VALUES OF INVENTORIED ROADLESS AREAS IN MONTANA

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Introduction

Prior to World War II (1946) most roads on Forest Service (FS) lands were constructed primarily for fire suppression and conservation activities. From the mid 1940s until the mid-late 1980s, the majority of roads constructed on FS lands were constructed to facilitate timber harvest (Space 1979, pg 3-102 FS FEIS 2000).

Inventoried roadless areas (IRAs) were designated during the Roadless Area Review and Evaluation process (RARE II) for the purpose of assessing their suitability for inclusion in the National Wilderness Preservation System. The 6,397,000 acres encompassed by IRAs in Montana represent 6.8% of Montana's land area and 38% of National Forest lands within the boundaries of Montana. Determinations of how individual inventoried roadless areas are managed were made during development of the corresponding Forest Plans. Ultimately, the Forest Service recommended that nearly 13% of IRA acreage be designated as Wilderness.

Caveats to keep in mind with regard to use of the term *inventoried roadless area* (IRA):

- Road-building is actually an allowable activity within 60% of inventoried roadless acreage in Montana, in accordance with Forest Plans. Roaded areas within IRAs have not been removed from the IRA designation.

- IRAs do not include all unroaded FS lands within Montana. Lands that were unroaded at the time of RARE II but did not meet the minimum size requirement of 5,000 acres to be considered for Wilderness designation, were not designated as IRAs. Some of these areas remain unroaded today and offer the same values as lands designated as IRAs.

Inventoried roadless areas within Montana feature a wide diversity of values and conditions. Many provide values and conditions that are similar to designated Wilderness, while others contain roads, areas where timber has been harvested, communications facilities, private land inholdings and other development. Some are remote, have a high level of ecological health and biodiversity, and provide opportunities to experience solitude and nature. Others are located in lower elevation areas, adjacent to housing developments, and contain forest fuels that may pose a significant fire risk to property and human safety.

Montanans have demonstrated strong support for protection of IRAs during hearings on the roadless conservation rule published January 12, 2001:

In all, 17,429 Montanans participated in the NEPA process and of those commenting, 11,654 favored even stronger roadless area protections than those proposed in the Forest Service's draft environmental impact statement (Attorney General Mike McGrath, 2001).

In December 1999, the Theodore Roosevelt Conservation Alliance surveyed 600 hunters and anglers to solicit their opinions regarding road management in existing inventoried roadless areas on NF lands. Eighty-six percent of the anglers and 83% of the hunters surveyed supported a policy to prevent future road construction in inventoried roadless areas. These hunters and anglers highly value many attributes of National Forest lands, including the habitat they provide for endangered species, protection of water quality, the opportunity to experience solitude and nature, and the hunting and fishing opportunities in remote places having few roads and people (pg 3-284 FS FEIS 2000).

The following information is intended to provide a broad overview of the value of inventoried roadless areas in Montana for fish and wildlife. Statements regarding inventoried roadless area values and conditions in this report are general in nature. They may be accurate for many inventoried roadless areas in Montana, but may not apply to others. This summary is not meant to take the place of a site-specific assessment of each inventoried roadless area.

Overview of roadless values

Inventoried roadless areas provide clean drinking water and large, relatively undisturbed landscapes that are important to fish and wildlife species and their habitat needs. Inventoried roadless areas provide opportunities for dispersed outdoors recreation, and biological strongholds for populations of threatened and endangered species. They also provide reference areas for study and research and serve as bulwarks against the spread of non-native invasive species that can displace native fish and wildlife. (Forest Roads Working Group)

Watershed Values: Many IRAs contribute to providing clean, high quality water, used as public drinking water and also important to agriculture and industry. In fact, one of the primary reasons for establishment of the national forests and grasslands (Organic Administration Act 1897) was to "secure favorable conditions of water flows" (pg 1-1 FS FEIS 2000). IRAs within watersheds can also contribute to providing flood protection (water storage capacity and volume and timing of spring run-off).

Native plants and natural plant communities: Many IRAs provide large, relatively undisturbed blocks of habitat for a wide variety of native plants. Compared to roaded areas, native plant communities in many unroaded IRAs are more intact because nonnative species, which often spread during road construction and use, are less likely to become introduced or established. Competition with nonnative invasive species is one of the leading reasons that native plant species decline to the point of becoming threatened or endangered. (pg 1-4, FS FEIS 2000)

Endangered Species

Some inventoried roadless areas serve as strongholds for wildlife populations. Nationwide, more than 55% of threatened, endangered and candidate species use habitat on or associated with FS lands inventoried as roadless. It is the policy of Montana that species or subspecies of wildlife indigenous to this state found to be endangered should be protected in order to maintain and, to the extent possible, enhance their numbers (Nongame and Endangered Species Conservation Act (87-5-103 (2) (b)). In Montana, inventoried roadless areas help maintain viable populations of the following federally listed species: grizzly bear, gray wolf, Canada lynx and bull trout. Roadless lands also contribute to the recovery of the arctic grayling, a candidate for listing under the federal Endangered Species Act. Roadless areas provide important habitat, refugia, and strongholds for sensitive species like westslope cutthroat trout, Yellowstone cutthroat trout, and numerous wildlife species; these strongholds help ensure that populations of important native species do not meet the criteria for listing under the ESA. Continued management of certain IRAs as roadless can serve to provide for these populations, while providing the opportunity for less restrictive management activity provisions elsewhere.

Roadless areas also minimize user conflicts. Thus, future management activities in roadless areas will have fewer provisions imposed to protect threatened, endangered, or candidate species or their habitats.

The analysis done for the Interior Columbia Basin Ecosystem Management Project (Lee and others 1997) indicates that strong fish populations are often associated with areas of low road density. That analysis showed that increasing road densities (miles of road per square mile) and their attendant effects were associated with declines in the status of bull trout, westslope cutthroat trout, Yellowstone cutthroat trout, and redband trout. Approximately 60% of unroaded or very low road density watersheds within the assessment area supported strong salmonid populations. By contrast, fewer than 25% of subwatersheds with moderate road density and 18% with high road density supported strong populations (Quigley and others 1996).

Provide high-quality, usable wildlife habitat: Compared to roaded areas, many roadless areas contribute substantially to the seasonal nutritional needs of wild ungulates due to the fact that disturbance is less likely to occur in roadless environments that would otherwise result in: preemption of foraging and other seasonal life-cycle activities; displacement; interference with physiological or behavioral adaptations, induced stress and physiological consequences of unnecessary energy consumption on reproductive success, and population vitality (Canfield and others 1999).

It has been repeatedly documented, in Montana and throughout North American elk range, that vehicle traffic on forest roads evokes an avoidance response by elk. Even though the habitat near forest roads is fully available to elk, it may not be effectively utilized. Significant reductions in habitat effectiveness are usually confined within a half-mile of roads but declines in elk use have been detected as far as 2 miles from open roads. Loss of habitat effectiveness has been shown to be greatest near primary roads and least near primitive roads, greatest where cover is poor and least where cover is good, and greater during the hunting season than at any other time of the year. As a general average, habitat effectiveness can be expected to decline by one-fourth when open road densities are 1 mile per square mile and by one-half when road densities are 2 miles per square mile (MT Dept of Fish, Wildlife and Parks 1984).

Habitat security for hunted populations: Elk security has been defined as "the protection inherent in any situation that allows elk to remain in a defined area despite an increase in stress or disturbance associated with the hunting season or other human activities" (Lyon and Christensen 1992). Poor elk security can result in re-distribution of elk from public lands to private lands during the hunting season, or overharvest of bulls.

Roads in relation to the sex and age structure of hunted wildlife populations: Roadless areas provide for balanced bull age structure for elk with some bulls living in excess of 10 years and over 30% of the bull population consisting of mature animals. Bull:cow ratios were also affected by access related hunting mortality rates. In the highly roaded treatment there were fewer than 10 bulls per l00 cows and only l.3 mature bulls per l00 cows. Closing roads boosted sex ratios to nearly 20 bulls per l00 cows and the unroaded treatment had 34.5 bulls per 100 cows. These results draw attention to the need for coordinated management of elk herds by both habitat and population managers (Leptich, D.J. and Pete Zager 1991)

Montana has maintained the longest general elk and deer hunting season (5 weeks) of all western states and had the fewest elk hunting districts with restrictive limited-entry hunts. In survey after survey, Montana hunters indicate that they wish to preserve this tradition. At some point, cumulative effects of cover reduction and/or increased roads and trails would make it unlikely that FWP could maintain a 5-week general bull elk hunting season and maintain objectives for post-season bull:100 cow ratios. Thus, to continue a 5-week general bull elk season popular among the hunting public, FWP biologists have generally recommended against or asked for mitigating actions or modifications to habitat management objectives that substantially or cumulatively reduce hiding cover or increase access to previously secure areas (pg 44-45 Montana Final Elk Management Plan 2005).

The economic value associated with hunting, fishing and wildlife-associated recreation is substantial and a growing sector of Montana's economy. Between 1996 and 2001, expenditures related to the state's fish and wildlife resources increased 30% (USDI: Fish and Wildlife Service 2001).

In 2004, resident and nonresident hunters, anglers, and wildlife viewers spent over $600 million in Montana on transportation, food, lodging, and miscellaneous items. These dollars help support a large number of businesses in local communities, large and small, throughout Montana, creating thousands of jobs for Montana citizens (Duffield 1988, Loomis 1988, Brooks 1998, USFWS National Survey 2001 – figures updated using the consumer price index).

In addition to actual out-of-pocket expenditures by hunters, anglers, and wildlife viewers, the "net economic value" associated with hunting and fishing puts into perspective the overall economic value of Montana's fish and wildlife resources and the need to preserve the lands that help produce this bounty. In 2004 the "net economic value" (what hunters and anglers said they would be willing to pay to hunt and fish over and above their actual expenditures) was estimated to be $692 million (Duffield 1988, Loomis 1988, Brooks 1998, USFWS National Survey 2001 – figures updated using the consumer price index). Elk hunting supports a substantial outfitting and guiding industry. In 2002, an estimated 6,765 elk hunters used the services of an outfitter. At an average outfitting expenditure of $3,472 for an elk hunt, outfitted hunters may have contributed about $23,488,080 in income to Montana Outfitters. (pg 52, MT Elk Plan 2005)

The 1999 Outfitter Jobs/Income study conducted by the Montana Wilderness Association in 1999 indicated that 235 outfitters (77% of all wildlands outfitters) depend on roadless areas for more than 60% of their businesses. Thirty percent of wildlands outfitters depend entirely on roadless areas to provide a "wild" experience to their clients. The survey concluded that outfitters that use roadless areas generated an estimated $82,829,361 (money spent by outfitter clients) in economic activity for the Montana economy in 1998 (MWA 2000).

EXAMPLES OF VALUES PROVIDED BY INVENTORIED ROADLESS AREAS

The relationship between elk security and its role in sustainable elk harvest and hunting recreation: contrasting examples from Oregon and Montana (provided by Gary Hammond, Management Bureau Chief, Wildlife Division, FWP).

Oregon: In response to low bull carryover on the eastern slopes of the Cascades, hunting seasons became more restrictive with a corresponding loss in hunting opportunity in the Chesnimnus Management Units, northeastern Oregon. In response to reduced habitat security from logging and associated road building, the season structure was changed from general season bull elk hunting to limited permit hunting. Average hunter participation declined from 3,693 hunters to 1,420. Reductions in habitat security and concomitant changes in the hunting season resulted in a decline of 2,273 hunters (61.6%), and a corresponding loss of hunting opportunity. The trend of declining hunting opportunity due to increasing elk vulnerability (increased public access and reductions in cover) was expected to continue elsewhere in Oregon (Leckenby and others 1991).

Montana: By contrast, the relatively unfragmented hunting districts encompassing the Pioneer Mountains in southwestern Montana (HDs 331 & 332) have consistently provided hunting opportunities for over 4100 hunters, accounting for a total of 26,761 hunter-days of elk hunting recreation in 2004. These hunting districts provide high elk security, and are characterized by large, undisturbed contiguous blocks of old growth coniferous forest cover, moderate topographic relief, and very few roads.

This unfragmented environment can sustain significant hunting opportunity while maintaining good bull carryover post-hunting season (in excess of 20 bulls per 100 cows as well as a well-distributed age structure within the bull segment of the population.

Arctic grayling in the Big Hole (Provided by Peter Lamothe, Arctic Grayling Habitat Biologist stationed in Dillon, FWP).

While Arctic grayling are found primarily in the valley bottom of the Big Hole watershed, the tributaries of the Big Hole River that flow through Forest Service lands play an important role in the life history of this fish that is currently recognized as a Candidate Species for listing under the Endangered Species Act by the U.S. Fish and Wildlife Service and deemed a species "of concern" by the State of Montana. When the temperatures in the Big Hole River begin to warm in the late summer, many grayling move into the tributaries in search of cool, clear water. Degradation in quality or quantity of streamflows flowing through Forest Service lands could have serious impacts on the survival rates of the grayling temporarily inhabiting the lower reaches of these tributary streams. Also, any increase in sediment loads within these tributary streams may have adverse effects on the quality of spawning areas in the Big Hole River due to the connectivity of these aquatic systems.

BULL TROUT EXAMPLE

There are several specific analyses showing a negative correlation between road densities and bull trout distribution and abundance. In the Boise River basin, there was a negative correlation between bull trout abundance and human disturbance in the form of roads (Dunham and Rieman 1999). In the Swan drainage, there was a significant correlation between road development and increased fine sediment in the streambed, which reduces survival of incubating bull trout embryos (Leathe and Enk 1985; Fraley et al. 1989). In an analysis of the distribution of bull trout across their range within the Columbia River basin, bull trout are more likely to occur and the populations are more likely to be strong in colder, higher elevation, low- to mid-order watersheds with lower road densities. Bull trout populations were reported as 'strong' nearly seven times more frequently in those colder sub-watersheds with less than 2.5 miles of road per square mile than those with more (Rieman et al. 1997). An analysis of bull trout across western Montana revealed that bull trout strongholds occur in areas with road densities less than 0.4 miles of road per square mile of land area (Western Native Trout Campaign 2001, Hitt and Frissell 1999).

In the Swan River basin, a stronghold for bull trout in Montana, bull trout population indices were negatively correlated with the density of roads in spawning tributary catchments. Scientists concluded that protection of critical spawning tributary catchments from additional road-building and associated land-use disturbance will likely be necessary for the maintenance of viable bull trout populations in the Swan Basin (Baxter et al. 1999).

POTENTIALLY DETRIMENTAL IMPACTS OF ROADS ON FISH AND WILDLIFE AND THEIR HABITATS

Watershed: Roads contribute more sediment to streams than any other land management activity. Road construction, maintenance, use and even the presence of roads in a watershed can have numerous adverse impacts to aquatic systems and the species they support. Effects can potentially include (Furniss and others 1991; USDA Forest Service 2000; pg 3-164 FS FEIS 2000):

- Increasing sediment loads, especially harmful fine sediments, in streams
- Modifying watershed hydrology, altering groundwater exchange, and altering stream flows (including peak flow timing and magnitude)
- Altering stream channel morphology
- Degrading water quality, including chance of chemical pollution. Some pollutants are from road construction and maintenance equipment, or are brought into the watershed through public road use (pg 3-167 FS FEIS 2000)
- Altering water temperature regimes
- Fragmenting habitat and preventing access to upstream habitat due to inadequate or malfunctioning road crossings (e.g., perched culverts)
- Increasing access to streams, which may facilitate increased angling mortality, spread of disease (e.g., whirling disease) and aquatic nuisance species, and introductions of non-native salmonids.

Roads also increase the potential for erosion and slope failure in many areas. (pg 3-165 FS FEIS 2000)

Native Plant Communities: Rapid dispersal of weeds is characteristic of motorized routes where a vehicle in one trip, can spread 2,000 knapweed seeds over a 10-mile course. (MSU Extension 1992) Although dispersal of weeds is a prodigious issue, disturbance of soils by vehicles has long-term effects that favor the establishment of weedy species (Blackburn and Davis 1994). After disturbance, weedy, often exotic species, are likely to gradually crowd out native vegetation; thus biodiversity may be drastically lowered (Stout 1992).

Roads through Oregon coniferous forests were found to facilitate movement of invasive exotics in three ways. First, roads provide corridors for movement of seeds by vehicles. Second, they create a high-light habitat appropriate for weed growth in an otherwise shady environment. Finally, roadsides also contain seed banks that may spark future episodes of invasion (Parendes and Jones 2000).

Fish

Roads modify natural drainage networks and accelerate erosion processes. These changes can alter physical processes in streams, leading to changes in streamflow regimes, sediment transport and storage, channel bank and bed configurations, substrate composition, and stability of slopes adjacent to streams. These changes can have biological consequences, and they can affect all stream ecosystem components. Salmonids require stream habitats that provide food, shelter, spawning substrate, suitable water quality, and access for migration upstream and downstream during their life cycles. Road can cause direct or indirect changes in streams that affect each of these habitat components. (Furness et al 1991, FS Wilderness Needs Assessment 2003).

The broad-scale assessment of aquatic species and habitats in the Columbia River Basin (Lee and others 1997) demonstrated sizeable losses of large pools, critical habitat features for many fish species, in streams in managed areas (multiple-use, roaded areas) over the last 50 or 60 years, compared with streams in unmanaged areas. This analysis showed that streams in 20 managed watersheds in the Central Idaho Mountains had a 40% decrease in the frequency of large pools, whereas large pools in 11 unmanaged streams in the same area showed no noteworthy changes. A substantial decrease was also found in the frequency of deep pools in managed streams, in contract to a considerable increase in streams in unmanaged areas. Pools showed a clear decline in size and frequency with increasing road density. (pg 3-168 FS FEIS 2000)

The U.S. Fish and Wildlife Service (USDI Fish and Wildlife Service 1998) found that bull trout are exceptionally sensitive to the direct, indirect, and cumulative effects of roads. Dunham and Rieman (1999) demonstrated that disturbance from roads was associated with reduced bull trout occurrence. They concluded that conservation of bull trout should involve protection of larger, less fragmented, and less disturbed (lower road density) habitats to maintain important strongholds and sources for naturally recolonizing areas where populations have been lost. (pg 3-168&169 FS FEIS 2000)

Wildlife

Elk Vulnerability: Bull elk in roaded habitats are more than twice as likely to be killed during fall hunting seasons as those in areas with very few roads (Unsworth and Kuck 1991). A direct relationship exists between levels of road access and bull mortality, with increasing mortality with increasing road density (Unsworth and Kuck 1991, Leptich and Zager 1991).

Results of analysis of two Montana hunting districts revealed large increases in vulnerability occurred concurrent with periods of peak road construction and logging. The influence of weather on elk vulnerability differed between the two hunting districts. In one western Montana hunting district, where elk migrate from large tracts of secure habitat to concentrate on highly fragmented accessible areas, weather accounts for up to 50% of the variation in the harvest. While in another western Montana hunting district where elk migration is less pronounced and elk are uniformly more accessible, numbers of hunters and road density are more important in determining vulnerability (Youmans 1992).

Grizzly Bears and Roads: Researchers and wildlife managers agree that areas without motorized access during the non-denning period are important to grizzly bears. Studies of the influences of roads on grizzly bears have demonstrated that bears avoid habitats near roads. Mattson and others (1987) found that grizzly bears in Yellowstone National Park tended to avoid habitat within 500 M (.31 mile) of roads during spring and summer. Aune and Kasworm (1989) reported less than expected use of habitat within 200 M (.12 miles) of roads during spring, 100 M (.06 miles) during summer and 400 M (.25 miles) during autumn on the Rocky Mountain Front. A study of road influences on grizzly bears in the Cabinet Mountains indicated less than expected use within 914 M (.57 mile) of roads with no significant seasonal variation (Kasworm and Manley 1990). Relationships between grizzly bears, habitat, and roads were also investigated between 1990 and 1994 in the Swan Mountains. Grizzlies highly selected for lands having no roads and avoided areas within 0.5 km (.31 mile) of roads used by more than 10 vehicles per day (Mace and others 1996). Based on the results of these investigations and others, the Interagency Grizzly Bear Committee adopted the criterion of "a minimum distance of .3 miles from any open road or motorized trail" to identify core habitat areas for grizzly bears (IGBC 1994).

REFERENCES

Aune, K. and W. Kasworm. 1989. East Front grizzly bear study; final report. Montana Department of Fish, Wildlife and Parks, Helena. 332 pp.

Baxter, C.V., C.A. Frissell, and F.R. Hauer. 1999. Geomorphology, logging roads, and the distribution of bull trout spawning in a forested river basin; implications for management and conservation. Transaction of the American Fisheries Society128:854-867.

Blackburn, J., and M. Byrd Davis. 1994. Off-road vehicles: fun or folly. Livingston, Kentucky. ASPI Publications. 56pp.

Brooks, Rob. 1998. The Net Economic Value of Deer Hunting in Montana, Montana Fish, Wildlife & Parks.

Canfield, J.E., L.J. Lyon, J.M. Hillis, and M.J.Thompson. 1999. Ungulates. Pages 6.1-6.25 *in* G. Joslin and H. Youmans, coordinators. Effects of recreation on Rocky Mountain wildlife: a review for Montana. Committee on effects of recreation on wildlife, Montana Chapter of The Wildlife Society. 307pp.

Duffield, John, J. Loomis and R. Brooks. 1987. The net economic value of fishing in Montana. Montana Fish, Wildlife & Parks.

Duffield, John. 1988. The net economic value of elk hunting in Montana. Montana Fish, Wildlife & Parks.

Dunham, J.B. and B.E. Rieman. 1999. Metapopulation structure of bull trout, influences of physical, biotic, and geometrical landscape characteristics. Ecological Applications 9(2): 642-655.

Forest Roads Working Group: Recommendations for Protection of Roadless Areas. (The Forest Roads Working Group is an ad hoc coalition comprised of organizations that collectively represent conservationists, sportspersons, members of the forest products industry and outdoor recreation businesses that support the protection of roadless areas of the National Forest System.)

Fraley, J., Weaver, T., and J. Vashro. 1989. Cumulative effects of human activities on bull trout (Salvelinus confluentus) in the upper Flathead drainage of Montana. Headwater Hydrology, American Water Resources Association: 111-120.

Furniss, M.J., T.D. Roeloffs and C.S. Yee. 1991. Road construction and maintenance. In: W.R. Meehan, ed. Influences of forest and rangeland management on salmonid fishes and their habitats. Special publication 19. Bethesda, Maryland: American Fisheries Society. Pp. 297-323.

Hitt, N.P., and C.A. Frissell. 1999. Wilderness in a landscape context: evaluation of wilderness and aquatic biological integrity in western Montana. Presented at the Wilderness Science Conference, May 1999, Missoula, Montana.

Interagency Grizzly Bear Committee. 1994. IGBC Access Taskforce Report. 8pp.

Kasworm, W.F. and T. Manley. 1990. Road and trail influences on grizzly bears and black bears in northwest Montana. Int. Conf. Bear Res. and Manage. 8:79-84.

Leathe, S.A., and M.D. Enk. 1985. Cumulative effects of microhydro development on the fisheries of the Swan River drainage, Montana. Volume I, Summary Report. Montana Department of Fish, Wildlife and Parks, Kalispell. 114 pp.

Leckenby, Donavin, C. Wheaton and L. Bright. 1991. Road access management effects on elk mortality and population dynamics. In: Christensen, A.G., Lyon, L.J., Lonner, T.N. comps. Proceedings: elk vulnerability symposium. Bozeman, MT. Pp 89-93.

Lee, D.C., J.R. Sedell, B.R. Rieman, R.F. Thurow, J.E. Williams, and others. 1977. In: Quigley, T.M. and S.J. Arbelbide, tech eds. An assessment of ecosystem components in the interior Columbia Basin and portions of the Klamath and great basins. Volume 3, Chapter 4 General Technical Report PNW-GTR-405. Portland, Oregon. USDA, Forest Service, Pacific Northwest Research Station. Pp 1058-1496.

Leptich, D.J. and P. Zager 1991. Road access management effects on elk mortality and population dynamics. In: Christensen, A.G., Lyon, L.J., Lonner, T.N. comps. Proceedings: elk vulnerability symposium. Bozeman, MT. Pp 126-131.

Loomis, John and Joseph Cooper. 1988. The net economic value of antelope hunting in Montana. Montana Fish, Wildlife & Parks.

Lyon, L.J. and A.G. Christensen. 1992. A partial glossary of elk management terms. General Technical Report INT-GTR-288. U.S. Forest Service, Intermountain Research Station, Ogden, Utah. 6pp.

Mace, Richard D., J.S. Waller, T.L. Manley, L.J. Lyon and H. Zuuring. 1996/12. Relationships among grizzly bears, roads and habitat in the Swan Mountains, Montana. J. Applied Ecology 33(6):1395-1404.

Mattson, D.J., R.R. Knight and B.M. Blanchard. 1987. The effects of developments and primary roads on grizzly bear habitat use in Yellowstone National Park, Wyoming. Int. Conf. Bear Res. and Manage. 7:259-273.

McGrath, Mike. 2001. (Attorney General, Montana) June 6, 2001, press release addressing friend-of-the-court brief filed with the Ninth Circuit Court of Appeals.

Montana Department of Fish, Wildlife and Parks. 1984. Coordinating elk and timber management: final report of the cooperative elk-logging study1970-1985. 53pp.

Montana Department of Fish, Wildlife and Parks. 2004. Montana Statewide Elk Management Plan. Wildlife Division. 397 pp.

Montana State University Extension Service Bulletin. 1992. Controlling knapweed on Montana rangeland. Circular 311, February 1992.

Montana Wilderness Association. 2000. Wildlands outfitters: contributions to Montana's economy. 48pp.

Parendes, L.A, and J.A. Jones. 2000. Role of light availability and dispersal in exotic plants invasion along roads and streams in the H.J. Andrews Experimental Forest, Oregon. Conservation Biology 14: 64-75.

Quigley, T.M., R.W. Haynes and T.T. Graham, tech eds. 1996. Integrated scientific assessment for ecosystem management in the interior Columbia River basin. General Technical Report PNW-GTR-382. Portland, Oregon: USDA, Forest Service and USDI, Bureau of Land Management, Pacific Northwest Research Station. 310pp.

Rieman, B.E., D.C. Lee, and R.F. Thurow. 1997. Distribution, status, and likely future trends of bull trout within the Columbia River and Klamath River basins. North Am. Journal of Fisheries Management 17: 1111-1125.

Space, R.S. 1979. The Clearwater story, a history of the Clearwater National Forest. Northern Region 79-03. Missoula, Montana: USDA, Forest Service.

Stout, B.M. III. 1992. Impacts of off-road vehicle use on vegetative communities of Northern Canaan Valley, West Virginia. Prepared for the Canaan Valley Task Force. Final Report. Pp 12-13.

Unsworth, J.W. and L. Kuck. 1991. Bull elk vulnerability in the Clearwater drainage of north-central Idaho. In: Christensen, A.G., Lyon, L.J., Lonner, T.N., comps. Proceedings: elk vulnerability symposium. Bozeman, MT. Pp. 85-88.

USDA, Forest Service. 1999. Roads analysis: informing decisions about managing the national forest transportation system. Miscellaneous report FS-643. Washington, D.C.: USDA, Forest Service.

USDA, Forest Service. 2000. H. Gucinski and M. Furniss, eds. Forest roads: a synthesis of scientific information. Washington, D.C.: USDA, Forest Service. http://www.fs.fed.us/eng/road_mgt/science.pdf#xml=http://www.fs.fed.us/cgi-bin/texis/searchallsites/search.allsites/xml.txt?query=roads&db=allsites&id=4248e5090

USDA, Forest Service. 2000. Forest Service roadless area conservation final environmental impact statement. Volume 1. Many, many pages.

USDA, Forest Service, Northern Region. 2003. Wilderness needs assessment 2003. 58pp.

USDI, Fish and Wildlife Service. 1998. Biological opinion for the effects to bull trout from continued implementation of land and resource management plans and resource management plans as amended by (INFISH) and (PACFISH). Portland, Oregon. 232pp.

USDI, Fish and Wildlife Service, and U.S. Department of Commerce, Bureau of the Census. 2001 National Survey of Fishing, Hunting and Wildlife-Associated Recreation.

Western Native Trout Campaign. 2001. Imperiled western trout and the importance of roadless areas. A report by the Western Native Trout Campaign. 19 pp.

Youmans, C.C. 1992. Assessment of habitat fragmentation, roads, and weather on elk harvest and elk vulnerability in the upper Bitterroot Valley, Montana (*Cervus elaphus*). Dissertation. Montana State University, Bozeman, Montana. 181 pp.

Many of the FS publications listed above can be found at: www.fs.fed.us. Many of the other references are included in the partially annotated bibliography developed by the Montana Chapter of The Wildlife Society (http://www.montanatws.org/chapters/mt/pages/page4b.html).