacts be concentrated into already heavily used areas rather than dispersed.

3. Fish: (Roads and Aquatic Species)

(Consulting CDOW Specialist: Sherman Hebein, Senior Aquatic Wildlife/ Fish Biologist, West Regions

a. Inventoried roadless areas provide diverse habitats for numerous aquatic species. Waters in inventoried roadless areas have been shown to function as biological strongholds and refuges for many fish species. Some of these waters may now play a relatively much greater role in supporting aquatic species viability and biodiversity than in the past due to cumulative degradation and loss of other, potentially more biologically rich habitat within associated drainages. In considering the contributions of large unroaded areas for conservation of aquatic habitats and species, comparisons can be drawn from research in other areas lacking roads and with minimal levels of human disturbance.

b. For example, in evaluating the role of Wilderness Areas in conserving aquatic biological integrity in Western Montana, Hitt and Frissell (1999) concluded that, although the presence of designated Wilderness does not guarantee aquatic biological integrity due to factors such as fish stocking practices and impacts from adjacent roads, “the importance of Wilderness in aquatic conservation is extraordinary.” Their analysis showed that more than 65% of waters that were rated as having high aquatic biological integrity were found within subwatersheds containing Wilderness. They also concluded that, given the relative rarity of unprotected areas that support a relatively greater degree of aquatic biological integrity, undisturbed areas warrant permanent protection.

c. The relative importance of Wilderness and Inventoried Roadless Areas to the conservation and preservation of Colorado’s three native cutthroat trout species (Greenback, Rio Grande, and Colorado River cutthroat trout) can be derived by determining the locations of the waters where conservation or core conservation populations of these fish are found. There are slightly more than 114,000 miles of stream in Colorado (Table 1), and almost twenty-nine percent of these miles are located on USFS land. Conservation or core conservation populations of the three cutthroat trout species occupy approximately 1,866 miles of the waters statewide. About two-thirds of the total critical stream mileage for cutthroat trout is found on USFS land, and more than seventy-five percent of the miles of cutthroat water on USFS land are located within Inventoried Roadless or Wilderness Areas. Waters outside of USFS boundaries comprise the largest portion of the total miles of Colorado’s aquatic resource but contribute the least toward suitable stream mileage for cutthroat trout.

d. Table 1. Total miles of waters in the State of Colorado and miles occupied by conservation or core conservation cutthroat trout populations on and off of USFS lands.

	All Waters	**Perennial Streams Only**	**Cutthroat Trout Waters**
Total miles of water	114,853	32,186	1,866
Wilderness Areas	6,343	5,029	359
Inventoried Roadless Areas	11,048	6,146	571
USFS Lands total	33,024	18,753	1,238
Other	81,829	13,443	629

Information for Table 1 extracted from GIS Databases
by Sherman Hebein, Senior Aquatic Wildlife/ Fish Biologist

e. Most aquatic conservation strategies acknowledge the need to identify the best habitats and most robust populations to use as focal points from which populations can expand. Adjacent habitat can be usefully rehabilitated, or the last refugia of a species can be conserved in unroaded areas where natural biophysical processes are still operating. The construction, maintenance, use and presence of roads in a watershed can have numerous adverse impacts to aquatic systems and the species they support. These effects can potentially include (Furniss and others 1991; USDA Forest Service 2000h):

i. Increased sediment loads in streams;
ii. Modification of watershed hydrology and stream flows;
iii. Alteration of stream channel morphology;
iv. Increased habitat fragmentation and loss of connectivity;
v. Degraded water quality, including increasing chance of chemical pollution;
vi. Altered water temperature regimes.

f. Roads contribute more sediment to streams than any other land management activity. Most land management activities (recreation, grazing, mining, timber harvest, and water diversions) depend on roads for access and the transportation of materials. Serious degradation of fish habitat can result from poorly planned, designed, located, built, or maintained roads.

g. Road-stream crossings can be a major source of sediment to streams, resulting from channel fill around culverts and subsequent road-crossing failures (Furniss and others 1991). Plugged culverts and fill-slope failures are frequent and often lead to catastrophic increases in stream channel sediment, especially on old abandoned or unmaintained roads (Weaver and others 1995). Unnatural channel widths, slope, and stream-bed form are found upstream and downstream of stream crossings (Heede 1980), and these alterations in channel morphology may persist for long periods. Channelized stream sections resulting from riprapping roads adjacent to stream channels are directly affected by sediment from side casting, snow removal, and road grading; such activities can trigger fill-slope erosion and failures. Because improper culverts can reduce or eliminate fish passage (Belford and Gould 1989), road crossings are a common migration barrier to fishes (Evans and Johnston 1980, Clancy and Reichmuth 1990, Furniss and others 1991). The loss of fish passage at a culvert crossing can be beneficial as a species conservation tool if a barrier to upstream fish migration is desirable at a given location. Culverts can be used to create velocity barriers or as drop structures if properly engineered.

h. Roads directly affect natural sediment and hydrologic regimes by altering streamflow, sediment loading, sediment transport and deposition, channel morphology, channel stability, substrate composition, stream temperatures, water quality, and riparian conditions in a watershed. Interruption of hill slope drainage patterns alters the timing and magnitude of peak flows and changes base stream discharge. The construction of new roads in a watershed may contribute to the fragmentation of aquatic habitat in a drainage and establish new barriers to fish movement within or between watersheds. Fish passage barriers affect the exchange of genetic material between populations and assist in the creation of isolated populations that may eventually exhibit a loss of genetic fitness. Colorado River cutthroat trout metapopulations are presently found only in roadless or wilderness areas.

i. Poor road location, concentration of surface and subsurface water by cross-slope roads, inadequate road maintenance, undersized culverts, and side cast materials can all lead to road-related mass movements. These movements can continue for decades after the roads have been built and adversely affect all life stages of fishes, including migration, spawning, incubation, emergence, and rearing.

j. These changes to the physical environment can potentially result in a variety of adverse impacts to aquatic species including:

   i. Filling of deep pools from excess sediment deposition and the loss of spawning and egg incubation habitat;
   ii. Reduced oxygen levels in stream gravels resulting in increased mortality of eggs and young;
   iii. Increased possibility of reproductive failure;
   iv. Shifts in macroinvertebrate communities to those tolerating increased sediment or other types of diminished water quality;
   v. Increased vulnerability to over harvest and poaching;
   vi. Loss of habitat variability through changes in channel structure including large woody debris, overhanging banks, and deep pools;
   vii. Competition from nonnative species;
   viii. Loss of habitat caused by habitat degradation, the formation of barriers to passage, increased gradient, more extreme temperatures, and other factors; and
   ix. An increased vulnerability of subpopulations to catastrophic events and the loss of genetic fitness related to a decreased propensity for metapopulation establishment.

k. Budgetary constraints on land management agencies may lead to a lack of maintenance, resulting in the progressive degradation of road-drainage structures and functions, and the likelihood of increased erosion (Furniss and others 1991). Older roads in sensitive terrain and roads that have been functionally abandoned but not adequately configured for long-term drainage are more likely to be problematic. Applying erosion prevention and control treatments to highrisk roads can drastically reduce risks for future habitat damage and can be both effective and cost-effective. In watersheds that contain high-quality habitat and have only limited road networks, large amounts of habitat can be secured with small expenditures by decommissioning or storm proofing roads (Harr and Nichols 1993).

l. Substantial increases in sedimentation are unavoidable even when the most cautious roading methods are used (McCashion and Rice 1983, Megahan 1980). Improving road building and logging methods, however, can reduce erosion rates and sediment delivery to streams. The amount of sedimentation or hydrologic alteration from roads that aquatic species can tolerate before a negative response appears is not well known, though general effects of sediments on fishes are known. Sediment that exceeds natural background loads can fill pools, silt spawning gravels, decrease channel stability, modify channel morphology, and reduce survival of emerging salmon fry (Burton and others 1993, Everest and others 1987, MacDonald and others 1991, Meehan 1991, Rhodes and others 1994).

m. The effects associated with roads reach beyond their direct contribution to the disruption of hydrologic function and increased sediment delivery to streams. Roads provide access, and the activities that accompany access magnify the negative effects on aquatic systems beyond those caused solely by the roads themselves. Activities associated with roads include fishing, recreation, timber harvest, livestock grazing, and agriculture. In addition, roads provide avenues for invasion by non-native organisms, such as illegal stocking of non-native fish, inadvertent introduction of competing taxa, and spread of pathogenic diseases.

n. Temporary roads may have fewer adverse effects than do permanent roads, depending on the extent to which they are decommissioned. Distinguishing the direct effects of roads from the cumulative effects of other activities associated with roads is sometimes difficult. Thus, temporary roads may reduce the direct effects of roads, but the effects of activities for which the temporary roads were built will still affect the environment.

o. Although unroaded areas are significantly more likely to support strong populations, populations are not excluded from roaded watersheds. Several possible reasons for this have been suggested: The inherent productivity of some areas allows fish populations to persist despite disturbances linked to roads; real or detectable effects on fish populations may lag behind the initial physical effects in watersheds that have been roaded in the last several years; and the scale of the subwatershed (8,000 hectares on average) at which strong populations are identified may mask a potential disconnect between the real locations of strongholds and roads. The fact that strong salmonid populations have persisted in some roaded areas does not mean they will in others. In general, lower short-term or long-term watershed and ecological risks are associated with roadless areas even than with cautiously managed activities in roaded areas.

4. Small Game

(Consulting CDOW Specialists: Tom Remington, Terrestrial Resources Section Manager)

a. Scientific literature indicates that the most blatant intrusions affecting small game are from off-road vehicle (OHVs) use (Webb and Wilshire 1983).
   i. Alpine Habitats:
      1. Alpine habitats are ecologically sensitive and show significant impacts after minor use (Hay Smith and Hunt 1995). The dry, cold climate; short growing season; and slow formation of new soil affect the time required for plant regeneration, making these habitats particularly fragile and susceptible to disturbance (Fitzgerald et al. 1994). Some alpine small mammal species, e.g., marmot, are not common suggesting that they may be intolerant of human disturbance while other species are common e.g., chipmunks, and persist in areas of human disturbance. Nevertheless, if recreational activity displaces individuals from their home ranges, their susceptibility to predation may increase (Clarke et al. 1993).
      2. Clark and Stromberg (1987) suggest that overgrazing by cattle in alpine meadows can have negative impacts on native small mammal species that rely on dense herbaceous vegetation for food and/or cover. Roads allowing extensive human use of alpine meadows could have similar effects on alpine mammals.
      3. Nevertheless, the greatest threat to alpine small mammals may be their isolation from one another. Alpine zones are arrayed as discontinuous islands along mountain ranges (Fitzgerald et al. 1994, Brown 1971, Clark and Stromberg 1987).
   ii. Bogs
      1. Bogs are another rare and ecologically fragile and rare habitat. Bogs develop on undrained or poorly drained sites where chemical conditions hinder decomposition of organic matter. These wetlands are characterized by standing water interspersed with vegetated ridges or floating mats of vegetation on organic soils (Hansen et al. 1995). Many bog plants and their associated animals are sensitive and specialized for existence on these distinctive habitats.
      2. Extensive use of bogs by OHVs could occur, in spite of the presence of standing

water year-round. Specialized OHVs are capable of going through these areas. In addition, snowmobile use on frozen bogs in winter and OHV use of trails passing through bogs could degrade these fragile habitats more than other recreational uses. The destruction of wetland vegetation and the soil compaction and associated reduction in invertebrate abundance and water quality (Cole and Landres 1995) could directly and indirectly affect small mammals through habitat destruction, reduced food, and reduced cover. Trails and roads may divert or alter surface water flows, thus changing water levels and drainage patterns and significantly altering the unique bog habitat. Trail management aimed at reducing impacts of foot and horse traffic through bogs may be inadequate to compensate for impacts of OHVs and may require modification in areas with high OHV use.

3. Wanek (1973) reported on the effects of snowmobiling on bog plants in northern Minnesota. He found snowmobiling caused a delay in the spring thaw by as much as 2 weeks due to deeper frost penetration. Even though he found that snowmobile impacts on sphagnum moss were negligible, herbs and shrubs showed declines directly related to the intensity of snowmobile traffic. Bog plants were affected both by physical damage and from the results of cold temperatures, which caused physical damage, retarded growth, desiccation, or death.

iii. Subnivian Environments (under the snow)

1. Snow cover is important to the over-winter survival of many species. It provides protection from the stresses of direct exposure to severe winter weather and predation (Formozov 1946, Pruitt 1957 and 1970, Fuller 1969). Consequently, the use of snowmobiles should be taken into account on Colorado's Inventoried Roadless Areas as they may impact to some degree the subnivian environmental requirements of small mammals. Several studies have shown that snow packing by snowmobile use reduces the insulating value of the snow, caused significant changes in snow structure, increases mechanical barriers to small mammal movements beneath the snow, cause damage to browse plants, subject small mammals to greater temperature stress, and cause winter mortality of small mammals (Boyle and Samson, 1985; Jarvinen and Schmid, 1971; Neumann and Merriam, 1972).

2. Bury's (1978) analysis of snowmobile impacts on wildlife concluded that the major effects of snowmobiles on most wildlife species appeared to be "changes in the animals' daily routine, rather than direct mortality." For small mammals, this was found to be the case for rabbits by Baldwin and Stoddard (1973). For subnivian small mammals, ". . . experimental manipulation of a snowfield has shown that the mortality of small mammals is markedly increased under snowmobile compaction" (Schmid 1972). A number of researchers (Mezhzherin 1964, Schwartz et al. 1964, Fuller 1969, Fuller et al. 1969, Brown 1971) have shown that small mammals experience reduced growth during the winter. Jarvinen and Schmid (1971) stated, "The colder temperatures of winter seem to be stressful to small mammals, even if moderated by snow cover." Small mammals under this type of stress are certainly more vulnerable to the added impacts of snowmobile usage. Obviously, as the population of small mammals is reduced, the populations of predators that prey on them (e.g. foxes, weasels, hawks, owls, etc.) may also be reduced (Brander 1974).

iv. Bat Habitats Other than cave exploration or "spelunking," the effects of roads that provide access for such recreation on bats is not documented. We can infer some potential threats to bats from road access based on available information regarding bat biology and ecology. The most important manner in which human activity is likely to impact bats is the direct disturbance of bats in maternal or hibernacula roosts. These are during periods when it is crucial that bats conserve energy.

v. The sensitivity of bats to human disturbance of roost sites is well documented

(Pearson et al. 1952, Graham 1966, Stebbings 1966, Mohr 1972, Humphrey and Kunz 1976, Stihler and Hall 1993, Pierson and Rainey 1994). Caves visited by humans during stressful periods for bats (e.g. hibernation and rearing of young) have shown population declines in some bat species such as Townsend's big-eared bat. In some instances, visitations may result in roost abandonment (Graham 1966). Pierson and Rainey (1994) have shown that bat colonies that experienced the most severe population declines had a high rate of visitations by humans. Excluding human use from sensitive bat roosting sites can help recover populations that have been reduced by disturbance.

vi. Colorado Division of Wildlife has an active bat monitoring program.

vii. Motorized recreation at night may interfere with bats' ability to effectively use echolocation for communication, navigation, and prey detection; such interference was observed near running water (Mackey and Barclay 1988). Roads, because of coincident noise, likely reduce the quality of roosting habitat nearby (Harvey 1980).

b. **RECREATIONAL IMPACTS ON SMALL MAMMALS** August et al. (1979) stated, “Demographic patterns of small mammals can be useful in determining the effects of human use upon a given area. Comparisons of populations before and after periods of human use reveal changes associated with the use which may serve as a measure of disturbance” Bury et al. (1977) demonstrated the direct impact of OHVs on species richness, abundance, and biomass. Areas of ORV use have significantly fewer species of vertebrates, greatly reduced abundance of individuals, and noticeably lower small mammal biomass. Bury et al. (1977) also showed that diversity, density, and biomass of small mammals are inversely related to the level of ORV use in an area.

c. The impacts of OHV use on small mammals is more directly related to the impacts on vegetation and barriers created by trails and roads. Knight and Cole (1991), “Recreational activities…result in habitat modification by disturbing the vegetation and soil, and changing microclimates.” These vegetative impacts would be most severe in sensitive alpine areas, bogs, and arid regions. Consequently, any road or trail activities contemplated for these habitats should be carefully managed and researched thoroughly.

d. For some small mammal species, just the presence of humans may have adverse impacts. (e.g., Mainini et al. (1993) studied the reactions of marmots (*Marmota marmota*) to the impacts of tourist activities in alpine areas and stated, “In alpine regions the marked increase in. . . tourist activities could reduce the success of individual animals and in the longer term threaten the existence of animal populations or even species.” In this study, they found that even the presence of hikers negatively impacted foraging.

e. There have been few studies considering small mammal habituation when/after they become accustomed to human activities (including those associated with roads and travel). It is likely that in many cases small mammals rapidly become habituated to recreational activities, and the impacts may prove to be inconsequential. Adaptations, on the other hand, may require multiple generations. Consequently, until more detailed studies can be done, prudence would dictate that The Colorado Inventoried Roadless Area Taskforce recommend a conservative approach to the impacts of roads on small mammals within Colorado’s IRAs.

5. Semi-Aquatic Wildlife

(Consulting CDOW Specialists: Tom Remington, Terrestrial Resources Section Manager)

a. Beaver, mink, muskrat, and river otter are dependent on both the aquatic and riparian environments for food and shelter and they concentrate their activities along the shore of streams, rivers, ponds, lakes and reservoirs. The closer any road, trail or recreational activity is to the shoreline the greater the disturbance potential. Disturbance during spring and early summer, when breeding, dispersal, parturition, and the post-natal period take place, may be most detrimental to productivity, although disturbance at any time of the year may lower fitness, reproductive success, and survival.

b. Most disturbance studies and information specific to semi aquatic wildlife and recreation deal with boats, boating and contaminates associated with these activities and can not be reasonably extrapolated to impacts that are necessarily directly associated with Colorado Inventoried Roadless Areas in general. However, bank stability is an important habitat component for beavers, muskrats, mink, and river otters. Erosion of natural riverbanks can be problematic and can compromise banks and cause loss of streamside cover and increased sedimentation.

i. Off-road vehicles traveling along riparian areas, running up and down the banks, or through temporarily dry wetlands will impact the bank and shoreline configuration, vegetation, and soils.

ii. Snowmobiling may also be detrimental. Snowmobiling in a cattail marsh caused a 23% decrease in cattail density, 12% decrease in cattail height, and a 44% increase in sedge (*Carex* spp.) density (Sojda 1978). Confining snowmobiling to dispersed trails was recommended to prevent serious alteration of wildlife habitat in cattail marshes. Snowmobile and OHV activity may also cause unstable banks to collapse and compromise the stability of bank dens.

iii. Non-motorized recreational activities may also impact shoreline habitats used by semi-aquatic mammals. People recreating along the shore may trample bank and emergent vegetation, reducing the amount of cover available to semi-aquatic mammals and facilitating erosion in these trampled areas. Plants in wet soils are especially vulnerable to trampling (Willard and Marr 1970). People walking up and down the banks along runs used by semi-aquatic mammals can remove important trailside security cover, decrease the stability of the bank, and destroy important river otter latrine sites and territorial scent markings left by beavers, mink, and muskrats. Walking along the edge of the bank can also cause unstable bank dens and undercut banks to cave in.

iv. Responses to activities:

1. Behavioral response studies to human outdoor recreation regarding semi-aquatic mammals appear to be limited however, the elusive nature of most semi-aquatic mammals and the importance of secure den sites indicate an overall low tolerance to human presence. Bown (1988) indicated that extensive recreational use and shoreline development concentrated in low-relief areas may be one reason for the lack of beaver on some lakes while reservoirs that had little to no human access or shoreline development showed higher colony densities. Melquist and Hornocker (1983) indicated that otters in Idaho seemed to prefer areas with minimum human activity and exhibited a nocturnal activity pattern in summer but not in winter, possibly in response to increased human disturbance during summer daylight hours.

2. Stressful physiological responses in semi-aquatic mammals may result from disturbance by motorized and non-motorized recreationists. Gabrielsen and Smith (1995) reviewed physiological responses of wildlife to disturbance and explained the “active defense response,” better known as the flight or fight response, and the “passive defense response” such as hiding or playing dead. When river otters, mink, muskrats, and beavers encounter recreationists and flee in response, they are exhibiting the active defense response. Increased heart rate and blood flow are associated with this response. Semi-aquatic mammals that remain hidden in the den and do not flee may be exhibiting the passive defense response, which is also associated with physiological changes including decreased heart rate.

   Note: Recreational activities that take place while semi-aquatic mammals are in their dens may be mistakenly interpreted as having little effect. However, Smith and Woodruff’s (1980) study of woodchucks (*Marmota monax*) showed the stress that denning animals might experience from the presence of humans or dogs.

Woodchucks retreated to their burrow when disturbed by a human or dog and showed the active defense response, including increased heart rate. Once inside the burrow, they immediately responded with the passive defense response including reduced respiration and heart rate. The amount the heart slowed was stimulus dependent. When a dog or human approached the burrow and began digging, the heart rate would slow down even further.

c. Although some semi-aquatic mammals may habituate to non-threatening recreational activities if they occur in predictable areas at predictable times, it is recommended that disturbance of semi-aquatic mammals in response to roads and road activity may be similar to those documented for other wildlife species, and therefore should be considered as an important factor of road access until scientifically valid and compelling information is gathered that shows otherwise.

6. Ungulates

(Consulting CDOW Specialists: Tom Remington, Terrestrial Resources Section Manager and Dave Freddy, Mammals Research Leader)

a. Ungulates provide a large percentage of the recreational opportunities for wildlife enthusiasts in Colorado. Hunting, wildlife viewing, and photography annually generate significant economic benefits to Colorado. See Part 1 §294.14 (a) (3) for specific details.

i. **Hunting:** Hunting is the primary tool used by Colorado Division of Wildlife (CDOW) to manage ungulate populations. The CDOW emphasizes hunting as a traditional use and to control big game numbers on private land at levels that minimize game damage. To increase landowner tolerance for big game animals and to minimize big game damage, it is advantageous for public land managers to work with wildlife managers to reduce displacement of animals from public to private lands. Successful big game wildlife management in Colorado is dependent upon continuous coordination and cooperation between public and private agencies and individuals responsible for both wildlife and the habitats where they live.

1. Big game hunting has more immediate effects on ungulate population densities and structures than any other recreational activity. Hunting season security and management affects short and long-term hunting opportunities. Managers of public lands control only a few of the potential variables that contribute to security; including retention of important vegetative cover, travel management, and enforcement of travel regulations. There is a strong relationship between adequate security and predicted buck/bull carryover, but excessive hunter numbers will overwhelm any level of security. Hunting also has the potential to negatively affect herd productivity as mature males are lost from populations. Violations of ethical considerations including the concept of "fair chase" and the perception of the "sportsman" in the public mind, can increase ungulate vulnerability as well as influence social acceptance of the sport of hunting.

2. There are also situations in which flight and/or displacement are not possible, and, for lack of other options, animals become habituated to disturbance. Morrison et al. (1995) reported responses of elk to ski area development in Colorado were negative, but not as great as predicted. In part, this may have been evidence of habituation of the kind reported by Schultz and Bailey (1978) in which elk wintering adjacent to Rocky Mountain National Park often used a residential area at night and were little disturbed by normal visitor traffic on roads. Habituation can be far more serious than is usually suggested by complaints about damage to landscape plantings (Thompson and Henderson 1998). Once habituated to urban, or semi urban environments, ungulate populations are very difficult to control. In both Colorado and Montana, habituated white-tailed deer have attracted mountain lions to the edges of

housing developments, thus increasing the risk to both humans and their pets.

b. **Summer Range**: The importance of summer range to most ungulate populations has gone unrecognized for many years. It is apparent, however, that managers can contribute substantially to the health, productivity, and survival of these populations by reducing human disturbances to summering animals.

   i. Ungulate physiology and behavior favor physical development and fat accumulation in both sexes during the biological season after birthing (e.g., early June through October). Adult males of all ungulate speciesmust build fat reserves for the fall breeding season while meeting energy demands of horn and antler growth. Adult females must obtain forage of adequate quantity and quality to meet energy demands of lactation while simultaneously recovering from weight lost during the previous winter and building fat reserves for the coming winter.

   ii. During summer, ungulates continue to follow **the law of least effort** as a strategy for retaining and storing as much energy as possible (Geist 1982). However, recreationists can impact this effort through either direct disturbance of animals or by disrupting access to essential forage resources

c. **Winter Activities:**

   i. **Human disturbance of wintering animals should be avoided where possible.** During winter, many ungulates are seasonally confined to restricted geographic areas with limited forage resources. In these conditions, physiological adaptations and behavioral adaptations tend to reduce energy requirements. Despite lowered metabolic and activity rates, most wintering ungulates normally lose weight. Responses of ungulates to human recreation during this critical period range from apparent disinterest to flight, but every response has an energy consumption cost.

      1. Snowmobiles have received the most attention compared to other wintertime disturbances, and the majority of reports dwell on negative aspects of snowmobile traffic. However, snowmobiles appear less distressing than cross-country skiers, and for several ungulate species, the greatest negative responses were measured for unpredictable or erratic occurrences. In addition to increasing energy costs for wintering animals, recreational activity can result in displacement to less desirable habitats, or in some situations, to tolerance of urban developments.

   ii. For many species of northern ungulates, **winter range** is traditionally considered the **limiting factor within the environment**. According to Smith and Anderson (1998:1043), winter survival was reported to regulate, in a density-dependent fashion, both red deer on the Isle of Rhum, Scotland (Clutton-Brock et al. 1985), and northern Yellowstone National Park elk (Houston 1982, Singer et al. 1997). Animals that may have occupied thousands of acres of summer/fall range can be seasonally confined to relatively restricted geographic areas on which forage is limited and environmental conditions can cause physiological stress. As defined by Mackie et al. (1998:27) this is "**maintenance habitat**," environments that provide ". . .all resources necessary for adult survival, but not necessarily recruitment of young." The number of animals that can be successfully maintained in limited geographic areas is further limited by ". . . developments such as reservoir impoundments, subdivisions, access roads, highways, and the cultivation of land for agriculture. . . ." (Skovlin 1982:372).

   iii. Typically, winter ranges of elk and deer are south- and southwest-facing, low elevation slopes (Skovlin 1982) and the bottoms of large valleys (Telfer 1978) somewhat removed from areas occupied during the summer. The determining variable, however, is snow depth, and Mackie et al. (1998) have pointed out that deer a population winters where the least snow falls. "Snow impedes movement, increases energy expenditure, and reduces forage availability." (Parker et al.

1984:479). Energy expenditures for locomotion in snow increase curvilinear as a function of snow depth and density.

d. **Displacement**: As with other wildlife previously mentioned, recreational activities that utilize roads directly or roads that provide access to or through Inventoried Roadless Areas as well as other areas 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 on the populations themselves (Knight and Cole 1995). Wildlife responses to disturbance are shaped by 6 factors: type of activity; predictability of the activity; frequency and magnitude of the activity; timing (e.g., breeding season); relative location (e.g., above versus below on a slope); and the type of animal including size, specialized versus generalized niche, group size, and sex and age (Knight and Cole 1995).

i. Very often, road closures can be used as an adjunct method of reducing simultaneous disturbance by hunters and vehicles. Gates and Hudson (1979), found that activity by elk in cold temperatures results in a thermoregulatory penalty, that is, it takes more energy to move in winter than in the fall. Thus, while inactivity provides an energetic advantage for animals exposed to cold, forced activity caused by human disturbance exacts an energetic disadvantage. Geist (1978) further defined effects of human disturbance in terms of increased metabolism, which could result in illness, decreased reproduction, and even death.

ii. Specific investigations of winter disturbance have primarily examined skiers, snowmobiles, and, to a lesser extent, helicopters. Snowmobiles have received far more attention than all other disturbance factors combined, and the reports, not unexpectedly, express the complete range of possible results. Bollinger, et al. (1972) reported that deer activity increased when snowmobiles were present, but deer were not driven out of their normal home range. Lavigne (1976) reported that snowmobile trails enhanced deer mobility during periods of deep snow in Maine. This study was followed by a report (Richens and Lavigne 1978) that white-tailed deer were not driven out by snowmobiles, but were following snowmobile trails because the snow was firmer. In a slightly more negative series of studies, Eckstein and Rongstad (1973), Dorrance et al. (1975), and Eckstein et al. (1979) found that while some deer showed avoidance when snowmobiles were present, there were no significant changes in home range or daily movement patterns. Doyle (1980) summarized two studies reporting negligible impacts by snowmobiles on the environment.

iii. <u>Snowmobiles:</u> The majority of reports on this subject, however, dwell on negative aspects of snowmobile traffic. Malaher (1967) complained that snow machines were illegally used for hunting, while Neuman and Merriam (1972) reported the loss of insulating quality in snow packed by snowmobiles as well as damage to vegetation. Baldwin (1970) suggested a luxury tax on snowmobiles for the damage they cause. Fancy and White (1985) found that the energy cost for caribou of cratering through snow compacted by a snowmobile was 2-4 times as great as for uncrusted snow. Other authors have reported disturbance of wild animals as disparate as muskoxen (McLaren and Green 1985), caribou (Fancy and White 1985), and white-tailed deer (Kopischke 1972, Moen et al. 1982,). Huff and Savage (1972) reported that the size of home ranges for whitetails was reduced in high-use areas, and snowmobile use appeared to force deer into less preferred habitats. Aasheim (1980) observed that animals accustomed to humans are less affected by snowmobiles than animals in more remote areas.

iv. <u>Snowmobiles and Cross Country Skiers:</u> Apparently, however, snowmobiles are less disturbing than cross-country skiers. Freddy (1986*a*) and Freddy et al. (1986), found that responses by mule deer to persons afoot, when compared to snowmobiles, were longer in duration, more often involved running, and involved greater energy costs. Aune (1981) classified responses of wildlife to winter recreationists in Yellowstone National Park as attention or alarm, flight, or, rarely, aggression. He agreed with Chester (1976) in concluding that winter recreational activities were not a major factor influencing wildlife, although minor displacement was observed. Such displacement might have indicated only movement away from active ski trails, as reported for elk by Ferguson and Keith (1982) in Elk Island National Park, Alberta, but it could also have involved over-winter displacement as reported for Elk Island moose (ibid.). Almost certainly because of increasing recreational pressure in Yellowstone National Park, Classier et al. (1992) found that 75% of flight behavior by elk occurred within 650 m of skiers and recommended that restrictions be imposed. Parker et al. (1984:484) observed, "Flight distances decline from early to late winter as the animals become habituated and as body energy reserves are depleted. Greater flight distances occur in response to skiers or individuals on foot than to snowmobiles, suggesting that the most detrimental disturbances to the wintering animal is that which is unanticipated." This greater response to unpredictable or erratic disturbance was also noted for pronghorn (Segerstrom 1982) and bighorn sheep (Stemp 1983).

v. Helicopters: Most research testing helicopter disturbance to wildlife has been related to oil exploration activities. However, these data sets can be applied to some recently popular winter skiing activities. Bleich et al. (1994) recorded negative responses of bighorn sheep to helicopter overflights. Joslin (1986b) reported a decline in mountain goat reproduction and/or recruitment of kids in response to disturbance by helicopters in Montana, and Côté (1996) reported that mountain goats were disturbed by 85% of all flights within 500 m. Foster and Rahs (1985) have even suggested that localized goat mortality and temporary range abandonment is a result of hydroelectric exploration activities. Luz and Smith (1976) found that pronghorn responses to helicopters varied from mild to strong in relation to decibel levels.

vi. The degree of disturbance caused by skiers, snowmobiles, and helicopters has mostly been reported in terms of flight distance or in some observed change in behavior manifested by animals. Based on elk heart rate data, Chabot (1991) showed that even when disturbances do not induce an overt behavioral response, the increased heart rates can result in relatively high energy expenditures. These results have been confirmed and expanded for a variety of ungulates including mule deer (Freddy 1984*a*, Weisenberger et al. 1996, Freddy 1977), caribou and reindeer (Nilssen et al. 1984, Fancy and White 1985, Floyd 1987), white-tailed deer (Moen 1978, Moen et al. 1982), elk (Ward and Cupal 1979, Lieb 1981, Chabot 1991), red deer (Epsmark and Langvatn 1985, Herbold et al. 1992, Price and Sibly 1993) and bighorn sheep (MacArthur et al. 1979, MacArthur et al. 1982, Stemp 1983, Geist et al. 1985, MacArthur and Geist 1986, Hayes et al. 1994**)**. In summary, it has been shown repeatedly, and for virtually every ungulate species, that even minor, seemingly harmless sorts of disturbance cause increased heart rates -- and increased energy expenditure.

e. Another potential result of disturbance or harassment of wintering animals can be movement from historical and accepted winter ranges (usually on public land) to private lands where haystacks and forage for domestic livestock are at risk.
   i.

f. **Habituation**: Tendencies to habituation vary by species, but habituated ungulates are almost always undesirable. Managers can provide an important contribution to energy conservation by reducing or eliminating disturbance of wintering ungulates and restricting recreational use of spring ranges that are important for assuring recovery from winter weight loss. During summer, the biological focus for ungulates includes restoring the winter-depleted body condition and accumulating new fat reserves. In addition, females must support young of the year and males meet the energy demands of horn and antler growth. The potential for impacts increase and options for acquiring high quality nutrition, with the least possible effort, decline as the size of the area affected by recreationists expands to fill an increasing proportion of the summer range.

i. One of the less desirable behaviors noticed for several ungulate species has been habituation to human habitations. Thompson and Henderson (1998) reported an increasing occurrence of elk not responding to predictable and harmless human activities on winter ranges in the urban fringe. They noted that the habituation response was an adaptive behavioral strategy promoted by the need to conserve energy, avoid bodily damage, out-compete other individuals, and find unutilized resources.

g. **Displacement Impacts**

i. Perhaps more important than the short-term energetic effects of human disturbance are the longer-term influences of displacement from selected habitats. Relatively high levels of human disturbance are often confined within a narrow corridor through wildlife habitat, such as a road. These may have little or no measurable impact on ungulates during summer if essential foraging sites are not directly impacted or limited in availability across the summer home range. However, a substantial number of studies have demonstrated that vehicle traffic on forest roads does establish a pattern of habitat use in which the areas nearest the road are not fully available for use by elk (Ward et al. 1973; Rost and Bailey 1974, 1979; Rost 1975; Marcum 1976; Perry and Overly 1976; Thiessen 1976; Ward 1976; Lyon 1979*a*, 1983; Edge 1982; Edge and Marcum 1985,1991; Edge et al. 1987; Marcum and Edge 1991). The extent of reduced habitat use can be very substantial. With only two miles of roads open to vehicular traffic per square mile, the area affected can easily exceed half of available elk habitat (Lyon 1983).

ii. Once the original purpose of a forest road is satisfied (normally a timber sale), management agencies tend to assume that daily traffic is primarily recreational in nature. Accordingly, many roads have been gated under the assumption that limited use by "administrative traffic" will not unduly disturb elk and other wildlife. Unfortunately, this assumption is untrue, and even a limited amount of administrative traffic behind closed gates provides more than adequate reinforcement of the avoidance behavior (Lyon 1979*b*).

iii. As the size of the area affected by recreationists expands to fill an increasing proportion of the animals' summer range, the potential for impact increases because options decline for acquiring high-quality nutrition with the least possible effort. In some cases, there may be no options available. Populations of mountain goats and bighorn sheep, for example, are often confined to relatively narrow bands of suitable habitat associated with very steep and rocky slopes. Population impacts may be expected where summer recreation is concentrated in such areas. Kuck (1986) reported, ". . . that elk, deer and moose may be capable of adapting to many phosphate mining activities in southeastern Idaho, but cannot compensate for disturbance on important seasonal ranges. . . " such as those used for calving and winter migration. Similarly, Lieb and Mossman (1966) found that human disturbance caused Roosevelt elk with young calves to move to secondary forage areas away from the central parts of their home ranges. In Colorado, Phillips (1998) was able to show that repeated displacement during the calving season resulted in major declines in survival of elk calves. He recommended that recreational traffic be routed away from areas in which elk were known to calve. In Montana, summertime occurrences of known human recreational impacts on reproductive performance in ungulate populations have been limited to relatively few situations and circumstances, but managers need to be aware of the potential problems.

iv. Bear and Jones (1973) reported that camping, hiking, and OHVs negatively influence sheep distributions and activities. Many other authors have confirmed these observations and recommended regulating ORV use and human activities where they affect sheep (Tevis 1959; Wilson 1969, 1975; Dunaway 1971a; Geist 1971b; Graham

1971, 1980; Demarchi 1975; DeForge 1976; Douglas 1976; Horejsi 1976, 1986; Elder 1977; Hicks and Elder 1979; Thorne et al. 1979; Leslie and Douglas 1980; Skiba 1981; Hansen 1982; Stevens 1982; Stemp 1983; King 1985; King and Workman 1986; Krausman and Leopold 1986a; Stockwell et al. 1991; and Harris et al. 1995a). Wehausen et al. (1977), however, concluded that human disturbance was not as important as previously assumed.

v. Areas of intensive summer recreation, where they occur in the urban interface or very near cities, are often crisscrossed by many miles of trails across thousands of acres of summer habitat for deer and elk. Persistently high levels of forest recreational use by hikers, joggers, mountain bikers, and Frisbee golfers are fueled by close proximity to a major human population center. Where summer recreational activities approach high levels, elsewhere or in the future, impacts on reproductive performance of ungulate populations may be expected. However, little direct research describing this level of disturbance has been reported. Bullock et al. (1993) recorded the responses of deer in two English deer parks and reported encounter rates with people, dogs, and vehicles between 6 and 40 per hour. Resulting withdrawal percentages by deer were less than 10%. Areas of potential concern for the future include increasing development of summer recreational facilities at high-elevation ski areas and development of expansive forest trail networks for mountain bikers. Morrison et al. (1991) discovered that ski-area development caused elk to partially abandon the area developed along with a concurrent reduction of timbered-habitat use from 80-95% down to 20%. In a follow-up study, Morrison et al. (1995) compared two ski-area developments and found that physical disturbance caused a 30% reduction in elk use of one area while human activity in another area led to 98% reduction in elk use. Recreational use may also alter migratory movement patterns of ungulates, like deer and elk, using public lands and result in situations where more time is spent on private lands.

h. Indirect impacts on ungulates by recreationists may also be of major immediate concern. Vehicle traffic on and off roads has been linked with high rates of establishment and spread of noxious weeds in wildlife habitat. Competition from noxious weeds may reduce quality and quantity of summer forage for ungulates, resulting in poorer reproductive performance during the lifetime of an animal.

7. Carnivores

(Consulting CDOW Specialist: Tom Remington, Terrestrial Resources Section Manager)

a. Members of the mammalian order Carnivora have a wide variety of responses to human activity. Some species like skunks, raccoons, and coyotes have adapted to the presence of humans and to human activities including travel corridors (roads and trails as well as outdoor recreation activities). These species in general will most likely not be negatively impacted by roads in national forests. For other species, human outdoor activities associated with travel corridors (roads and trails) and recreational are documented or suspected to have significant adverse impacts. Because they are listed under the Endangered Species Act and, consequently, have been subjected to significant research on decimating factors, evidence of such impacts is most compelling for grizzly bears and wolves.

b. For some carnivores like black bear, mountain lion, lynx, bobcat, and most furbearers, the preponderance of evidence of impacts comes from studies designed to evaluate the impacts of hunting and trapping activity and other, less direct, recreational impacts have not been adequately researched. Research motivated by take (hunting and trapping) typically focuses on demographic impacts and population assessment rather than on habitat impacts. Correspondingly, this then may understate the importance of habitat deterioration caused by recreational activities using roads.

c. **Effects of Roads and Trails -**Limited research is available concerning the effects of recreational use of roads and trails on carnivores. However, Young and Beecham (1986) and Beecham and Rohlman (1994) report that Idaho black bears may react to increases in road densities by shifting the location of their home ranges to areas of lower road densities. Female black bears avoided roadsides, while males used roadsides in proportion to their availability. This was probably due to differences in mobility. Kasworm and Manley (1990) found that black bears in northwestern Montana avoided habitat within 274 m of open roads. **Trails displaced black bears less than open roads**. Overall, both sexes prefer to stay at least 50 yards from roads, except when feeding (Beecham and Rohlman 1994). Bears crossed low-traffic volume roads more frequently than roads of higher traffic volume (Brody and Pelton 1989), however, bears may not necessarily restrict their movements in reaction to road density within established home ranges.

d. Tietje and Ruff (1980) reported that the numbers and sex and age structure of bear cohorts before and during oil and gas development in Alberta (during 1976 and 1977) were not significantly different. In general, activity patterns and movements remained unchanged. The data suggests that in the absence of appropriate management strategies, secondary impacts of *in situ* oil extraction, such as new roads, increased bear hunting (legal and illegal), and human habitation may be of greater consequence than the primary impacts of habitat alteration and loss.

e. It has been reported that reducing the number of timber access roads is a means of influencing bear harvests and mitigating the effects of timber harvest (Lindzey and Meslow 1977, Irwin and Hammond 1985, Lindzey et al. 1986, Unsworth et al. 1989, Beecham and Rohlman 1994, Mace and Waller 1997).

f. Roads and trails are directly correlated with trapper access to forest carnivore populations and, therefore, vulnerability of forest carnivores to trapping mortality. Impacts of increased trapping mortality of forest carnivores as a result of recreational development/use should be considered, especially if the recreational development is located in an area that currently/previously served as a refugia/source population. The following measures could be used to reduce the potential for increased trapper harvest associated with snowmobile trails: Avoid establishing road or trail routes that bisect or run parallel to preferred habitats. Avoid establishing road or trail routes that follow forested saddles linking major drainages (travel routes for forest carnivores). -Avoid establishing road or trail routes that separate mature, closed canopied forests from foraging habitats for fisher and marten (Spencer et al. 1983, Buskirk et al. 1989, Jones and Raphael 1991).

g. **Lynx**: Limited public data is available for release for this document. Lynx are typically found in mid to upper elevation coniferous forests in the cool, moist vegetation types. Mature coniferous forest stands as well as seral stages are important. Primary lynx habitat is defined as subalpine habitat usually between 4,000 and 8,000 feet elevation. Critical habitat component(s) for maternal dens appear to be mature forest, understory structure that provides security, and thermal cover for kittens (Aubry et al. 1999). Suitable understory structures are generally found in unmanaged, mature forests where blowdown patches of coarse, woody debris occur. A minimum size of these "patches" is not reported. However, recent research in the Yukon (Mowat et al. 1999) demonstrates that lynx may den in younger, regenerating stands (30 years old) that contain blowdown or structures such as roots and dense vegetation that seem to provide similar cover characteristics as described above. Understory structure may well be the critical component rather than forest stand age.

   i. Deep, low-density snow allows lynx to exploit higher elevation areas during winter that typically exclude competitors such as coyotes, bobcats, and mountain lions (Parker et al. 1983, Koehler and Hornocker 1991, Brocke et al. 1992).

   ii. Several authors (Bider 1962, Ozoga and Harger 1966, Murray and Boutin 1991, Koehler and Aubry 1994, Lewis and Wenger 1998 and Buskirk et al. 1999) suggested that packed trails created by snowmobiles, cross-country skiing, snow shoeing, snowshoe hares, and other predator trails may serve as travel routes for potential competitors and predators of lynx.

iii. Mowat et al. (1999) reported that lynx seem to be able to tolerate moderate levels of snowmobile activity and human presence. There is very little information on this topic. Human presence at denning time in late May and June may be the time that human disturbance affects lynx by causing den abandonment and potentially affecting kitten survival. It has been observed that human presence at a den site with young kittens can cause the female to move her young to another site

iv. Developed recreation sites such as resorts, ski areas, and campgrounds cause a direct impact through habitat loss/modification and the addition of various human activities in an area. These types of developments necessitate analyses of on-site impacts as well as a landscape-level view to analyze cumulative effects and whether the development occurs in large blocks of contiguous lynx habitat versus highly fragmented areas of lynx habitat. These broader levels of analysis provide the means to address issues of connectivity, refugia, and metapopulations.

h. **Mountain Lions**:

i. **Influence of roads -**As road access in forested areas increases, the avoidance of these roads by mountain lions may further fragment lion habitat and decrease dispersal of subadults. Lions in Arizona and Utah established home ranges in areas where improved dirt roads were underrepresented or absent and crossed these roads less than expected. Most lions frequently crossed unimproved dirt roads (Van Dyke et al. 1986). Yet, lions in Alberta did not avoid or prefer the secondary road corridor during the high-use summer recreational season. Lions did travel across the road during daylight, though they crossed more often between late afternoon and early morning (Jalkotzy and Ross 1995). Lions in Utah and Arizona selected areas with lower road densities than average on 2 study areas, yet in another region lions tolerated higher road densities when areas with lower densities were not available (Van Dyke et al. 1986).

ii. Only 1 lion died from an automobile collision in 115 monitored lion mortalities in 3 western states (Anderson 1983). Yet, small lion populations in southern California and southern Florida occupy habitats that are highly fragmented by roads and human disturbances, have experienced significant automobile-caused mortality. Underpass crossings, fencing, and road modifications have been built to mitigate this impact (Maehr et al. 1991, Beier and Barrett 1993).

iii. Roads that increase access to recreational areas can dramatically impact local lion populations by increasing access to lion hunters. Most lion hunters in Montana and Utah use automobiles to locate lion tracks and transport hunting hounds. The type, density, and distribution of roads within a lion's home range; lion movements and weather patterns greatly influence hunter success (Murphy 1983, Barnhurst 1986).

i. **Summary: Carnivore species differ in their susceptibility to human disturbance**. The carnivores least sensitive to human disturbance are the generalists such as coyotes, red fox, raccoons, and skunks. Other species such as Canada lynx that are more specialized in their foraging strategy, may be particularly vulnerable to disturbances that compromise their winter foraging efficiency. Other species like black bear have sufficient research to make conclusions about roads and road density. Nevertheless, in the absence of complete knowledge of habitat requirements of all carnivores and their susceptibility to human disturbances including roads and road activity, consideration should be geared toward conservative measures.

i. More research is needed to document the magnitude of this potential effect. Potential impacts of dispersed and developed recreation projects and activities are variable and complex. To analyze project effects on medium- to large-sized carnivores, it is particularly important to consider not only direct project impacts, but also potential impacts on a landscape basis in the context of connectivity, refugia, and metapopulations. For example, new groomed snowmobile trails will have immediate area effects; the next level to consider is the impact of all snowmobile trails within a large area (at least the size of a national park or forest) to delineate cumulative effects. Refugia (landscapes, generally wilderness or back-country, that are not readily subject to hunting, trapping, and frequent human disturbance) are recognized as necessary for persistence of forest carnivore populations by supporting source populations that can repopulate adjacent landscapes via dispersal and emigration.

ii. In addition to the necessity to analyze impacts on carnivores at varying geographic scales, it is important to consider impacts specifically on biological elements, such as: productivity, mortality, movements, and dispersal. For an example of this approach, refer to the Draft Canada Lynx Conservation Assessment and Strategy (BLM et al. 1999).

iii. Socio-economic considerations are important in the context of carnivore management. Some of these values include impact to domestic livestock operations and opportunities for trapping and hunting. Social values of wildlife, present new considerations for resource managers (Duda et al. 1998). Undoubtedly the fastest growing carnivore "use" is appreciation through viewing, photographing, and symbolic values.

iv. With increasing human pressures for recreational opportunities, it is imperative to gain more information on carnivores so they can be managed in a context of species requirements, ecosystem (landscape) scale, and socioeconomic values.

v. Mid- to large-sized carnivores require large home ranges; they characteristically conduct wide-ranging movements, and exhibit specialized biological and habitat requirements. Because of these characteristics, they are particularly vulnerable to habitat fragmentation and alteration.

8. Vegetation, Soil and Water

(Consulting CDOW Specialist: None used for this Sub-Section 8 a)

a. Travel routes (roads and trails) can affect vegetation, soils, and water. These components of the environment would benefit from limiting of all off-highway vehicles (OHV) use to official routes, as well as devising timing and use standards for moderate, to high impact, non-motorized recreation areas. Additionally, all recreational activities should be carefully controlled and monitored in fragile and unique vegetation communities. Establishment of a monitoring system to determine the effect of various weed control methods on native vegetation could ultimately benefit wildlife habitat. Facilities should be developed where recreationists can wash weed seeds from sources of transportation.

The United States Forest Service Region 2 Species Conservation Project is producing species assessment reports for the majority of the sensitive species and management indicator species for the region.
Ultimately, they expect to post over 200 peer reviewed reports on this Web site.

http://www.fs.fed.us/r2/projects/scp/assessments/

This United States Forest Service site includes a number of Colorado's native amphibians and reptiles, birds, fish, and mammals etc.)

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