The Contribution of Roadless Areas To An Ecologically Representative Network of Conservation Reserves

Protected Areas **-** protecting biodiversity in a network of reserves and parks has been a major goal of conservationists for more than a century (Noss 1996). Since the designation of the nation's first national park, Yellowstone, in 1872, the United States has set aside more than 100 million acres in wilderness and national parks (DellaSala et al. in review). However, most scientists agree that it will take far more land in protection to achieve a reserve system that is more representative of a broader array of habitat types and species distributions.

The WWF and CBI have completed the nation's first comprehensive assessment of protected areas (Appendix A). We also provide the attached CD ROM as the supporting metadata files for our analysis and consideration in this EIS. The protected areas assessment was based on standardized protected areas classifications developed by the US Geological Survey, National Biological Survey GAP Analysis Project. Our analysis is the most up-to-date compilation of protected area designations across the United States and Canada and is available in digital format. Protection categories considered by the WWF/CBI study ranged from "strictest" level of protection such as national parks and wilderness areas (GAP 1) to more "relaxed" levels of protection such as state parks and wildlife refugees (GAP 2) that allow more human activities but do not allow timber or mineral extraction. The study indicates substantial gaps in the amount and representativeness of our nation's protected areas, particularly low-to-mid elevation forests and grasslands that are under-represented in the current network of reserves. Additionally, most reserves were <25,000 acres (Appendix A, Fig. 2); too small to insulate species with large home ranges (e.g., large carnivores) from the effects of fragmentation and human caused mortality.

According to the WWF/CBI study, the United States has set aside only 5% of its land in strict protection and another 5% in more relaxed protection categories across all ownerships (Appendix A, Table 2). On Forest Service lands, about 17% or nearly 33 million acres are in strict and relaxed protection status, with the remaining 160 million acres open for multiple-use management (DellaSala et al. 1999 – available as a metadata file). The WWF/CBI metadata file summaries for approximate levels of federal lands protection are provided for this EIS as follows:

- Forest Service land (Gap 1 or 2): 32,612,884 acres (17%)
- BLM land (Gap 1 or 2): 9,839,819 acres (4%)

- All Federal lands (Gap 1 or 2): 208,940,018 acres (33%)

In general, protection across the nation varied widely from state to state with most states east of the Mississippi protecting less than 1% of their land area. Southern and mid-western states had the lowest levels of protection with only 0.2-0.4% protected. Most protected areas were concentrated in the western United States with Alaska (35%) and California (19%) having the highest levels of protection for the nation. However, even these states have not protected enough of their wildlands to achieve representation since most protected areas are at high elevation (rock and ice), missing key low-elevation areas of high conservation value. Levels of protection in all forested ecoregions across the United States were considered far too low to maintain many species at risk of extinction. Nation-wide, forests provide habitat for nearly 1/3 of all endangered and threatened species (Flather et al. 1992). Additionally, about ¼ of more than 1,400 forest associations identified by The Nature Conservancy are considered "critically imperiled" or "imperiled" (Heinz Center 1999). Many of these species and associations make use of relatively intact forest areas free of disturbances introduced through road access (e.g., cattle grazing, logging, mining, poaching and over collecting).

Globally Outstanding Ecoregions **-** Biodiversity is not uniformly distributed across the landscape or any particular region or country. Research on distribution of species indicates specific ecoregions where biodiversity levels are exceptionally high (Ricketts et al. 1999, DellaSala et al. 1999). WWF has identified 15 forested ecoregions in the United States with biodiversity levels unparalleled in the temperate world (see Appendix A, Table 5). Protection of these "globally outstanding" ecoregions; however, only averages 6% with some ecoregions having <1% in protection status (DellaSala et al. in review, Appendix A). We request that the EIS include a discussion of how roadless areas contribute to the maintenance of biodiversity in these exceptional ecoregions and to the completion of a reserve network considered inadequate with respect to representation and viability concerns as presented here and in the scientific literature. Some examples of globally outstanding ecoregions and the value of roadless areas to biodiversity conservation in these regions are described below in the case studies.

The attached study (Appendix A) lays the ground work for scientific justification of including roadless areas in our nation's reserve network since these areas would significantly contribute to a reserve system more representative of habitat and elevation types than the current system as demonstrated below. We request that the EIS include these analyses in determining the contribution of roadless areas (both large and small) in meeting representation goals for our nation's protected areas and as a source of new GAP 1 reserves.

Key Regulatory and Other Biodiversity and Sustainability Processes –the Forest Service has taken a lead role in assembling a roundtable of key stakeholders involved in compliance with the Montreal Process Criteria and Indicators. Specifically, the Montreal Process includes several criteria and indicators related to the conservation of biodiversity and forest ecosystem health that is relevant to roadless area protections. Thus, the Forest Service should determine how roadless area protection contributes to compliance with

Criterion 1 (Conservation of Biological Diversity) and Indicator 3 (extent of area by forest type in protected area categories as defined by IUCN or other classification systems) and Indicator 5 (fragmentation by forest types). Attachment A provides a protected areas database for determining how much of the nation's forested ecoregions (especially those considered "globally outstanding") are in GAP 1 or equivalent IUCN I-III protection designations. However, we request that roadless areas protection be discussed in the context of additional GAP 1 protections in compliance with the Montreal Process and their overall contribution to the recovery and/or maintenance of viable populations as specified under the National Forest Management Act (NFMA) and Endangered Species Act. To this extent, the EIS should acknowledge the unique role that roadless areas play in relation to the stewardship recommendations of the Committee of Scientists (1999) in their recent review of federal lands management.

Conservation Benefits of Roadless Areas as a "Coarse Filter" For Biodiversity Conservation: Regional Case Studies

Case Study: Klamath-Siskiyou – the conifer forests of the Klamath-Siskiyou region in northwest California and southwest Oregon are among the most diverse temperate forests in the world (DellaSala et al. 1999-Appendix B). More than 3,500 plant species occur in the region; 281 are found nowhere else on earth. The region has some of the highest diversity of conifers in the temperate world (30 species). More than 60% of the mollusks are endemic to the region and several local sites have globally significant centers of endemism. Most mollusks, however, have declined by 90% of their historic range due, primarily, to stream degradation, logging, grazing, and destruction of type localities (DellaSala et al. 1999). Up to 154 species of wildlife in this region (138 terrestrial and 16 aquatic) have conservation status as defined by state Heritage programs and several plant communities are considered critically, globally imperiled. The remaining blocks of undisturbed roadless habitats are key to the viability of these species (DellaSala et al. 1999).

We have provided the raw metadata files (see attached CD ROM) and a manuscript on our findings (Appendix C) for the Klamath-Siskiyou roadless areas that was recently submitted to *Conservation Biology*. These attachments contain more detailed explanations on the ecological attributes of roadless areas used in the following summary and we submit them for inclusion in the EIS. Based on our work, nearly 3 million acres of unprotected, unroaded lands exist in the rugged mountains of the Klamath-Siskiyou region. The region's relative remoteness has resulted in 44% of the federal lands in unprotected roadless condition--over 2 million acres of which are unroaded blocks at least 5,000 acres (Appendix C). In summary, our research indicates that roadless areas have the following ecological attributes that excel in comparison to roaded landscapes:

- Relatively high levels of intact, old-growth forests
- Essential habitat for species of conservation concern
- Broad array of habitat types and elevation bands

- Important habitats such as serpentine soil types where most endemic plant species are found
- "Buffers" from invasive exotic species (most of which are spread along roads and by livestock grazing).
- "Aquatic strongholds" for salmon and native trout
- Critical wintering habitat for deer and elk
- Travel corridors for dispersal of forest carnivores (wolverine, fisher) and migratory birds

<u>Heritage Elements</u> – state heritage programs keep periodic inventories on the location of rare, threatened, endangered, and other state and federal species and community types of conservation concern. We accessed these records for the Klamath-Siskiyou region and overlayed roadless area categories of 1,000-5,000 ac and >5,000 acres to determine how many heritage elements would be captured by roadless area protection. Appendix C indicates that small roadless areas capture about 29% of all heritage elements recorded in the study area and the combination of large and small roadless areas would increase protection of heritage elements by 36%. Combined with wilderness, 43% of all heritage elements would be protected in roadless or wilderness designation.

<u>Serpentine Habitats</u> – serpentine habitat contains extraordinary levels of endemic plant species and the Klamath-Siskiyou region is known for its "hemisperhically" significant concentrations of unusual community types characteristic of serpentine soils (DellaSala et al. 1999). Small roadless areas would capture about 22% of the serpentine habitat in this region and the combination of small and large roadless areas would result in 37% additional protection (Appendix C). Combined with wilderness areas, 54% of the serpentine habitats would be protected in this region; thus capturing significant refugia for many endemic plants with highly restricted geographical distributions (DellaSala et al. 1999).

<u>Late-Seral Forests</u> – late-seral forests are of critical conservation concern in this region because they contain many species found in reduced numbers or not at all in early seral stages and they are rare regionally and nationally (FEMAT 1993, DellaSala et al. 1995, Noss et al. 1995). Small roadless areas would capture 28% of the remaining late-seral forests and the combination of large and small roadless areas would provide protection for 36% of the late-seral forests (Appendix C). The addition of wilderness and all roadless areas would capture a total of 52% of the late-seral forests in strict protection.

<u>Key Watersheds</u> – key watersheds have been recognized by FEMAT (1993) for their critical conservation benefits to salmonids. Small roadless areas would provide additional protection for 18% of key watersheds and the combination of small and large roadless areas would add 42% protection to key watersheds (Appendix C). The addition of wilderness and all roadless areas would capture 68% of all the key watersheds identified in this region and thus roadless areas are highly significant for salmonid recovery.

Elevation Representation – critics of roadless area conservation argue that protecting roadless areas is akin to no more than conservation of rock and ice. Our results indicate otherwise. Roadless areas would capture 26% and 31% of the elevation bands in low (0-3,000 ft) and mid (3,000-6,000 ft) elevations, respectively (Appendix C). When compared to the high elevation band (6,000-9,000 ft), the addition of roadless areas reflects a greater incremental increase in protection than what would be achieved for high elevations (i.e., many high elevation areas are already protected as wilderness, low-mid elevations are underrepresented in wilderness). Thus, roadless area conservation would provide many benefits for salmonids and wildlife that make use of low-mid elevation areas. Notably, DellaSala et al. (1999) indicate that >60% of all heritage occurrences recorded in this study area occur below 5,000 ft elevation, including many endemic mollusks and serpentine endemic plant species.

Habitat Representation – adequate representation of habitat types in protected areas is a key component of biodiversity conservation, necessary for maintaining viable populations of sensitive species, habitat types, and ecosystem processes (Noss and Cooperrider 1994). In this assessment, 214 distinct habitat types were recognized in the Klamath-Siskiyou that were stratified by geo-physical/climatic zones (see Strittholt et al. 1999 – CD ROM) and evaluated using four representation criteria: >50% of the area of a given habitat type represented in protected areas, 25-50% represented, >0-25% represented, and 0% represented. Protecting roadless areas would result in 36 habitat types (17% of all habitat types) having at least 50% of their area represented in roadless areas and 96 (45%) having >25% represented (Appendix C). More than 85% of all habitat types (183 types) had at least some area (>0%) represented in the combined wilderness/roadless area category and only 31 (15%) had no area represented. Thus, roadless areas provide a coarse filter for biodiversity conservation, capturing a broad suite of habitat types in various percentages of their spatial extent.

Invasive Exotic Species – many invasive exotics make use of forest clearings and roads as habitat. Appendix E includes several references of exotic species that disperse along forest roads. Our analysis makes use of data provided by the BLM (Medford District) on the location of exotic species. Although BLM sampling was primarily along roads, the species sampled are known to use forest clearings and roads and sampling was performed up to ¼ mile in from existing roads. In general, most roadless areas are relatively free (2%) of exotic species (Appendix C). However, we note that undoubtedly roads are not the only vector for dispersal of exotics that can be spread by birds, livestock grazing, and other dispersal agents. While our results do not account for the influence of these dispersal vectors, they do support the value of roadless areas as refugia for native species.

Regional Connectivity – maintaining connections among undisturbed areas is key to the dispersal of many species, particularly those sensitive to habitat fragmentation and distributed as metapopulations. The Klamath-Siskiyou region has 367 unroaded areas smaller than 5,000 acres, many of which are adjacent to larger, intact blocks that together have exceptional biodiversity values. An analysis currently in progress (using FRAGSTATS and spatial modeling) indicates that smaller roadless areas are typically clustered near large roadless areas and wilderness. The influence of roadless areas (large and small) to regional connectivity is strikingly evident in Appendix C, Fig. 4. Note how many of the small roadless areas are juxtaposed with larger roadless areas and wilderness. In addition, Fig. 3 indicates the level of fragmentation caused by road building in the region; thus, highlighting the significance of small roadless areas in the maintenance of regional connectivity. Setting the conservation minimum at 1,000 acres would therefore hold more of the pieces together, providing for regional connectivity. Moreover, we note that closing and decommissioning roads at strategic locations (e.g., next to roadless areas) can actually increase both the size and functionality of roadless areas.

<u>Specific Roadless Areas At Risk</u> - On February 12, 1999 the Forest Service published a final rule, referred to as the "interim rule," that temporarily suspended road construction and reconstruction in unroaded areas (64 FR 7290-7305). Option 9 forests were excluded from this ruling under the assumption that the existing forest plans addressed road building activities. However, we are aware of several roadless areas in this region that are at risk from development. Some examples include the following:

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1) Sturgis Timber Sale (Rogue River NF, Applegate RD) – about 250 acres were recently logged in the uninventoried roadless area next to the Kangaroo RA.
2) Beaver Newt (Rogue River NF, Applegate RD) – about 600 acres were recently logged in the Pierce Gulch uninventoried roadless area.
3) Silver Fork (Rogue River NF, Applegate RD) – about 200 acres were recently logged in this 2,000 acre uninventoried roadless area.
4) Cougar Ridge (Rogue River NF, Applegate RD) – logging is proposed in the "Cougar Ridge" uninventoried roadless area. Total acres (no EA yet) unknown.
5) Wagner Gap (Rogue River NF, Ashland RD) – about 100 acres is proposed for logging within an uninventoried roadless area.
6) McDonald Peak inventoried RA - The Ski Ashland (Rogue River NF, Ashland RD) expansion (about 500 acres) is proposed.
7) Appleseed RA (BLM/Medford) - proposal to cut in the 5,800 acre uninventoried Long Gulch roadless area. About 1,000 acres (est) could be impacted. It will also cut in three other uninventoried roadless areas (total about 6,000 acres). About 2,000 acres would be impacted.
8) The BLM/Medford Glendale RA - proposal to cut in the 45,000 acre Zane Gray uninventoried roadless area.
9) Condrey Mt. RA, California - portions of 200 acres private inholding are to be helicopter logged next summer.
10) Orleans Mountain RA (an inventoried RARE II area) in the Six Rivers NF. The Six Rivers is in the initial planning stages of a salvage logging effort following the large fires in the area this summer.

In addition to the above at risk roadless areas within this region, a proposed ski development threatens late-seral reserves, key salmonid watersheds, and roadless areas in the southern Cascades ecoregion (Pelican Butte) just to the east of the Klamath-Siskiyou region. According to the Winema National Forest, the single largest roadless area on the Forest is Pelican Butte, with 9,863 inventoried roadless acres. Frank Erickson, spokesman for the Winema National Forest, indicates that "Pelican Butte roadless area extends approximately halfway down the westside of the butte, where development is proposed."

We request that EIS immediately address "at risk" roadless areas and suspend activities in these areas and that areas with proposed logging, road building, or ski development not be "grand fathered" in the Record of Decision. In addition, we request that the Forest Service use land exchanges for private inholdings located within roadless areas (e.g., Condrey Mt. RA) to ensure continuity of management.

Case Study: Appalachia/Blue Ridge Forests – the mixed-mesophytic forests of Appalachia are among the world's most biologically diverse temperate broadleaf forests (only the temperate flora of central China is slightly richer). The mesic forest types of this region have exceptional levels of species richness in several taxa, including salamanders, invertebrates (especially butterflies), trees, and neotropical migratory birds (Ricketts et al. 1999). However, only 1.3% of this region is protected in reserves (Appendix A, Table 5) and more than 80% of the habitat in this ecoregion has been fragmented by road building, logging, and other land disturbances (Ricketts et al. 1999; Appendix D, maps 1-9).

The series of map-based assessments provided in Appendix D summarize more detailed information provided in the attached CD ROM metadata files and information supplemented from the Southern Appalachia Assessment (Man And the Biosphere program). The purpose of this summary is to provide scoping comments for inclusion in the EIS to document the level of fragmentation caused by road building and other disturbances across the region and the importance of roadless areas as key to the region's ecological integrity. We request that the following summary figures (Appendix D, all maps) and supporting CD ROM be included in the EIS as documentation for the importance of roadless areas in this globally outstanding ecoregion:

- Map 1 - indicates the level of road building that has contributed to extensive habitat fragmentation throughout much of this region and the eastern United States.
- Map 2 - illustrates additional levels of fragmentation and habitat destruction from large urban areas – the combination of Maps 1 and 2 reveal, at a coarse scale, the level of fragmentation characteristic of most eastern US ecoregions.
- Map 3 - reflects Multi-Resolution Land Characterization (MRLC) data provided by the EPA for habitat fragmentation analyses used in subsequent maps. The different colors reflect different habitat types as indicated in the figure legend.
- Map 4 – provides a simplified version of the MRLC data set showing fragmented polygons and roads in pink.
- Map 5 - provides a blow up of the Appalachia/Blue Ridge ecoregion with two classes of MRLC (forest vs. no forest) and roads superimposed on the ecoregion boundary - a sample analysis area (landscape unit) within which various fragmentation indices were computed is provided for subsequent analyses.

- Map 6 - illustrates fragmentation statistics that were run on the sample landscape unit – similar statistics are provided for the entire ecoregion in the subsequent maps and soon for the entire continental US.
- Map 7 - is a composite map of the ecoregion illustrating landscape units ranked according to their relative degree of intactness (darker colors reflect more intact landscape units).
- Map 8 - provides composite scores with protected areas (GAP 1 and 2) and multiple use management (GAP 3) overlays – this map illustrates the vulnerability of remaining intact areas (orange) to multiple use activities (cross hatching)
- Map 9 - provides a roadless area overlay documenting the overlap between intact areas of high conservation value and unprotected roadless areas – high conservation value areas contain concentrations of rare community types and pockets of late-successional/old growth habitat many of which are found in roadless landscapes in the region.

The above analysis demonstrates the importance of even small roadless areas in this region. In addition, closing and decommissioning roads in strategic locations (next to roadless areas) would increase the size and functionality of these smaller roadless areas thereby reducing fragmentation effects. Given the level of fragmentation in most eastern US ecoregions, including this globally outstanding one, and the lack of adequate protection (only 1.3% of the region protected), we request that the EIS identify the importance of protecting small roadless areas coupled with strategic road closures as a means for restoration of highly fragmented ecoregions as illustrated here.

Case Study: Tongass National Forest – the extensive coastline juxtaposed with numerous mountainous islands, streams, estuaries, and dense forests makes the Northern Pacific Coastal Forest ecoregion one of the most productive (in terms of marine and terrestrial biomass) in North America (Ricketts et al. 1999). Because this ecoregion contains nearly ¼ of the world's temperate rainforest (DellaSala et al. 1996), it was considered by WWF as "globally outstanding" (Ricketts et al. 1999). Many of the few remaining intact (unlogged) watersheds in North America and relatively abundant old-growth forests are present within the Tongass National Forest. Also of global importance is the capacity of these forests to store carbon and subsequent role they play in regional and global maintenance of climatic processes. High-volume, old growth and low-elevation forests are of greatest importance to wildlife as they contain high levels of species richness, provide important winter refugia for birds and mammals, and contain abundant anadromous fish runs (DellaSala et al. 1996, Ricketts et al. 1999). However, roughly 10% of the high-volume, old-growth forests remain on the Tongass and some ecological provinces (e.g., Prince of Wales Island) are highly fragmented by road building (DellaSala et al. 1994, 1996). Projected logging and road building levels are expected to result in population declines in management indicator species on the Tongass (Suring et al. 1993, Lande 1994, McCullough 1994, Pletscher 1994), including northern goshawk, Alexander Archipelago wolf, marten, northern flying squirrel, brown bear, and some neotropical migratory and resident birds (DellaSala et al. 1996).

Our comments below provide scientific justification for including roadless areas protection on the Tongass that would benefit management indicator species and other resource values. They are derived from published sources, a scientist letter sent to President Clinton this December from the National Audubon Society, and the Audubon Society's appeal of the Tongass Land Management Plan.

The brown bear panel of the interagency task force on population viability of management indicator species (Suring et al. 1993) recommended that the Forest Service retain unroaded watersheds in a roadless condition as refugia for bears. If road access is increased, the panel suggested that significant gaps in the distribution of brown bears may occur. The expert panel on wolves raised similar concerns about road management and increased mortality of wolves, and the fish experts expressed concerns about road construction and its effects on spawning and rearing habitat for anadromous salmon. Additionally, DellaSala et al. (1996) indicated that intact forests on the Tongass provide key nesting and wintering habitat for several bird species, including management indicator species. Relatively intact blocks of old-growth forests (even parcels as small as 100 acres) are important wintering habitat for birds (particularly during harsh winters) and provide relatively, snow-free conditions for Sitka black-tailed deer in comparison to young (20-30 years) forests (DellaSala et al. 1994, 1996). In particular, old-growth forests have multi-layered tree canopies more capable of intercepting snow than simplified canopies found in young forests. DellaSala et al. (1994, 1996) indicated that extensive fragmentation on Prince of Wales Island has substantially reduced patch size of old-growth forests creating viability concerns for management indicator species.

On the Tongass, there are roughly two million acres of roadless areas left open to development, including 450,000 acres of roadless old growth. These roadless reserves are especially critical because only 4% of the Tongass land-base encompasses the low elevation, large old growth areas that are most important to fish and wildlife and much of this has already been logged. Further, the ecological risks associated with developing roadless areas are high, and may jeopardize fishing, hunting, tourism, recreation and subsistence use in Southeast Alaska. Protecting roadless areas on the Tongass, however, would not eliminate commercial forestry. According to Audubon Society estimates, there are already at least 4,650 miles of permanent roads within the Tongass and over ten billion board feet of timber is available to support logging from the existing road network. The EIS should therefore recognize opportunities for transitioning the timber industry away from industrial scale logging and ecosystem degradation to ecological sustainability as derived from a combination of roadless area protection and logging outside roadless areas and other protected areas designations on the Tongass.

We request that the preferred alternative address the importance of roadless areas to the maintenance of viable populations on the Tongass and include the Tongass National Forest under the proposed roadless protection. Protecting even small roadless areas (1,000 acres) would increase habitat capability values for management indicator species and provide crucial wintering and breeding bird habitat on the Tongass in a way that would make TLMP scientifically defendable.

Contribution of Roadless Areas to Restoration and Ecosystem Management on Federal Lands

Forest restoration can be defined as the deliberate alteration of ecological patterns and processes for the purpose of recreating some presumed set of natural, pre-disturbance ecosystem conditions (Brown and Lugo 1994, Higgs 1997). Restored forests would be similar in structure, function, and composition to the historic forests of the region prior to disturbance by humans. In our view, this is the only true forest restoration, and what is most commonly practiced throughout the world (e.g., reforestation, plantation forestry, reclaimed forests) is actually less ecologically sound forms of restoration (i.e., do not contribute much to ecosystem integrity; Strittholt and DellaSala in review and available upon request).

Although the concept of "ecological integrity" is complex and somewhat difficult to define in terms of specifics, "ecological integrity" has gained wide acceptance among both the scientific and regulatory communities (Davis 1995). The most influential definition of integrity was proposed by Karr and Dudley (1981), and states that biological integrity describes the:

> "ability of an ecosystem to support and maintain a balanced, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitats within a region."

Integrity implies not only continuity of function and productivity but also "an unimpaired condition or the quality or state of being complete or undivided" and "correspondence with some original condition" or naturally evolved state (Karr 1992). From this vantage, the goal of forest restoration can be seen as the reestablishment of the integrity of forest ecosystems as determined through comparisons with reference conditions. Because roadless areas have high ecological integrity, they act as the ecological "blueprints" or reference conditions for ecosystem restoration and thus should be recognized as such in the EIS. In particular, since much of the landscapes of the Pacific Northwest, Rockies, and eastern United States have been highly fragmented by roads and other land disturbances, roadless areas provide numerous restoration opportunities in the context of ecosystem management. Even regions such as the northeastern United States, where forest cover is greater today than during the past century (Heniz Center 1999), have experienced a 99% decline in old-growth forests due to forest conversions (Noss et al. 1995). Older forests of the eastern United States, however, persist in many places as small pockets or inclusions within younger forests (Davis 1996), and, as in the case of Appalachia, in many remaining roadless areas (see Appendix D).

In addition to the restoration benefits of roadless areas, we request that the EIS consider road closures adjacent to roadless areas both as a means of increasing the size and functionality of small roadless areas and as a basis for ecosystem restoration.

Impacts of Roads on Biodiversity and Ecosystem Processes

General Impacts - roads are often the first major human disturbance into a forest, which is then followed by land clearing and other anthropogenic disturbances (see Appendix E for additional literature reviews). Roads may lead to development and more development may lead to more roads. Thus, most researchers agree that road densities are a good indicator (surrogate) of the effect of land-use intensity and the human ecological footprint across the landscape.

Roads may act directly or indirectly on wildlife population viability and/or ecosystem process as follows:

- dispersal bottlenecks for propagules of sensitive species, thereby fragmenting populations (Wilcove 1996, see Special Issue of Conservation Biology 1996 Vol. 10 No. 4)
- dispersal conduits for invasive species (e.g., roads and associated vehicular traffic are a major contributor to the spread of root rot fungus *Phytophoris lateralis* into Port Orford cedar forest—Hansen et al. 1994, in press)
- impediments to hydrological properties and processes, particularly changes in drainage patterns and stream morphology (e.g., higher peak flows of streams and rivers, more localized flooding events, floodplain alterations -- see Eaglin and Hubert 1993, Roth et al. 1996, Haskins and Mayhood 1997-- also on moist slopes inadequate culvert size, location, or number causes a higher and lower water table upslope and downslope, respectively (Stoeckeler 1965)
- degradation of fish habitat (well documented, see Henjum et al. 1994, Hitt and Frissell 1999, USDA For. Serv. 1999 -- also minimizing road impacts is a major component of salmonid recovery in the Northwest Forest Plan and INFISH)
- mass wasting events and slope instability (particularly road building on steep slopes)
- poaching, over-hunting, and trapping of wildlife
- collisions with wildlife - Lalo (1997) estimates more than 1 million vertebrates nation-wide are killed each day by collisions with vehicles -- roadkill is the leading cause of death of the endangered Florida panther and key deer; Harris and Gallagher (1989)
- alteration of fire patterns (e.g., increased risk of arson due to human access exacerbated by roads; DellaSala et al. 1995)
- soil and water pollution, air pollution, particularly a build up of nitrous oxides in soils and streams that has been associated with the spread of exotics (Schowalter 1988, Tyser and Worley 1992)
- erosion, sedimentation of streams, edge effects, over collecting of rare plants and animals (e.g., cacti and reptiles), and the elimination of snags for firewood or road safety (Noss and Cooperrider 1994).

In forested ecosystems, roads result in cumulative impacts, which when combined with other anthropogenic disturbances, reduce habitat suitability for many species

(Bennett 1991, Noss and Cooperrider 1994). This is well documented across a range of taxa from small mammals (see additional citations in Appendix E) and carabid beetles (Niemela et al. 1993) to ungulates (moose: Timmermann and Gallath 1982; white-tailed deer: Sage et al. 1983; Rocky Mountain elk: Rost and Bailey 1979, Lyon 1983), large carnivores (Weaver et al. 1986a,b; 1996; Paquet et al. 1996; see *Conservation Biology* Vol 10 No. 4, 1996), forest interior species (Reijnen 1995), and reptiles (Rosen and Lowe 1994).

Roads and Habitat Fragmentation - Wilcove (1998) suggested that **"roads are the single greatest impact to the movement of sensitive species**" and Forman and Hesperger (1996) concluded that **"roads cause more effects and have a greater cumulative effect than vehicles."** While collectively only two percent of the conterminous United States is covered by roads, the ecological effect is much larger than the area cleared for roads (Forman and Hesperger 1996). The bottleneck effect of roads on wildlife has been documented by many researchers and includes the following examples:

- In southeastern Ontario and Quebec, several species of small mammals rarely ventured onto road surfaces when the road clearance exceeded 66 feet (Oxley et al. 1974).

- In Oregon, dusky-footed woodrats and red-backed voles were found at all distances from an interstate highway but never in the highway right-of-way (Adams and Geis 1983).

- In the Mojave Desert, only 1 of 612 white-tailed antelope squirrels was recorded as having crossed an unpaved road (Garland and Bradley 1984).

- In Kansas, very few prairie voles and cotton rats ever crossed a dirt track 10 feet wide (Swihart and Slade 1984).

- Road densities of one mile per square mile has been documented as decreasing habitat effectiveness for elk by 50% compared to roadless watersheds - as road density increased to 6 miles per square mile, elk habitat use fell to zero (Lyon 1983, Wisdom et al. 1986).

- In Arizona and Utah, cougars were concentrated mostly in areas of low road density - road avoidance was documented for paved and improved dirt roads (VanDyke et al. 1986 - also other studies show cougar density is lowest when road densities exceed 0.4 mi/mi^2).

- In the southern Appalachians, black bear cannot maintain viable populations when road density exceeds 0.8 mi/mi^2 due to poaching pressure (Brody 1984 -- also even tiny "first order" roads that permit hunters to easily reach remote areas have demonstrable impacts on black bear harvest -- see Brocke et al. 1990).

- In the mainly forested counties of the Adirondacks, there are many times more bears in low than high road-density areas (Brody and Pelton 1989).

- In northwest Montana, grizzly bears avoided habitat within 3,000 feet of open roads (Kasworm and Manley 1987).

- In southeast BC, grizzly bears used the area within 328 feet of roads less than expected and avoidance of roads was independent of traffic volume - suggests that even a few vehicles can displace bears (McLellan and Shackleton 1988).

- In Yellowstone Park, grizzly bears avoided habitat within 1,640 feet of roads during spring and summer and 1.9 mi of roads in fall (Mattson et al. 1987).

- Using radio collared wolves in the Bow Valley, Alberta, Paquet et al. (1996) documented that roads forced wolves into lower quality foraging habitats where snow depths were high and foraging success low and into valley bottomlands that acted as ecological "sinks" where mortality from humans was considerable.

- In Wisconsin, Michigan, Ontario, and Minnesota, studies have shown a strong relationship between road density and presence or absence of wolves. Wolves generally are not present where the density of roads exceeds 0.9 mi/mi^2 (Thiel 1985, Mech et al. 1988). Mech et al. (1988) report wolves using an area with road density above this theoretical threshold but it was adjacent to a large roadless area.

- In the Rocky Mountains of southeastern Wyoming, roads added to forest fragmentation more than clearcuts by dissecting large patches into smaller pieces and by converting forest interior habitat into edge habitat -- edge habitat created by roads was 1.5-2 times more than that created by clearcuts (Reed et al. 1996).

In summary, road density (e.g., mi/mi^2) is a useful index of road impacts because it integrates many ecological affects of roads and vehicles on flows and movements of wildlife across the landscape (as in the above examples and in the Appalachia/Blue Ridge case study). In addition, the ratio of road density to stream density is a useful indicator of the functionality of hydrological processes and particulate matter flows (Eaglin et al. 1993, Hitt and Frissell 1999). Because roads both remove habitat directly and dissect the remaining natural patches into residual small patches, they are a significant contributor to habitat fragmentation (Reed et al. 1996). Obviously, while roads per-se do not kill wildlife or start forest fires, they are associated (i.e., an indicator) with many types of human-caused changes in landscape dynamics and wildlife dispersal that can accumulate over a given area. Hence the importance of unroaded landscapes.

Scientific Support for Roadless Areas

Both President Clinton and Chief Dombeck have stressed the importance of developing forest policy based on sound science. The contribution of science in forest planning has been repeatedly recognized by numerous concerned scientists and professional societies particularly in light of the ecological benefits of roadless area. Appendix F is a letter endorsed by 136 scientists calling on the Forest Service to develop a nation-wide protection strategy on roadless areas, including the Tongass and those of 1,000 acres or greater. This supports a related one signed by 215 scientists in support of the Tongass National Forest recently submitted to the Forest Service by the National Audubon Society. Professional societies such as the Wildlife Society, American Ornithological Society, Society of Conservation Biologists, Natural Areas Association, and Ecological Society of America all have demonstrated support for roadless area protection. Probably no single conservation issue in the country today has galvanized as much scientific support as roadless area protection. Thus, we request that the preferred alternative amply reflect such scientific concerns.

Additional Concerns

Setting Conservation Thresholds (coarse vs. fine filter approaches) – the basic premise behind coarse-filter approaches is to protect representative samples of habitats or ecosystems (particularly in redundant sequence in order to avoid "museum type" conservation, see DellaSala et al. 1996) as a preventive strategy for biodiversity losses. Based on the above review and attached assessments, the supposition that roadless areas act a coarse filter for biodiversity is not only plausible but also scientifically defendable. In general, large roadless areas are more likely to capture a representative array of habitat types and elevation bands, particularly in highly complex regions (e.g., Klamath-Siskiyou) than small roadless areas. However, in many ecoregions (both eastern and western examples provided below) what remains of landscapes with ecological integrity is smaller than the RARE II threshold of 5,000 acres.

In eastern Washington and Oregon, from 70 to 95% of the late-successional and old-growth forest that remain cover less than 100 acres. Three national forests (Colville, Wallowa-Whitman, and Winema) have no late seral patches larger than 5,000 acres, and only one of the seven late-successional forests larger than 5,000 acres in three national forests (Malheur, Ochoco, and Umatilla) is protected (Henjum et al. 1994). For these reasons, the Eastside Scientific Society Panel (Henjum et al. 1994) recommended protecting all roadless areas of 1,000 acres or smaller areas of ecological significance as key to restoring ecological integrity (aquatic and terrestrial) and maintaining the remaining patches of late-seral/old-growth forests across the region. The examples we provide in case study ecoregions (Tongass, Klamath-Siskiyou, Appalachia) build on the ecological significance of small (<5,000 acres) roadless areas and provide a credible process for setting the conservation bar at 1,000 acres.

A more defendable threshold for protection therefore would be to use 1,000 acres as the initial starting point for conservation, back-filling with fine filter approaches aimed at smaller areas of ecological significance. Small roadless areas provide important habitat for wildlife and should be recognized for their unique ecological attributes in the EIS.

Ecological Attributes of Small Roadless Areas – the following attributes summarize some of the ecological attributes of small roadless areas:

- source areas for species distributed as metapopulations that are otherwise isolated from each other by the effects of habitat fragmentation
- refugia for endemic species and those species with restricted distributions or limited dispersal capabilities
- pockets of old-growth forests in areas where such habitats are rare
- areas of globally imperiled plant communities (as defined by state Heritage programs, see Appendix B for examples)
- propagules for taxa important in forest recovery such as various forbs, lichens, and mycorhizzal fungi typically present at reduced levels or not at all in intensively managed forests
- wintering habitat for resident birds (as in the Tongass example)
- microclimatic conditions for amphibians and mollusks (Klamath-Siskiyou example)
- dispersal "stepping stones" for migratory species
- thermal, hiding, and foraging cover for ungulates
- aquatic strongholds for fish (see Appendix C; Henjum et al. 1994, Hitt and Frissell 1999)
- broad suite of habitat types and elevation bands, including many ecologically important habitats (Appendix C)

In general, the above ecological benefits should be recognized as a more inclusive policy needed to ensure "adaptive" conservation is achieved through the use of coarse and fine filter approaches. This combination of small and large roadless areas would more closely achieve representation and viability goals for ecosystem management and is consistent with recommendations as proposed by the scientific community and the Eastside Scientific Society (Henjum et al. 1994). In contrast, setting the conservation threshold at 5,000 acres would increase ecological risks significantly by omitting many areas of high conservation value. Therefore, we request that the threshold be set at 1,000 acres nation-wide and that the Forest Service complete a nation-wide inventory of all uninventoried roadless areas to more specifically assess ecological importance. Two case studies (Klamath-Siskiyou and Appalachia/Blue Ridge) are provided as examples and additional work is proposed by the WWF and CBI throughout the west side of the Cascades in northern California, Oregon, and Washington that would be useful in documenting additional ecological attributes of small roadless areas in those regions. We request that the Forest Service recognize the importance of such efforts through collaborative partnerships with researchers and conservation groups in meeting inventory requirements for small roadless areas.

Roadless Areas and Fire Management/Access Issues – the testimony of Dr. Scott Schlarbaum at a November 3, 1999 hearing of the House Resources Committee on roadless areas perpetuated the false assumption that protecting roadless areas will increase pest and fire management problems due to lack of access to contain such problems. This view is based on the assumption that to ensure healthy forests every acre of a given landscape needs to be managed. Appendix G provides a review of the scientific basis for fire management in roadless areas, including criteria for prioritizing treatment of roadless areas within the context of maintaining ecological integrity and biodiversity attributes.

First, roads are a cumulative ignition source on the landscape and greater road access has been associated with increased risks from arson and accidental fires (DellaSala et al. 1995). Second, given the remoteness of most roadless areas and terrain and safety considerations fire control efforts are best carried out by helicopters and fixed wing aircraft than by vehicles. It should be noted that observations of fire behavior in several instances indicate that when fires reach plantations they often spread rapidly (i.e., "blow up") due to contact with fine fuels (slash). This phenomenon suggests that plantations may, in fact, be more vulnerable to fires than roadless areas and that most fire management methods should correspondingly be directed at managed landscapes (see DellaSala et al. 1995). In comparison, many roadless areas, because of access problems, have not been subjected to fire suppression and thus fuel loadings are typically within historic levels. Third, roads are a significant conduit for the transmission and spread of numerous invasive exotic species (see Appendix C, E) and actually contribute to forest health problems. Finally, given the preponderance of roads in most forested landscapes (more than 378,000 miles on federal lands alone) the cumulative forest health problems and fire risks of additional access will more than offset any benefits provided by access into roadless areas. Based on these concerns, we request that the EIS include discussion of the following issues related to fire management and roadless conservation:

- Road access needs to be discussed in the EIS not only in terms of the uncertainties of fire and pest control measures, but also how roads contribute to the spread of invasive exotics and elevated fire risks particularly within landscapes already sufficiently roaded.
- The efficacy of fire restoration treatments in roadless areas need to be evaluated with respect to how such treatments contribute to the maintenance or enhancement of ecological integrity and biodiversity attributes of roadless areas (see Appendix G for more detail).
- Many roadless areas require little if any treatment as compared to intensively managed landscapes with altered fire regimes.

With only 5% of our forested ecoregions in strict protection and another 5% in relaxed protection, the majority of landscapes are in some form of management status and intensively managed lands often amplify forest health problems (DellaSala et al. 1995). Many species and ecosystem process cannot tolerate multiple use management on every acre of the land, particularly for the unsubstantiated benefits of fire or exotic species controls (DellaSala et al. 1995, DellaSala and Olson 1996).

Creating an Appropriate Administrative Designation for Roadless Areas

We request that the Forest Service recognize the conservation values inherent to roadless areas by creating a new or modified designation consistent with their unique ecological status. The proposed National Forest System and Land and Resource Management Planning Rule (36 CFR Parts 217 and 219) recognizes land use designations that appear to be consistent with roadless area importance such as Reference Landscapes and Research Natural Areas. As an example, the Research Natural Areas (RNA) designation appears to be consistent with the maintenance of most of the ecological attributes of roadless areas as discussed in the comparisons below (with some modifications). In general, RNAs provide areas for research, observation, and study of undisturbed ecosystems (USDA For. Serv. 1990). According to Forest Service policy, "maintenance of natural processes within each area will be the prime consideration" for RNAs (USDA For. Serv. 1990). Roadless areas meet all of the criteria for RNAs as defined in Forest Service guidelines, including:

- landscapes that consist of naturally established patterns of vegetation
- baseline areas against which effects of human activities can be measured
- sites for study of natural processes in undisturbed ecosystems
- gene pool preserves for all types of organisms.

In addition, as specified in Forest Service guidelines, management activities in RNAs must be approved by the appropriate Director of the Forest and Range Experiment Stations. However, when conflict exists between RNAs and other resources, "the conflict will be resolved in favor of Research Natural Areas, subject to rights under law, regulation, and policy" (USDA For. Serv. 1990).

Relevant RNA guidelines and Roadless Area Conservation (example comparison)

RNA Activity	Relation to Roadless Areas Values
Recreation	
Off-road vehicle prohibited	Compatible
Range	
Grazing may be allowed when the Director of the Forest and Range Exp. Sta. authorizes such a management practice as essential to specific vegetation types	Incompatible
Timber	
Timber harvesting not allowed	Compatible
Minerals	
Recommend withdrawal of the area	Compatible

from mineral entry	
Provide for exploration, development and production of energy resources subject to applicable regulation.	Incompatible
Lands	
Utility corridors not compatible	Compatible
Facilities	
No roads, trails, or other facilities except those considered as essential by the Dir. of the Forest and Range Exp. Sta.	Compatible
Protection	
Suppress pest outbreaks if needed to meet RNA objectives (biological methods preferred)	Only under limited conditions using native species control agents; otherwise pest outbreaks should be considered as part of the natural cycles inherent to functional forest ecosystems (see DellaSala et al. 1995 for discussion)
Prohibit prescribed fire unless approved by the Forest and Range Exp. Sta.	Prescribed fire should be considered where ecologically appropriate as part of fire maintenance and restoration along with let burn and limited suppression policies (e.g., low level of prevention activities and primarily when human safety is a concern)
Conduct prescribed burning so that it will conform to applicable provisions of the Federal Clean Air Act and local state laws	Compatible

Based on the above review of RNA guidelines on one national forest (Rogue River, Oregon) we suggest that the EIS evaluate the importance of a modified RNA designation for roadless areas that more strictly limits activities considered incompatible with the ecological characteristics and maintenance of ecosystem processes unique to roadless areas. While RNAs permit certain activities, those activities are at the discretion of Directors of Forest and Range Experimental Stations. Because grazing and energy development represent conflicts with roadless area values, they should be prohibited in roadless RNAs as a conflict to the maintenance of ecological integrity. We therefore request that applying this designation to roadless areas also requires that the EIS include specific guidance to the Directors of Forest and Range Experimental Stations regarding activities that are incompatible with roadless attributes and not permitted inside roadless areas (e.g., all commercial activities, grazing, mining, logging, recreational vehicles). An alternative might be to create a new designation that is managed specifically to protect or maintain ecological attributes and processes within roadless areas. As an example, BLM policy directs the agency to designate Areas of Critical Environmental Concern (ACEC) or Ecological Emphasis Areas (see the Northwest Forest Plan for examples) such that management is consistent with the ecological importance of those areas. Forest Service policy for roadless areas should include appropriate ecological criteria for gauging what activities are permissible (as illustrated in the comparison above) and as guidance to regional managers and directors of Forest and Range Experimental Stations. This would more effectively ensure vertical integration of policy decisions regarding roadless areas and that implementation on-the-ground is compatible with public and scientific interest in roadless area conservation. In no cases, should roadless area be managed in a way that is equivalent to GAP 3 designation (multiple use). Strict level of protection (GAP 1) should be the predominate guideline in any new or modified designation. Finally, we request that our recommendations for a new or modified roadless area designation (e.g., RNAs) be tiered to the proposed National Forest System Land and Resource Management Planning (36 CFR Parts 217 and 219) such that the proposed rule is consistent with the comments submitted here regarding this designation. Under separate mailing, we have submitted comments with respect to this proposed ruling.

Conclusions

Our comments are based on more than three years of assessments conducted by WWF and CBI on protected areas and the ecological benefits of roadless areas obtained from numerous published and unpublished sources (our raw data). Appendices A-G and the enclosed CD ROM metadata files provide scientific documentation of the many ecological benefits of roadless areas. While we support the administration’s effort in developing a policy for roadless areas that is grounded in science, we believe that for the policy to be ecologically meaningful and scientifically credible the preferred alternative must meet the following conditions:

- Protect all inventoried roadless areas, including those on the Tongass and those identified in the Appalachian Assessment
- Permanently prohibit logging, mining, livestock grazing, road building, motorized access and other commercial activities within roadless areas
- Inventory all uninventoried roadless areas of 1,000 acres and immediately protect them
- Cease all commercial activities in roadless areas at imminent risk of development (do not grand father developments currently proposed in roadless areas)
- Do not defer protection of roadless areas to the forest planning process

- Include road closures and decommissioning of roads to increase the size and functionality of small roadless areas

The preferred alternative should set the protection threshold at a minimum of 1,000 acres and identify smaller areas of ecological significance for later inclusion. We request that the EIS adopt an "adaptive" conservation approach that makes use of coarse (roadless area protection in GAP 1 status) and finer filters (e.g., species recovery plans, survey and manage protocols) to achieve a representative network of reserves on public lands (particularly in globally outstanding ecoregions) and that such an approach be formally recognized in the proposed planning regulations also under consideration by the Forest Service (36 CFR Parts 217 and 219). This approach would more effectively ensure an ecologically representative system of reserves is present on national forest lands and more effective protection is in place for threatened species, endemic hot spots, and imperiled plant communities as well species sensitive to habitat fragmentation. Doing so would lower ecological risks and begin the process of ecosystem recovery urgently needed across most forested landscapes. Nation-wide protection for roadless areas of 1,000 acres or larger would ensure that national forest lands are managed in a way that meets scientific standards and ecological sustainability.

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