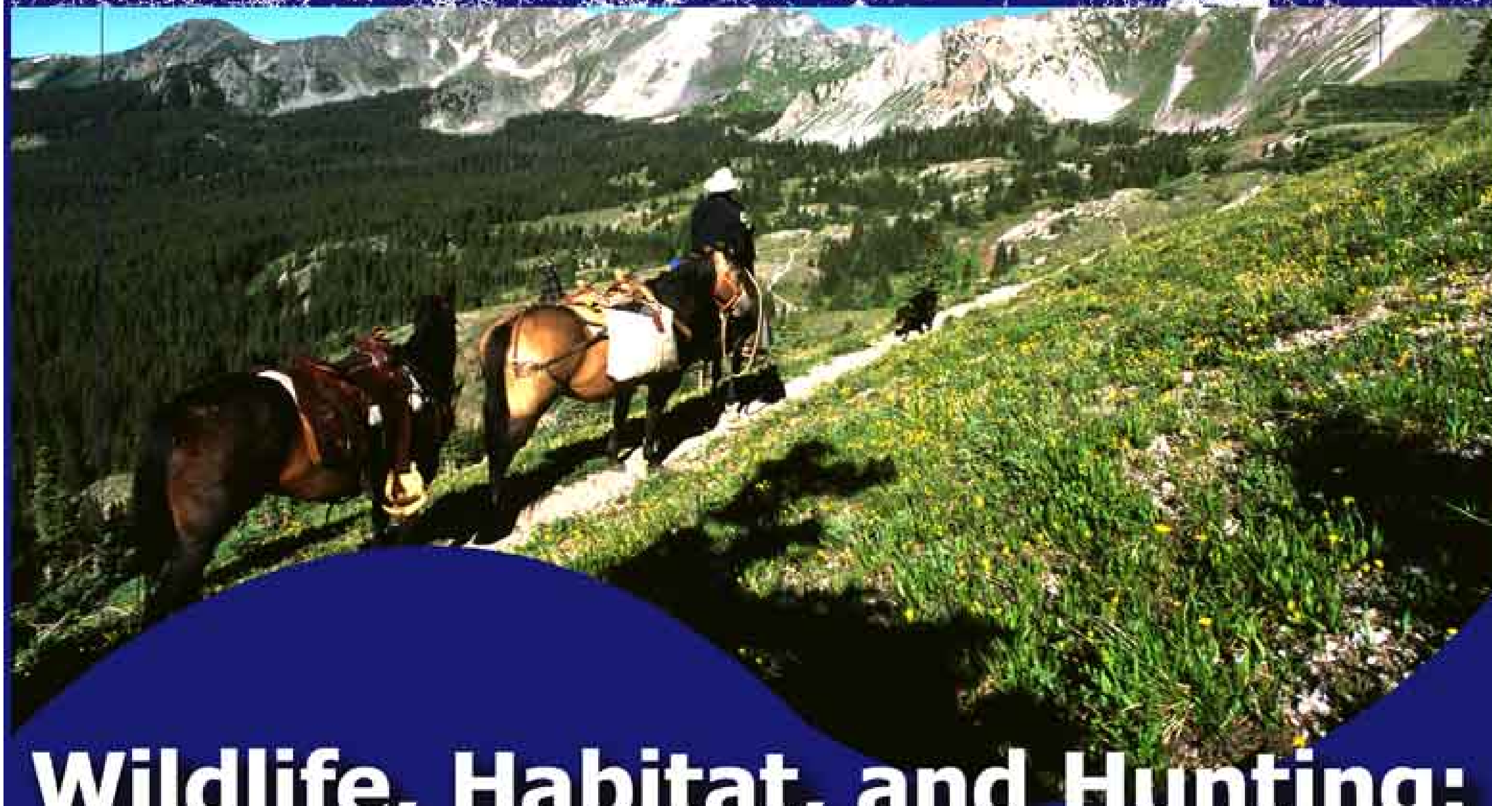

Wildlife, Habitat, and Hunting: New Mexico's Roadless Areas

Wildlife, Habitat and Hunting:
New Mexico's Roadless Areas

New Mexico Department of Game and Fish
Santa Fe, NM May, 2006

Mark L. Watson, Compiler - W. Mark Gruber, Ed.

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Executive Summary

New Mexico Roadless Areas

New Mexico contains approximately 1.6 million acres of Inventoried Roadless Areas (IRAs) in 6 national forests. Within these IRAs, 351,000 acres are not currently protected from additional road building by existing forest plans.

IRAs are portions of the National Forest System (NFS) generally over 5,000 acres in size that were inventoried for possible inclusion in the National Wilderness System. When inventoried, these IRAs did not contain roads recognized as official by the U.S. Forest Service. Of the initial 58.5 million acres of IRAs in the U.S., an estimated 2.8 million acres have been roaded since they were inventoried.

Roads, road-building, and the associated traffic they encourage, create a cascade of adverse effects to the forest ecosystem. These include stream sedimentation, reduced water quality, introduction of undesirable non-native plants and animals, habitat fragmentation that adversely affects fish and wildlife populations, and increased unintentional man-caused wildfires.

Of the 24,800 miles of National Forest System roads in New Mexico, only 4,240 miles, or 17%, receive annual maintenance. The annual maintenance backlog for these 24,800 miles is $37.7 million.

Inventoried Roadless Areas:

- Occur within 661 of the more than 2,000 major watersheds in the nation, providing clean, fresh water to thousands of communities and millions of people.
- Provide unique, high quality hunting and fishing opportunities. This is because they serve as core habitat areas for game animals and cold-water fish species. They are relatively undisturbed and remote due to the absence of roads.
- Contain essential habitat for more than 2,150 species of threatened, endangered, proposed, and sensitive plant and animal species.
- Furnish unique opportunities for human solitude and reflection.
- Are natural laboratories for the study of ecological processes and ecosystem services. They provide a measure of baseline ecological conditions to measure the effects of human impacts.
- Serve as a standard or model of functional ecosystem equilibrium for reclamation and restoration of disturbed habitats.

The National Forest System and Roads

First created by President Theodore Roosevelt in 1907, the National Forest System (NFS) provides 193 million acres of public lands scattered across the nation in 155 national forests. These public lands are managed by the U.S. Forest Service (USFS) for multiple uses, including timber, livestock grazing, mineral extraction, wildlife habitat, hunting, fishing, and other forms of recreation.

One of the longest-standing debates involving the management of these lands is the issue of roads. How many are necessary for the public to access its property? What impacts do these roads have on the forests, the wildlife, the watershed?

Since the early decades of the last century, when building roads was a primary concern of some fledgling land management agencies, voices called for areas where roads were excluded. They wanted places where "ancient skills" like horse packing could be kept alive, and wildlife could exist in a somewhat natural state.

Those voices cried for wilderness in the early years and today they call for the preservation of "roadless areas." Roadless areas are the buffer between wilderness and traffic, dripping oil pans and watershed, wildlife and roadkill.

The NFS road network contains 386,000 miles of roads, enough to circle the globe at the equator more than 15 times. The USFS currently has an $8.4 billion road maintenance backlog, and estimates that only 40% of their inventoried roads are fully maintained to the safety and environmental standards for which they were designed.

History and Status of Inventoried Roadless Areas

Background

Roads are a necessary component of human civilization. They provide access for people to conduct business, transport goods, visit friends and family, extract natural resources, and to visit parks, natural areas and other public lands for recreation, scientific study, and spiritual purposes. However, roads have well-documented short- and long-term adverse effects on the environment. Building new roads within public lands has become highly controversial because of the value society now places on roadless areas and because of wildland conflicts with resource extraction (Gucinski *et al*. 2001).

The United States contains approximately 3.9 million miles of public roads that cover 0.45% of the total land base. Of these, about 2.3 million miles are paved. The average density of public roads is about 1.2 miles of road per square mile of land base. Seventy-one million acres of public road surface now occupy what was once open space and wildlife habitat (Forman *et al*. 2003).

> One-fifth of the total U.S. land base is directly affected environmentally by public roads.

As the nation's farmlands, open space and wildlands are increasingly lost to development, remaining undeveloped areas become more valuable and important to protect. Between 1992 and 1997, nearly 16 million acres of non-federal forest, cropland, and open space were converted to urban and other uses. This rate of loss of open space equals 2.2 million acres per year, or 252 acres per hour. In that 5-year span, there was twice as much development in the U.S. than there was in the preceding 10 years (Natural Resources Conservation Service, NRI Inventory, 1982-1997).

Recent scientific evidence suggests that permanent and temporary road construction and reconstruction on federal public lands, particularly in unroaded areas, has caused substantial ecological effects including stream sedimentation, introduction of non-native invasive plants, fragmentation of wildlife habitat, landslides, reduced water quality, and barriers to fish. These effects from roads may persist for decades and cause lasting degradation to sensitive ecosystems (USFS 1999).

Americans own 230 million motor vehicles and use those vehicles for 89% of all daily travel. Americans increasingly own more vehicles per household. Travel by cars continues to grow faster than the population or the economy of the U.S., with more cars, more drivers, and more miles driven per person per year (Forman *et al*. 2003).

Roads facilitate the movement of vehicles, which in turn, change environmental conditions locally and at a landscape scale, directly or indirectly influencing wildlife behavior, water quality, clean air, and other ecosystem services and human quality of life attributes. Effects from vehicles such as chemical contamination and increased noise levels can extend outward from roads for over 100 yards in either direction (Forman *et al*. 2003).

> Americans own 230 million motor vehicles. Motorized travel continues to grow faster than the population or the economy of the U.S.

History and Status of Inventoried Roadless Areas

As of 2003, there were approximately 7 million motorcycles in the U.S. At that time, the motorcycle industry estimated that about 2,319,500 motorcycles, one-third of the U.S. total, were used off road. In 1989, the U.S. Consumer Product Safety Commission estimated that 3.9 million all-terrain vehicles (ATVs), which are designed for off-road use, were owned in the U.S. (Forman *et al*. 2003). Ownership of ATVs has greatly increased since then.

As these trends of more vehicles and more travel in the U.S. continue, land managers are increasingly challenged to control off-road uses on public lands (Forman *et al*. 2003). Some federal land managers state that this is the greatest challenge that they face in their careers (Havlick 2002).

Improper use of off-road vehicles threatens sensitive habitats and ecological processes.

Additional road building within unroaded areas of National Forest System (NFS) lands has become a major issue in New Mexico and other states within the U.S., which are faced with the daunting task of slowing or stopping the decline of native wildlife species and their associated habitats. A growing body of scientific evidence indicates that the current system of publicly owned and federally protected natural areas within the U.S. are too small and isolated from one another to conserve all native wildlife species and their habitats.

Inventoried Roadless Areas (IRAs) managed by the U.S. Forest Service (USFS) currently play a critical role in protecting native wildlife and their habitats. Because IRAs are essentially the last tracts of federal public lands that have not been significantly altered by human impacts such as road networks and traffic, they act as connecting biological corridors between protected areas such as national parks and designated Wilderness Areas, increasing the size and connectivity of protected lands, which increases the ability of these areas to maintain native biological diversity (Noss and Cooperider 1994).

Habitat connectivity is a critical component of wildlife habitats, which allows wide-ranging species such as bears, elk, and deer to migrate and disperse to suitable habitats. However, IRAs of our NFS can only continue to function in this role if they are protected from road development and other alterations caused by human activities (Noss and Cooperider 1994).

History of National Forest System Road Network

There are 193 million acres of public NFS lands managed by the USFS. The NFS is unique in that it is the largest system of federally managed public lands in the world. NFS lands are managed by law for multiple use and sustained yield of renewable and non-renewable resources to meet present and future needs of American citizens. These multiple uses are to be considered equally, and include recreation and fish and wildlife habitat conservation.

The current national forest road system includes 386,000 miles of roads, enough to circle the globe more than 15 times.

Within the 193 million acres of public NSF lands, the USFS currently maintains and administers

History and Status of Inventoried Roadless Areas

approximately 386,000 miles of roads, 10% of the length of the entire public road system in the U.S. National Forest System roads in New Mexico total about 24,800 miles, or 5.6% of all NFS roads in the U.S. These estimates of NFS road lengths does not include the estimated 60,000 miles of illegal and/or unofficial "ghost roads" created by off-road vehicles (ORVs) (Coghlan and Sowa 1998 in Forman *et al*. 2003). These roads are not maintained as part of the USFS road system and have escaped government inventory (Bissonette and Storch 2002 in Forman *et al*. 2003).

Seven million acres of National Forest System lands are under roads.

The NFS road network has grown and changed over time in response to shifts in management objectives, policy, and technology. By the end of World War II, most of the approximately 100,000 miles of existing NFS road network had been constructed primarily for fire and resource conservation and restoration activities. After 1946, and until the mid to late 1980s, the majority of the current 386,000 miles of NFS roads were constructed primarily for logging. During the earlier road building period, the need for protection standards for stream and riparian ecosystems was not recognized, so logging roads were generally constructed in valley floors where streams and riparian areas occur, and mid-slope on mountains. Both of these locations potentially maximize negative environmental impacts. As logging activities expanded up major watersheds, major roads built in the 1950s and 1960s required secondary and tertiary feeder roads to remove the timber. The average size of timber cutting units drove the development of the road network, resulting in NFS road densities of about 2 to 4 miles of road per square mile of land in federal and private forest lands studied in the Pacific Northwest (Forman *et al*. 2003). By the end of the 1970s, due to increasing environmental awareness, new roads within national forests were constructed primarily on ridges to minimize environmental impact. However, this enhanced awareness occurred relatively late in the development of the NFS road network, so much of the more environmentally high-impact portions of the old road networks remain (Forman *et al*. 2003).

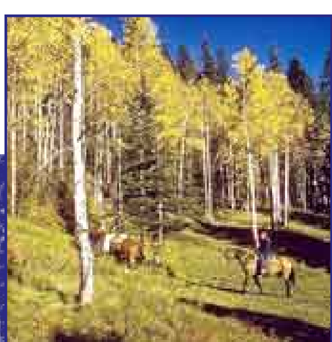
Creation and History of Inventoried Roadless Areas

NFS lands have a long history of contention regarding how these lands should be managed. Debates over designating worthy wildlands as "wilderness" can be traced back to the philosophies of the early romantics such as Henry David Thoreau. One of the earliest wilderness battle was fought between the preservationist John Muir and Gifford Pinchot, first chief of the U.S. Forest Service, over the fate of Hetch Hetchy Canyon in California's Sierra Nevada Mountains. More recent wilderness supporters included the scientist Aldo Leopold, who strongly advocated for what ultimately became the 1964 Wilderness Act.

"I am glad I shall never be young without wild country to be young in. Of what avail are forty freedoms without a blank spot on the map?"
Aldo Leopold

The 1964 Wilderness Act allowed Congress to immediately designate some Wilderness areas and increased wilderness planning by the USFS. In 1972 the USFS initiated a review of NFS roadless areas larger than 5,000 acres to determine their suitability for inclusion in the National Wilderness Preservation System. This review was known as the Roadless Area Review and Evaluation (RARE).

The second and final review process conducted in 1979, known as Roadless Area Review and Evaluation II (RARE II) resulted in a nationwide



History and Status of Inventoried Roadless Areas

inventory of roadless areas within the NFS, which then officially became IRAs (Wilkinson and Anderson 1987). Over the next several decades, using the 1979 RARE II inventory and other inventories conducted through the USFS land management planning process, the USFS identified 58.5 million acres of IRAs in the U.S. At that time, based on individual forest plans, road building was not allowed in 20.5 million acres of IRAs, but was allowed in the remaining IRA acreage.

Since RARE II, Congress has designated some IRAs as Wilderness. Although the majority of the remaining IRAs are greater than 5,000 acres in size, 20% are smaller. These smaller areas are generally the remaining portions of larger RARE II areas that were not designated as Wilderness, or parcels identified under a different set of criteria mandated by the Eastern Wilderness Act of 1975 (USFS 2000a).

Although Inventoried Roadless Areas comprise only 2% of the total U.S. land base, they are found within 661 of the more than 2,000 major watersheds. They provide clean, fresh water to millions of people, and provide important habitat for more than 2150 threatened, endangered, and sensitive species.

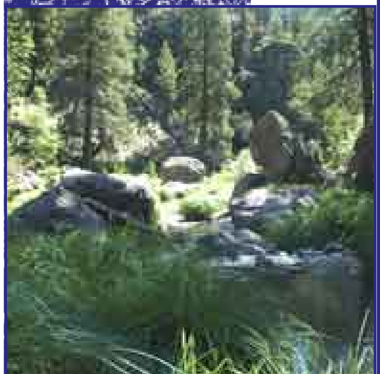
The USFS has attempted to address the management of roadless areas for over 30 years. In January 1998, the Forest Service initiated a process to consider changes in how the NFS road network is developed, used, maintained and funded and to temporarily suspend road construction in certain unroaded areas. At that time, New Mexico Department of Game and Fish submitted comments to the USFS (27 March 1998 NMDGF comments to Gerald Coghlan, Acting Director, USDA Forest Service) that stated: "Roads have had, and continue to have, a significant adverse impact on New Mexico wildlife. The Department has been expressing concern over excessive forest roads for many years. The Department strongly supports any Forest Service effort to reduce this serious problem by prohibiting new roads, and obliterating and making impassable excess existing roads."

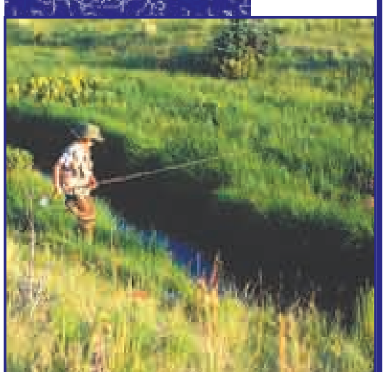
Road impacts include direct loss and degradation of habitat, disturbance, and increased illegal and legal take. More than 650 vertebrate taxa occur or used to occur on USFS lands in New Mexico. While all species may be impacted by direct loss of habitat to the roadbed, at least half also are indirectly impacted. One-fourth of the vertebrates on USFS lands in New Mexico are already federal- and/or state-listed threatened, endangered, proposed, candidate, sensitive or species-of-concern.

This initial process led to an "interim rule" in March of 1999 (USFS 1999) that temporarily suspended road construction and reconstruction in unroaded areas while a USFS proposal to develop a long-term road management policy was being developed. The USFS received more than 80,000 public comments on this initiative, the majority of which called for a permanent halt to road building in roadless areas.

This process led to the development of the June 2000 Forest Service Roadless Area Conservation Draft Environmental Impact Statement (Roadless DEIS), which proposed to protect IRAs from additional road building (USFS 2000a). The New Mexico Department of Game and Fish submitted comments identifying the importance of IRAs to terrestrial and aquatic wildlife populations, water quality, soil retention, quality hunting and fishing opportunities, and other ecosystem services, supported by over 150 scientific literature citations (14 July 2000 NMDGF comments to USDA Forest Service on Roadless Area Conservation Draft Environmental Impact Statement, NMDGF Doc. No. 7094).

History and Status of Inventoried Roadless Areas





The outcome of this process was the initial Roadless Rule, which was drafted after more than 3 years of planning under the National Environmental Policy Act (NEPA), which included 600 meetings around the U.S. and more than 2.3 million citizen comments.

> More than 90% of public comments supported implementation of the Roadless Rule of 2000.

According to the Roadless DEIS (USFS 2000a), of the initial 58.5 million acres of IRAs, an estimated 2.8 million acres had been roaded since they were inventoried during RARE I or II. The Roadless DEIS estimated that without instituting road building prohibitions in remaining IRAs, approximately 1,444 miles of new roads would be constructed in IRAs over the next 5 years. It also stated that without protecting IRAs from additional road building, construction in IRAs would continue at a rate similar to that experienced over the past 20 years, which would be expected to open up about 5% to 10% of current IRAs, or 3 to 6 million acres, to new roads within the next 20 years.

> Roadless areas represent less than 2% of the American land mass...they serve as a reservoir of rare and vanishing species.

At the time of the writing of the Roadless DEIS in 2000 (USFS 2000a), there were 2,832 IRAs in the U.S. comprising 28% of all NFS lands, and representing approximately 2% of the total land base of the United States. Although current existing IRAs still comprise only 2%, they are found within 661 of the more than 2,000 major watersheds in the nation (U.S. EPA 1997 and Sedell *et al*. 2000 in USFS 2000b). These IRAs provide clean, fresh water to millions of people. They also provide important habitat for more than 220 threatened, endangered and proposed species for federal listing under the Endangered Species Act, and 1,930 sensitive species (USFS 2000b).

The controversy over the fate of remaining IRAs continues today with the current administration's passage of the 2005 Rule (U.S. Fed. Reg. 2005), which requires states to submit individual petitions to the U.S. Department of Agriculture (USDA) to either protect IRAs from additional road building or to open them up to road building and resource extraction. Currently, national forest plans allow road building in 34 million acres of IRAs, or about 59% of the 58.5 million IRA acres. Therefore, most IRA acreage will likely be opened to new road construction for logging, energy development, and other commodity uses unless individual states petition to protect these areas and those recommendations are accepted by the USDA and codified in new federal rules.

Status and Distribution of IRAs in New Mexico

New Mexico currently has approximately 1.6 million acres of IRAs in 6 National Forests. Of these 1.6 million acres, 351,000 acres were not protected, and slightly more than 1 million acres were protected from additional road building by existing USFS Forest Plans.

History and Status of Inventoried Roadless Areas

National Forest System roads in New Mexico total about 24,800 miles, or 5.6% of all NFS roads in the U.S. If linked together, these NFS roads would circle the globe at the equator.

The table below identifies IRA lands in New Mexico that are protected and unprotected from additional road building by current USFS Forest Plans. The Coronado National Forest is not included.

IRAs in New Mexico represents 16% of all USFS lands in New Mexico.

IRAs in New Mexico with prescriptions that currently allow road building that would be protected under the original 2000 USFS Roadless Conservation Proposal (USFS 2000a) represents 3.7% of all NFS lands in New Mexico. Current management of these IRAs in New Mexico and the rest of the U.S. is dictated by individual Forest Plan prescriptions. Forest Plans will continue to dictate management of IRAs until individual states petition the federal government for protecting or opening up IRAs to road building. The recommendations may be accepted and a final rule will be posted in the Federal Register.

Under the current Rule (U.S. Fed Reg. 2005), the federal government retains the final decision-making authority over the outcome of individual state petitions. If individual states chose not to petition, or a state petition is denied, then future management of these IRAs will be determined when individual Forest Plans are rewritten over the next ten years. In the meantime, those IRA lands not protected from road building are vulnerable to road entry.

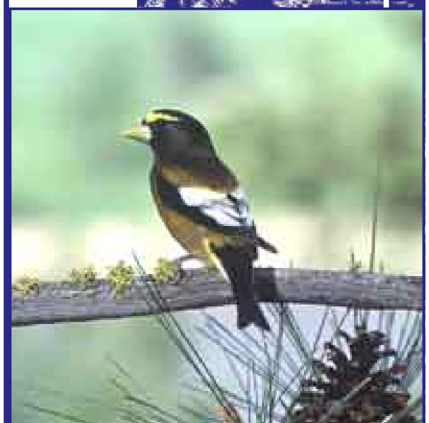
NFS Road Maintenance Backlog and Federal Budget Shortfalls

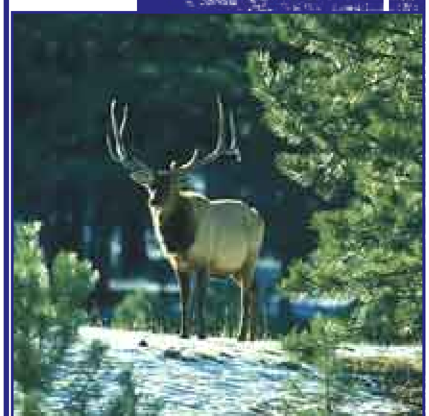
The USFS estimates that only 40% of their inventoried roads are fully maintained to the safety and environmental standards for which they were designed. Average costs to build new forest system roads range from $50,000 to $60,000 per mile, while average reconstruction costs range from $8,000 to $16,000 per mile. The USFS has an estimated $8.4 billion road maintenance and construction backlog nationally. Annual budget allocations have averaged less than 20% of the funds needed to do annual maintenance.

The USFS currently has a road construction and maintenance backlog of approximately $8.4 billion.

Each mile of road added to the road system competes for limited road

Forest	IRA Currently NOT Protected		IRA Currently Protected	
Carson	4,000	Acres	57,000	Acres
Cibola	86,000	Acres	161,000	Acres
Gila	49,000	Acres	635	Acres
Lincoln	158,000	Acres	0	Acres
Santa Fe	54,000	Acres	258,000	Acres





History and Status of Inventoried Roadless Areas

maintenance funding. On average, the need is approximately $1,500 per mile annually for maintenance. In fiscal year 2000, the USFS received less than 20% of the funding needed to maintain its existing NFS road network (USFS 2000b).

Each year's unmet maintenance needs increase the backlog as roads deteriorate and the cost of repairs continues to increase. The USFS (2000a) states that the lack of maintenance exacerbates the adverse effects of roads on the environment. This condition has led many people within and outside of the USFS to question the logic of building new roads when the agency is unable to manage and maintain the existing road system.

Roadless areas need to be viewed from a broader context. Between 1992 and 1997, nearly 16 million acres of forest, farms, and open space were converted to urban or other uses. In less than a decade, we have doubled the loss of undeveloped land.

In New Mexico, there is currently a $273 million maintenance backlog on NFS roads. Of the 24,800 miles of NFS roads in New Mexico, only 4,240 miles, or 17%, receive annual maintenance. The annual maintenance backlog for these 4,240 miles of roads is $37.7 million, with roads receiving only 15.2% of the maintenance budget needed to keep them safe and usable. An $8.4 billion maintenance backlog at the national scale makes it highly unlikely that the USFS will ever receive enough funding to maintain or improve the existing NFS roads in New Mexico to their intended standards.

Extent and Density of Roads in New Mexico's NFS Lands

Some of the most recent information obtained by the New Mexico Department of Game and Fish regarding roads on National Forests in New Mexico came from the late 1980s, from discussions with USFS personnel. At that time, the Lincoln National Forest identified 3,047 miles of existing roads, with 2,098 miles of roads open. The Gila National Forest identified 6,044 miles of existing roads, with 5,665 miles of roads open. The Cibola National Forest identified 4,995 miles of existing roads, with 253 miles closed. The Carson National Forest identified 3,587 miles of open road. The Santa Fe National Forest identified 3,750 miles of existing road (3 July, 1991, NMDGF memo). These numbers represented miles of classified, inventoried or authorized roads, and did not include illegal, unauthorized, or "ghost" roads.

Discussions with USFS personnel in 1991 suggested that as much as 25,000 miles of roads may have existed on all National Forest lands in New Mexico at that time. Regardless of road closure efforts, it is likely that at that time no net loss of roads occurred due to additional road construction or illegal road creation (1 July 1991 NMDGF memo). The Forest and Rangeland Renewable Resources Planning Act of 1974 requires that temporary roads be closed and re-vegetated after use. However, NFS roads are generally difficult to close and maintain as closed, especially when forests are managed as "Open unless signed closed", because signs are difficult to keep up due to vandalism and other causes (18 Feb., 1997, NMDGF memo).

In 1998 comments to the USFS on the proposed revision of the USFS Road Management policy, NMDGF identified adverse impacts to wildlife habitats from excessive road building for timber removal, including the actual loss of habitat from the road bed, which removes two acres of habitat per mile of 16-foot wide road. We also identified that some areas of the Carson National Forest had high road densities of as much as 22 miles of road per section, which equates to an actual habitat loss of 44 acres per section (27 March 1998 NMDGF

Ecological and Recreational Values of Roadless Areas

comments to Gerald Coghlan, Acting Director, USDA Forest Service). As a comparison, New Mexico Department of Game and Fish's recommended road densities for deer and elk primary winter and summer range vary from 0.1 to 1.0 miles of road per section (October 2003, Wildlife Parameters for Timber Sales. New Mexico Department of Game and Fish Habitat Handbook).

Once NFS lands become excessively roaded, it is virtually impossible to effectively close these roads and maintain as closed to ORV traffic to the point that they eventually return to pre-road, baseline conditions. The New Mexico Department of Game and Fish has documented this inability to maintain effective road closures on the Santa Fe and Carson National Forests, and this situation applies to National Forests statewide. To effectively maintain road closures would require substantially more USFS road closure funding and law enforcement capability, when in fact, law enforcement funding and personnel on USFS districts have been declining.

From an ecological, recreational, and conservation perspective, the NFS road network is the most important subset of the entire U.S. public road system. From a public lands management perspective, road systems are the largest human investment in terms of building and maintenance costs, and the human engineered feature most damaging to the environment. The management of the NFS road network involves important trade-offs, with almost all roads presenting benefits, conflicts and risks, although these effects can differ greatly in degree (Gucinski *et al*. 2001). Roadless areas are an important alternative.

Roadless Areas Protect Water Quality

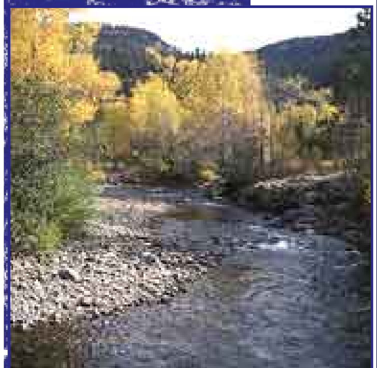
Excluding Alaska, about 14 percent of the total water runoff in the U.S. comes from NFS lands. NFS lands are the largest single source of water in the U.S., and provide high quality water. In the Rio Grande Valley of Colorado, New Mexico, and Arizona, 29% of runoff is provided by NFS lands. In USFS Southwestern Region, which is made up of New Mexico and Arizona, almost 7.5 million acre-feet of water are supplied by NFS lands, which has been valued at over $200 million (USFS 2000c).

A primary reason for establishment of National Forests and Grasslands was to "secure favorable conditions of water flows" (Organic Administration Act 1897). Wilderness areas and IRAs often protect watersheds that are water sources for human populations and important aquatic habitat for wildlife. Although IRAs comprise only 2% of the total U.S. land base, they are found within 661 of the more than 2,000 major watersheds in the nation (U.S. EPA 1997 and Sedell *et al*. 2000 in USFS 2000b).

In New Mexico, IRAs are components of the headwaters for most of the state's major rivers, including the Pecos, Gila, Canadian and Chama Rivers, and IRAs in Colorado are in headwaters of the Rio Grande River, which flows through the entire length of New Mexico. Of the major rivers in New Mexico, only the San Juan River in the far northwestern corner of the state does not gain some of its runoff from an IRA in New Mexico, but like the Rio Grande River, gains much of its runoff from IRAs in Colorado.

Many communities across the U.S. and New Mexico depend on the clean water that originates in or flows through IRAs and into facilities that treat and distribute water for consumption and other uses (USEPA 1997, Sedell *et al*. 2000 in USFS 2000b). Cities or towns in New Mexico that rely on water for consumption from roadless areas include Albuquerque, Santa Fe and Taos.

Ecological and Recreational Values of Roadless Areas



A 2000 New Mexico Water Quality Control Commission report to Congress states "Almost 1,204 miles of New Mexico's waters have been assessed and determined to fully support all designated uses. The majority of these waters are in wilderness areas or in watersheds protected from anthropogenic impacts (NMWQCC 2000)".

The most common direct and indirect physical effects of permanent and temporary road construction on watershed water, soil and air resources are loss of ground cover vegetation, soil compaction, reduced transpiration, loss of productive soils, increased water runoff, soil erosion, and dust levels. Proper design, construction and maintenance of forest roads can minimize these effects, but not eliminate them (1999 Interim Rule EA).

Roads can cause measurable reductions in water quality and have long been recognized as the primary human-caused source of soil and water disturbances in forested environments (Patric 1976 and Egan *et al*. 1996 in Gucinski *et al*. 2001). Roads contribute more sediment to streams than any other land management activity (Gibbons and Salo 1973, Meehan 1991 in Gucinski *et al*. 2001).

Roads also can affect water quality through applied road chemicals and toxic spills (Furniss *et al*. 1991 and Rhodes *et al*. 1994 in Gucinski *et al*. 2001), and the likelihood of toxic spills reaching streams has increased with the many roads paralleling them (Gucinski *et al*. 2001). Recently in the Jemez Mountains of the Santa Fe National Forest, chemicals used presumably to manufacture methamphetamine were dumped from a road into the Rio de las Vacas, killing fish, aquatic insects and plants for 7 miles downstream (Albuquerque Journal Santa Fe edition, 5 May 2006).

Chemicals applied to and adjacent to roads can enter streams by various pathways. The effect on water quality depends on how much chemical is applied, the proximity of the road to a stream, and the weather and runoff events that move chemicals and sediments (Gucinski *et al*. 2001). Roads also cause water temperatures to change where groundwater is intercepted and brought to the surface or where loss of tree cover reduces shading in riparian areas (USFS 1999).

Geomorphic effects of roads range from chronic and long-term contributions of fine sediment into streams to catastrophic mass failures of road cuts and fill during large storms. Roads may alter stream channel morphology directly or may modify channel flow and extend the drainage network into previously unchanneled portions of the hillslope. The magnitude of road-related geomorphic effects differs with climate, geology, road age, construction practices, and storm history (Gucinski *et al*. 2001).

Roads contribute to increased sedimentation, concentration of runoff, gully formation, and accelerated water delivery to streams.

Roadless areas eliminate three primary effects of roads on hydrologic processes. Roads intercept rainfall directly on the road surface and road cutbanks and affect subsurface water moving down the hill slope. Roads concentrate flow, either on the surface

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or in an adjacent ditch or channel. Roads divert or re-route water from paths it otherwise would take were the road not present. Most hydrologic and geomorphic consequences of roads result from one or more of these processes (Gucinski *et al*. 2001).

By intercepting surface and subsurface flow and concentrating it through diversion to ditches, gullies, and channels, road systems effectively increase the density of streams in the landscape. This changes the amount of time required for water to enter a stream channel, which alters the timing of peak flows and hydrographic shape, which can affect fish spawning (King and Tennyson 1984 and Wemple *et al*. 1996a in Gucinski *et al*. 2001). Similarly, concentration and diversion of flow into headwater areas can cause incision of previously unchanneled portions of the landscape (Montgomery 1994 in Gucinski *et al*. 2001).

All of these watershed effects can have direct impacts on trout species and their habitats (Furniss *et al*. 1991). Many roads built next to streams isolate or disconnect streams from their floodplains, with adverse effects to stream dynamics and associated aquatic biota. Roads can block the upstream movement of fish with perched culverts (Gucinski *et al*. 2001).

Roadless Areas Protect Stream and Lake Habitat for Aquatic Wildlife

Road entry into unroaded areas generally presents short and long-term risks to aquatic ecosystems (USFS 1999). Road density, design, location, maintenance, and use are important factors affecting the health of aquatic ecosystems. Seldom can roads be constructed or reconstructed without any effect on streams (Furniss *et al*. 1991).

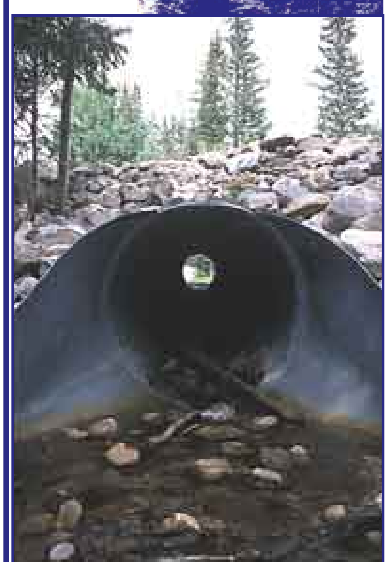
Road entry into unroaded areas presents short and long-term risks to aquatic ecosystems.

The effects of roads on aquatic habitats include physical alterations in stream channel morphology and substrate composition, increased sediment loading, stream bank destabilization, changes in riparian conditions, woody debris recruitment, modification of stream flow and temperature regimes, alteration of watershed hydrologic response, isolation of streams from floodplains, and habitat fragmentation. Such habitat alterations can adversely affect all life stages of fish, including migration, spawning, incubation, emergence, and rearing (Furniss *et al*. 1991, MacDonald *et al*. 1991, Henjum *et al*. 1994 and Rhodes *et al*. 1994 in Gucinski *et al*. 2001).

The effects of roads on aquatic habitat are believed to be widespread. A growing body of evidence indicates that the complexity of aquatic habitat and the predictability of disturbance and flow regimes influences species diversity. At the landscape scale, correlative evidence suggests that roads are likely to influence the frequency, timing, and magnitude of disturbance, which are likely to influence community structure (Gucinski *et al*. 2001).

Roadless areas support a diversity of aquatic habitats and communities.

Increased fine-sediment deposition in stream gravel, a common consequence



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of road-derived sediments entering streams, has been linked to decreased fry emergence, decreased juvenile densities, loss of winter carrying capacity, and increased predation of fishes (Gucinski *et al*. 2001). Roads can cause mortality of eggs and fry through increased sedimentation in stream gravels (USFS 1999). Roads can act as barriers and impede migration of adults to spawning areas. Improper culvert placement, where roads and streams cross, can limit or eliminate fish passage (Gucinski *et al*. 2001).

Roadless areas support a diversity of aquatic habitats and communities. Waters within roadless areas have been shown to function as biological strongholds and refuges for many species of fish. Some of these headwaters may now play a relatively greater role in supporting viable populations of aquatic species, due to cumulative degradation and loss of downstream aquatic habitats.

Strong fish populations were more frequently found in areas with low rather than high road densities.

Several studies correlate road density or indices of roads to fish density or measures of fish diversity. One study demonstrated a negative correlation between increasing road densities and viable native bull, redband, and Yellowstone and westslope cutthroat trout populations in the Columbia River Basin. Supplemental analyses clearly showed that increasing road densities and their attendant effects were associated with declines in the status of these four non-anadromous salmonid species, which were less likely to use highly roaded areas for spawning and rearing, and, where found, were less likely to be at strong population levels. Mechanisms for these outcomes are thought to include effects of fine sediment deposition, changes in stream flow, changes in water temperature caused by loss of shade cover or conversion of groundwater to surface water, migration barriers, vectors of disease, exotic fishes, changes in channel configuration from encroachment, and increased fishing pressure (Lee *et al*. 1997 in Gucinski *et al*. 2001).

In the Medicine Bow National Forest of Wyoming, a positive correlation was demonstrated with numbers of culverts and stream crossings and amount of fine sediment in stream channels, and a negative correlation was shown with fish density and numbers of culverts (Eaglin and Hubert 1993). Survival of incubating salmonids from embryos to emergent fry has been negatively related to the proportion of fine sediment in spawning gravels (Everest *et al*. 1987, Chapman 1988, Scrivener and Brownlee 1989, Young *et al*. 1991, and Weaver and Fraley 1993 in Gucinski *et al*. 2001).

Increased fine sediment in stream gravel can reduce intra-gravel water exchange, thereby reducing oxygen concentrations, increasing metabolic waste concentrations, and restricting movement of larval fish) (Cordone and Kelly 1960, Coble 1961, and Bjornn and Reiser 1991 in Gucinski *et al*. 2001). Survival of embryos relates positively to dissolved oxygen and apparent velocity of intra-gravel water, and positively to gravel permeability and gravel size (Everest *et al*. 1987 and Chapman 1988 in Gucinski *et al*. 2001). Consequently, juvenile salmonid densities decline as fine sediment concentrations increase in rearing areas (Bjornn *et al*. 1977, Shepard *et al*. 1984, Alexander and Hansen 1986, Chapman and McLeod 1987 and Everest *et al*. 1987 in Gucinski *et al*. 2001).

In New Mexico, many state-listed and native fishes, both warm- and cold-water species, are highly susceptible to habitat fragmentation caused by culverts, and also to adverse impacts by sedimentation from roads. Fragmentation of species ranges have, in most instances, undetermined

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impacts on the genetic integrity and diversity of native fishes. Loss of genetic information, which could be caused by culverts and other impediments to gene flow, limits species abilities to adapt to changing environments, limiting conservation options (Propst 1999, NMDGF 2004).

Budgetary constraints on land management agencies may lead to a lack of maintenance, resulting in progressive degradation of road drainage structures and functions, increased erosion rates, and the likelihood of increased erosion (Furniss *et al*. 1991 in Gucinski *et al*. 2001). Substantial increases in sedimentation are unavoidable even when the most cautious road building methods are used (Megahan 1980 and McCashion and Rice 1983 in Gucinski *et al*. 2001).

Excessive harvest of game fish and illegal introduction of non-native fish species are less likely to occur in roadless areas due to lack of easy access (Gucinski *et al*. 2001).

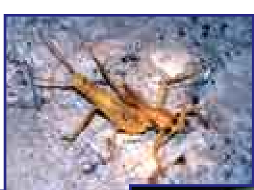
Road and stream crossings have effects on stream invertebrates which are primary prey for fish. Increased sediment reduces populations of benthic (underwater) organisms by reducing interstitial spaces and flow used by many species. Fine sediment reduces algae production, the primary food source of many invertebrates (Chutter 1969 and Hynes 1970 in Gucinski *et al*. 2001). Hawkins *et al*. (2000; in Gucinski *et al*. 2001) found that the aquatic invertebrate species assemblages (observed versus expected, based on reference sites) were related to the number of stream crossings above a site. Total taxa richness of aquatic insects was negatively related to the number of stream crossings. McGurk and Fong (1995 in Gucinski *et al*. 2001) found that macroinvertebrate diversity negatively correlates with an index of road density.

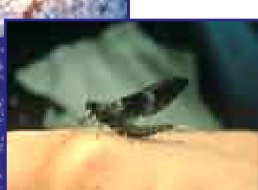
New Mexico's two native trout species, the Rio Grande cutthroat trout and Gila trout, are both found primarily in high elevation wilderness or roadless area strongholds. Core populations of Rio Grande cutthroats are found in the Valle Vidal Unit of the Carson National Forest, 90% of which is managed as roadless, the Latir Peaks Wilderness and Arroyo Hondo Wilderness Study Area of the Carson National Forest, and the San Pedro Parks Wilderness and Pecos Wilderness of the Santa Fe National Forest. The federally-endangered and state-threatened Gila trout is found almost exclusively within roadless areas of the Gila National Forest. Efforts by the New Mexico Department of Game and Fish and U.S. Fish and Wildlife Service are focused on reestablishing these two native salmonids within their roadless core population strongholds, because these areas are less likely to be contaminated by non-native fish species through bait-bucket introductions, and the relatively undisturbed, high quality cold water stream conditions that occur in these areas.

State-listed native warm water fish species that rely in part on unroaded sections of the Gila River within the Gila National Forest for habitat strongholds include the headwater chub, Gila chub and roundtail chub. Many state-listed and native fishes, both warm- and cold-water species, are highly susceptible to habitat fragmentation caused by culverts that are improperly constructed and placed, and also to adverse impacts by sedimentation from roads and road maintenance (Propst 1999, NMDGF 2004).

Roadless Areas Benefit Terrestrial Wildlife

Wildlife that require terrestrial habitats are benefited by roadless conditions in IRAs, due to the direct and indirect effects of roads. Roads provide motorized access to public lands, which allows for the implementation





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of a broad array of land management actions, while precluding other options such as non-motorized recreation or wildlife refugia. Even a well-designed road system inevitably modifies the local landscape in unintended ways, and some values are lost as others are gained. However, in general, greater short- and long-term ecological risks are associated with building roads into unroaded areas than with upgrading, maintaining, closing, or obliterating existing roads (Gucinski *et al*. 2001).

Findlay and Bourdages (2000) found that evidence is accumulating that road construction may result in significant loss of biological diversity at local and regional scales due to 1) restricted movement of species between local populations; 2) increased mortality; 3) habitat fragmentation and edge effects; 4) invasion by exotic species; and 4) increased human access to wildlife habitats. All of these factors are expected to increase local extinction rates or decrease local recolonization rates.

Information from one of the few large landscape scale studies on the effect of roads, conducted in the Columbia River Basin (an area that encompasses 144 million acres, seven states, and 35 national forests) found that more than 70% of 91 wildlife species studied were negatively affected by many factors associated with roads (Wisdom et al 2000). Specific factors included habitat loss and fragmentation, adverse edge habitat effects, reduced densities of snags and logs used for nesting and cover, over-hunting, over-trapping, poaching, collection, disturbance, collisions, barriers to movement, displacement or avoidance, and chronic, negative interactions with people (Gucinski *et al*. 2001).

Roadless Areas Offset Habitat Loss and Fragmentation

By far the largest single threat to biological diversity worldwide is the outright destruction of habitat, along with habitat alteration and fragmentation of large habitats into smaller patches (Meffe *et al*. 1997). Habitat fragmentation creates landscapes made of altered habitats or developed areas fundamentally different from those shaped by natural disturbances that species have adapted to over time (Noss and Cooperrider 1994 in Meffe and Carroll. 1997). The two components of habitat fragmentation are the reduction of the total amount of a habitat type in a landscape and the reapportionment of the remaining habitat into smaller, more isolated patches (Harris 1984, Wilcove *et al*. 1986, and Saunders *et al*. 1991 in Meffe and Carroll. 1997).

By far the largest single threat to biological diversity worldwide is the outright destruction of habitat.

Adverse effects of habitat fragmentation to wildlife populations and species include:
- Increased isolation of populations or species;
- Adverse genetic effects, such as inbreeding depression (depressed fertility and fecundity, increased natal mortality) and decreased genetic diversity from genetic drift and bottlenecks;
- Increased potential for extirpation of localized populations or extinction of narrowly distributed species from catastrophic events such as hurricanes, wildfires or disease outbreaks;
- Altered habitat vegetative composition, often to weedy and invasive species;
- Altered type and quality of the food base;

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- Altered microclimates by altering temperature and moisture regimes;
- Altered flows of energy and nutrients;
- Altered availability of cover and increased edge effect, bringing together species that might otherwise not interact, potentially increasing rates of predation, competition and nest parasitism;
- Increased opportunities for exploitation by humans, including poaching or illegal collection for the pet trade.

Roads are major contributors to habitat fragmentation, as they divide large landscapes into smaller patches, convert interior habitat into edge habitat, and increase the uniformity of patch characteristics. As additional road construction and associated timber management activities increase habitat fragmentation across large areas of NFS lands, isolation of populations of some species can produce increased demographic fluctuation, inbreeding, and loss of genetic variability. These fragmentation effects increase the risk of local population extirpations or extinctions (Noss and Cooperrider 1994).

> Road construction converts large areas of habitat to non-habitat.

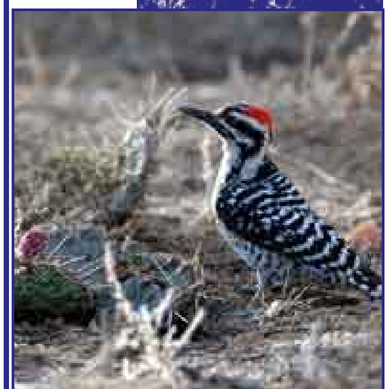
Wildlife species vary in their vulnerability to habitat loss and fragmentation, with habitat generalist species being more adaptable than habitat specialists. For example, increased forest edge habitat from roads facilitates increased predator and competitor interactions, such as nest parasitism by brown-headed cowbirds on interior forest-nesting neotropical migrant warbler and vireo species (Gucinski *et al*. 2001).

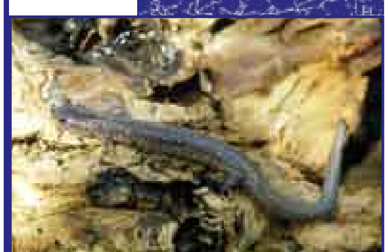
Large carnivores are some of the most vulnerable wildlife species to habitat fragmentation because they are larger, long-lived species with low densities, relatively low reproductive rates, and large home range requirements. Based on accumulating evidence, conserving populations of large carnivores may be possible only in landscapes containing road densities less than about 1.0 mile of road per square mile of landscape. The average road density in the U.S. is 1.9 miles per square mile (Forman *et al*. 2003).

Road avoidance behavior is characteristic of large mammals such as elk, bighorn sheep, pronghorn, and wolves. Radio-telemetry studies during the last 30 years have shown that buffer areas around roads are generally avoided by ungulates and large carnivores, with the avoidance zone apparently dependent on traffic volume (Forman *et al*. 2003). Some studies have shown that the existence of a few large areas of low road density, even in a landscape of high average road density, may be the best indicator of suitable habitat for large vertebrates (1999 Interim Rule EA, Gucinski *et al*. 2001).

Loss of large trees, snags, and logs in areas adjacent to roads through commercial harvest or firewood cutting has had adverse effects on snag and cavity dependent birds and mammals (Hann *et al*. 1997).

In New Mexico, the state-listed Jemez Mountain salamander and Sacramento Mountain salamander are threatened in part by habitat fragmentation caused by roads and additional road building (NMDGF 2004). Many state-listed fish species' ranges are fragmented by culverts installed beneath road





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crossings of aquatic habitats (NMDGF 1999).

Wildlife in Roadless Areas Not Vulnerable to Road Mortality

Wildlife in roadless areas are not subjected to the substantial direct mortality associated with roads. It is estimated that 1 million vertebrates are killed daily on roads in the United States (Gucinski *et al*. 2001). The number and frequency of vertebrate animals killed on roadways is correlated with traffic volume and speed of vehicles. As roads are upgraded to accommodate greater traffic volume, the rate of successful wildlife crossings decreases significantly (Forman *et al*. 2003).

It is estimated that 1 million vertebrates are killed daily on roads in the United States.

Populations of wide-ranging carnivores are particularly vulnerable to road traffic accidents. Collision with motor vehicles accounted for 49% of the mortality of the endangered Florida panther before wildlife underpasses and wildlife-proof fencing greatly reduced this percentage. Road kill is a significant cause of mortality for the endangered ocelot in Texas and for wolves in Minnesota (Forman *et al*. 2003).

In New Mexico and Arizona, roads and associated traffic have proven to be a major factor in the mortality of state- and federally-endangered Mexican wolves by facilitating illegal killing and roadkill. Since reintroduction efforts started in 1998, 32 of 46 documented mortalities were from illegal shooting or roadkill (Mexican Wolf Interagency Annual Report 2005).

Forest roads with relatively slow speeds and low traffic volumes pose a greater hazard to slow-moving amphibians and reptiles than to mammals or birds. Reptiles seek roads for thermal cooling and heating, which can lead to significant, chronic mortality from motorized vehicles (Vestjens 1973 in Forman *et al*. 2003). Roads that bisect migration corridors with moderate rates of vehicle traffic may create population sinks for many species of amphibians and reptiles, resulting in reduced population size and increased isolation of populations (Bennet 1991 in Forman *et al*. 2003). Numerous records exist of salamander and toad seasonal migrations and resulting mass mortalities on roads worldwide (Forman et al. 2003). Rare amphibians and reptile species, or those with highly restricted distributions, may be dangerously reduced by road kills or intentional killing or collecting (Gucinski *et al*. 2001).

Significant effects of road density have been reported for species richness of amphibians, reptiles, birds and plants within 1.25 miles of wetlands. A study of painted turtles at varying distances from roads found both lower density and higher mortality near roads. In Florida, vehicle collisions have been reported as the largest source of mortality for panthers, black bears, key deer, American crocodiles, and bald eagles (Forman *et al*. 2003).

In New Mexico, at least 4 state-listed amphibian and reptile species are threatened in part by road mortality, including the Sonoran Desert toad, Gila monster, gray-banded kingsnake, and narrow-headed garter snake (NMDGF 2004).

Roadless Areas Reduce Noise and Visual Disturbance for Wildlife

Many animals detect and depend on sound to communicate, navigate, avoid dangers, and find food. Human-made noise alters the behavior of wildlife, and if excessive, can alter reproduction, survivorship, habitat use, distribution, abundance, or genetic composition. Noise disturbance can also harass, threaten, and cause increased levels of stress in wildlife (Forman *et al*. 2003).

Breeding birds appear to be heavily

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affected by traffic disturbance, in particular, traffic noise. In one study, disturbance distances and grassland bird densities were related to traffic volume and associated traffic noise (M. Reijnen *et al*. 1995, R. Reijnen *et al*. 1995, 1996 in Forman 2000). Physiological measures of stress can be a valuable tool for evaluating impacts of disturbance, including roads. Recent research shows that northern spotted owls living close to forest roads experienced higher levels of a stress-induced hormone than owls living in areas without roads (Forman *et al*. 2003). Increased stress in some wildlife species can lead to decreased reproductive rates and survivorship (Yarmaloy *et al*. 1988).

Roadless Areas Provide Refuges for Sensitive Plant and Animal Species

Although IRAs comprise only 2% of the total U.S. land base, they are found within 661 of the more than 2,000 major watersheds in the nation (U.S. EPA 1997, Sedell *et al*. 2000 in USFS 2000b). IRAs are often located in higher elevation headwater areas, providing important habitat for more than 220 threatened, endangered and proposed species for federal listing under the Endangered Species Act, and 1,930 sensitive species (USFS 2000b).

In the USFS Southwestern Region, which includes New Mexico and Arizona, 57% of threatened, endangered and proposed species under the federal Endangered Species Act, and 54% of the USFS sensitive species are dependent on habitat within or affected by IRAs (NMDGF 2005, USFS 2000).

In the USFS Southwestern Region, 57% of Threatened, Endangered and Proposed species and 54% of USFS Sensitive Species are dependent on habitat within or affected by Inventoried Roadless Areas.

Roads affect threatened, endangered and sensitive species through the same mechanisms that they adversely affect other wildlife, including habitat loss and fragmentation, introduction of exotics, interspecific interactions such as disease, predation, and competition, increased human disturbance, and illegal hunting. Roads in otherwise large natural patches of vegetation, riparian areas, major wildlife corridors, areas with unique habitats, or habitats with rare species have greater effects on these species than roads in other areas (Forman *et al*. 1997).

Roadless areas are particularly important for species that require large home ranges.

Flather *et al*. (1994) provides an overview of species endangerment patterns in the United States. Habitat loss associated with land-use intensification was the most important factor in species endangerment, affecting more than 95% of the 667 species included in the overview. Many factors that Flather *et al*. (1994) identified are directly linked to roads and the activities associated with road access (USFS 1999).

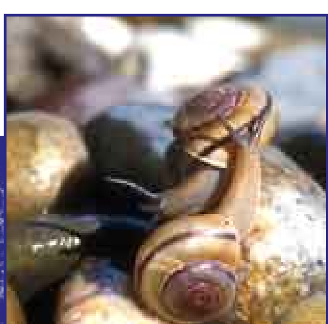
Because of the extensive occurrence of threatened, endangered and sensitive (TES) species in roadless areas, USFS management practices in roadless areas of NFS land and their subsequent effects on aquatic and terrestrial ecosystems are of greater consequence to TES species than to non-TES species (USFS 1999).

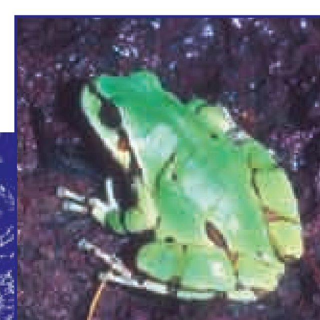
Enhanced Hunting and Fishing Experiences in Roadless Areas

Road closures in the Tres Piedras area in New Mexico during big game season had general public acceptance and increased elk harvest.

Johnson 1977

In general, roadless areas provide higher quality hunting and angling experiences. There may be greater associated harvest opportunity





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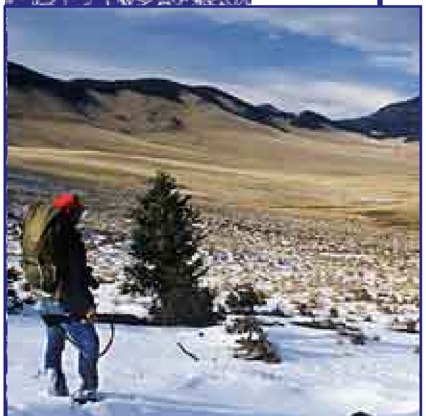

depending on management objectives for game species within individual states. Roadless areas in New Mexico, including Wilderness areas, provide some of the highest quality elk hunting opportunities and provide habitat that sustain elk populations for surrounding areas.

IRAs provide some of the best hunting, fishing, and non-consumptive recreational opportunities in the nation.

In December 1999, the Theodore Roosevelt Conservation Alliance, composed of member organizations such as the Rocky Mountain Elk Foundation, the Mule Deer Foundation, and Trout Unlimited, conducted a survey of 600 hunters and anglers to solicit their opinions regarding road management in existing roadless areas of NFS lands (TRCA 1999). The survey found that 86% of anglers and 83% of hunters surveyed support a policy to prevent further road building in roadless areas.

The value of having roadless areas is that they provide a much higher quality hunt, with fewer people, less interference, and the opportunity to harvest a bigger animal.

Len Carpenter, SW Field Representative
Wildlife Management Institute

These hunters and anglers highly valued many attributes of unroaded NFS lands, including the habitat they provide for endangered species, protection of water quality, and opportunity to hunt, fish and experience solitude in remote places with few roads and people.

Excessive harvest of game fish is less likely to occur in roadless areas due to lack of easy access.

Elk Management and Conservation Related to Roads on National Forests

The following discussion of elk response to roads and traffic underscores why roadless areas provide a higher quality large game hunting experience.

Increased timber harvest in National Forests, beginning in the 1960s, led to a proliferation of road networks in forested ecosystems inhabited by elk (Hieb 1976 and Lyon and Christensen 2002 in Rowland *et al*. 2005). Roads have been identified as a major factor influencing distributions of elk across the landscape (Leege 1984, Lyon 1984, Lyon *et al*. 1985, Roloff 1998, Lyon and Christensen 2002, and Wertz *et al*. 2004 in Rowland *et al*. 2005). The total loss of elk habitat from road construction is unknown. A rough estimate of 5 acres per linear mile of road is often applied (Forman *et al*. 2003 in Rowland *et al*. 2005).

With regard to elk habitat, the primary effect of roads is habitat fragmentation. Areas with many roads may contain few patches of forest cover large enough to function effectively as security habitat for elk, especially where elk are hunted (Leege 1984 and Rowland *et al*. 2000 in Rowland *et al*. 2005).

Elk occurred in greater densities and hunter success was higher in roadless areas compared to roaded areas in west central Idaho.

Thiessen 1976

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Roads may also exert more subtle influences on habitat, for example by facilitating the spread of exotic vegetation (Gelbard and Belnap 2003 in Rowland *et al*. 2005) which may subsequently reduce quality and abundance of forage available to elk. Gaines *et al*. (2003 in Rowland *et al*. 2005) listed 5 road-associated factors that affect elk populations: hunting, poaching, collisions, displacement or avoidance, and disturbance.

Cook *et al*. (2004 in Wisdom *et al*. 2005) found that off-road recreational activities appear to have a substantial effect on elk behavior. If the additional energy required to flee from an off-road activity reduces body fat of elk below 9% as elk enter the winter period, the probability of surviving the winter is diminished (Cook *et al*. 2004 in Wisdom *et al*. 2005). During other periods, elk energy budgets may also be adversely affected by loss of foraging opportunities when animals are responding to off-road activities, and from displacement from foraging habitat (Wisdom *et al*. 2005).

> Off-road vehicle activities such as all-terrain vehicle use alters elk foraging behavior, potentially adversely affecting energy budgets and winter survival.
>
> *Wisdom et al. 2005*

The direct impacts of roads and associated traffic on elk, in addition to outright mortality from collisions with motorized vehicles, can be summarized as follows:
Elk avoid areas near open roads. Many studies have demonstrated an increasing frequency of elk occurrence or indices of elk use, such as pellet groups, at greater distances from open roads (defined here as any road where motorized vehicles are allowed). This response varies in relation to traffic rates (Wisdom 1998, Johnson *et al*. 2000, and Ager *et al*. 2003 in Rowland *et al*. 2005), the extent of forest canopy cover adjacent to roads (Perry and Overly 1977, Lyon 1979, Wisdom 1998, and Wisdom *et al*. 2004b in Rowland *et al*. 2005), topography (Perry and Overly 1977 and Edge and Marcum 1991 in Rowland *et al*. 2005), and type of road (e.g., improved vs. primitive), (Perry and Overly 1977, Lyon 1979, Witmer and de Calesta 1985, Marcum and Edge 1991, Rowland *et al*. 2000, Lyon and Christenson 2002, and Benkobi *et al*. 2004 in Rowland *et al*. 2005), which also correlates with traffic rates.

> Roads reduce big game use of adjacent habitat from the road edge to more than 1/2 mile away.
>
> *Berry and Overly 1976*

Responses may also differ between sexes, with bull elk demonstrating a stronger avoidance of areas close to roads than do cow elk (Marcum and Edge 1991 in Rowland *et al*. 2005). In addition, daily movements and size of home ranges of elk may decrease when open road density decreases. These reductions could lead to energetic benefits that translate to increased fat reserves or productivity (Cole *et al*. 1997 in Rowland *et al*. 2005).

On a larger scale, entire ranges can be abandoned if disturbance from traffic on roads and the associated habitat loss and fragmentation exceeds some threshold level. The ultimate effect of displacement of elk, by motorized traffic as well as other disturbances, is a temporary or permanent reduction in effective habitat for elk. Concomitant

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with loss of effective habitat are reduced local and regional populations (Forman *et al*. 2003 in Rowland *et al*. 2005).

Entire ranges of elk can be abandoned if disturbance from traffic on roads and associated habitat loss and fragmentation exceed some threshold level.

Higher levels of physiological indicators of stress, such as fecal glucocorticoids, have been observed in elk exposed to increased road density and traffic on roads (Millspaugh *et al*. 2001 in Rowland *et al*. 2005).

In areas of high road density, elk exhibit higher levels of stress and increased movement.

Elk vulnerability to mortality from hunter harvest, both legal and illegal, increases as open road density increases. Many factors affect elk vulnerability to hunter harvest, but survival rates of elk are reduced in areas with higher road density (Leege 1984, Leptich and Zager 1991, Unsworth *et al*. 1993, Gratson and Whitman 2000a, Weber *et al*. 2000, Hayes *et al*. 2002, and McCorquodale *et al*. 2003 in Rowland *et al*. 2005).

Increased hunter success in Idaho was demonstrated in unroaded areas (25%) and reduced open-road density areas (24%), as compared to more densely roaded areas (15%).
Gratson and Whitman 2000

Closing roads offers more security to elk and is likely to decrease hunter densities (fewer hunters may be willing to hunt without vehicle access). Poaching losses may decrease when roads are closed (Cole *et al*. 1997 in Rowland *et al*. 2005).

The following partial list of studies document 1) avoidance of roads by elk and deer; or 2) enhanced large game hunt quality and/or success. These studies indicate the value of roadless areas versus roaded forests for quality hunting experiences:

- Travel restrictions on roads appeared to increase the capability of the area to hold elk in Montana (Basile and Lonner 1979).
- Closure of roads provided improved hunting success (Black *et al*. 1976).
- Home-range size and daily movement of white-tailed deer increased with increasing snowmobile activity in Minnesota (Dorrance *et al*. 1975).
- Repeated human disturbance or harassment of big game populations on crucial winter ranges can change activity patterns, increase predation, reduce access to resources, and increase energy expenditures necessary for survival (Geist 1978 and Hobbs 1989, in Easterly *et al*. 1991).
- Road closures allowed elk to remain longer in preferred areas. (Irwin and Peek 1979).
- Logging and road-building activity along major migration routes changed the winter distribution of elk (Leege 1976).
- In highly roaded areas in Montana, no bull elk lived more than 5.5 years, and only 5% lived to maturity. Closing roads extended the age structure of the bull population to 7.5 years, and 16% of the bull population consisted of mature animals. One result of road construction is the decreased capacity of the habitat to support elk from decreased habitat effectiveness. Loss of habitat effectiveness can be at least partially reversed by road closures (Leptich and Zager 1991).
- Elk in Montana avoided habitat adjacent to open forest roads, and that road construction creates habitat loss that increases impacts to elk as road densities increase (Lyon 1979).
- An expanding network of logging roads made elk more vulnerable to hunters and harassment. Higher road densities caused a reduction in the length and quality of the hunting season, loss of habitat, excessive

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harvest, and population decline (Lyon and Vasile 1980).

- Road-related variables have been implicated as increasing elk vulnerability in virtually every study in which the influence of roads has been examined. Bull elk vulnerability is highest in areas with open roads, reduced in areas with closed roads, and lowest in roadless areas Lyon *et al*. 1997).
- Deer and elk avoided roads, particularly areas within 200 yards of a road, with deer exhibiting a stronger avoidance response than did elk (Rost and Bailey 1979).
- Activities associated with roads in Montana can reduce the quality and quantity of elk hunting opportunities available in an area (Sundstrom and Norberg 1972).
- Logging roads made nearby elk herds more vulnerable to human interference year-round, not just during hunting season (Wray 1990).
- Mule deer experimentally harassed by an ATV altered feeding and spatial-use patterns, and produced fewer offspring the following year (Yarmaloy *et al*. 1988).

Roadless Areas Reduce Potential for Illegal Killing and Collecting of Wildlife

Roads facilitate poaching of many large animals such as deer, elk, caribou, pronghorn, mountain goat, bighorn sheep, wolf and grizzly bear (Mech 1970, Stelfox 1971, Yoakum 1978, Dood *et al*. 1985, Knight *et al*. 1988, McLellan and Shackleton 1988, Cole *et al*. 1997).

Bancroft (1990) documented the widespread illegal practice of road hunting in Arizona using decoy deer and elk. Eleven of 19 archery elk and deer hunters and 41 of 53 firearms hunters committed violations by attempting to illegally kill a game animal after observing a decoy from their vehicle (Bancroft 1990).

In New Mexico and Arizona, roads and associated traffic have proven to be a major factor in the mortality of state- and federally-endangered Mexican wolves by facilitating illegal killing and roadkill. Since reintroduction efforts started in 1998, 32 of 46 documented mortalities were from illegal shooting or roadkill (Mexican Wolf Interagency Annual Report 2005).

New Mexico state-listed species that are vulnerable to illegal killing or collecting along roadsides include the white-sided jackrabbit, Mexican wolf, jaguar, desert bighorn sheep, American marten, Gila monster, gray-banded kingsnake, New Mexico ridge-nosed rattlesnake, green ratsnake and mottled rock rattlesnake (NMDGF 2004).

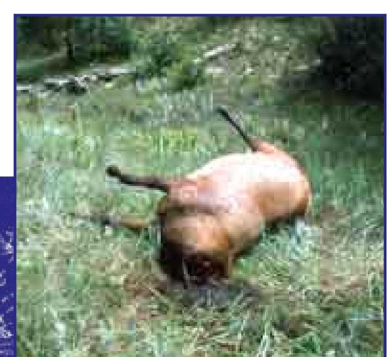
Roadless Areas Promote Natural Resilience to Invasion by Non-native Species

Roadways can facilitate establishment of non-native plants, insect pests, and pathogens in forest landscapes. Roads may be the first points of entry for exotic species into a new landscape (Lonsdale and Lane 1994 and Greenberg *et al*. 1997 in Gucinski *et al*. 2001).

Roadsides penetrating forested lands provide favorable habitat for weedy species, especially on bare soil and in sunny areas. Vehicles and passengers may serve as dispersal agents for the spread of seeds. Non-native plant and animal species can also be dispersed along roads by wind and water (Gucinski *et al*. 2001).

> Invasion by exotic plants may have significant biological and ecological effects if the species are able to disrupt the structure and function of an ecosystem.

Approximately 6 to 7 million acres of NFS lands are infested with noxious weeds and non-native invasive plants. Their estimated rate of spread is between 8% and 12% per year. Permanent and temporary road construction and reconstruction presents the greatest opportunity for infestation of NFS lands. Because



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road construction and maintenance disturb the ground, they form easy points of entry and infestation (USFS 1999).

Continued road building in National Forests poses the greatest risk for increased spread of non-native invasive species due to the disturbance associated with roads. Continued construction would allow a corresponding increase in the adverse ecological effects associated with establishment of invasive species, such as habitat alteration, replacement of native species, and alteration of ecosystem processes (USFS 1999).

Roadless Areas Promote Soil and Vegetation Productivity

Permanent and temporary road construction and reconstruction causes a direct loss of soil and vegetation productivity on the areas occupied by the road. This is more important with roads near or encroaching on wetland or riparian areas. Although not irreversible, land occupied by roads is essentially lost to long-term productive vegetation growth (USFS 1999).

Forest roads can have significant effects on soil and vegetation productivity by removing and displacing topsoil, altering soil properties, changing microclimate, and accelerating erosion. Road building changes the physical properties of soils including depth, density, infiltration capacity, water holding capacity, and gas exchange rate, nutrient concentrations, and microclimate (Gucinski *et al*. 2001).

Roadless Areas Reduce Human-caused Wildfires

Roads in and adjacent to many forest, shrubland, and grassland habitats affect the patterns of fire on the landscape. Roads provide access to suppress fires, and roads can act as linear fuel breaks that retard fire spread. However, increased road networks also increase the potential for and frequency of human-caused fires across the landscape. Therefore, NFS road networks have resulted in changes in fuel patterns and fire regimes on a broad scale (Gucinski *et al*. 2001).

USFS analyses determined that IRAs would not be a fuel treatment priority for 20 years because of the generally remote locations of these areas. However, fuels reduction is needed immediately to protect human lives and property within millions of acres of wildland-urban interface, where human development has encroached into forested areas (15 March, 2001, Albuquerque Journal).

The degree of overlap between areas that the USFS has identified as having a high risk from wildfires and IRAs is relatively small. About 3 million acres of the estimated 24 million acres of IRAs in the West need fuel reduction treatments. This can be attributed in part to many IRAs occurring at higher elevations that are typically wetter and cooler, not typically being adjacent to communities, and not generally having been influenced as much by past land management activities such as fire suppression.

> Many fire ecologists believe that unroaded areas have smaller, less intense, and less severe forest fires than roaded areas.

Fire suppression has been focused more in roaded than unroaded areas allowing more fuels to accumulate in

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the roaded areas. In some areas, past logging practices have left many acres with additional dead and down woody material on the ground. Timber stands are generally more dense in roaded than unroaded areas, particularly in logged areas that have regenerated. These regenerated stands are often highly susceptible to forest fires because previous fire suppression activities have allowed the buildup of fuel loads, dog-hair thickets and ladder fuels (USFS 1999).

Scientific Value of Roadless Areas

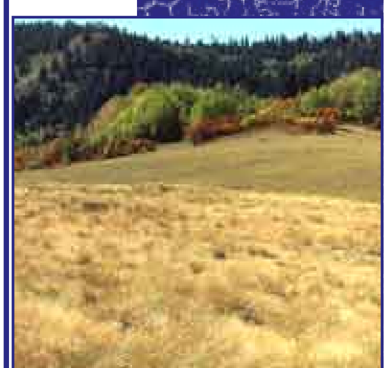
Primitive, roadless, natural environments such as IRAs and Wilderness areas are living laboratories of relatively unaltered ecological processes. Scientific studies are conducted using these areas as natural benchmarks, reference areas or controls to measure against the effects of human development and impacts on natural systems and processes.

Primitive roadless areas provide baseline ecological conditions, establishing ecological standards against which to measure success for coal and hard rock mine reclamation, and other habitat projects. Standard terrestrial success criteria measured in these wildlands include plant species diversity indices and plant cover and production, and wildlife species diversity indices and abundance.

Roadless areas are typically used to establish baseline conditions for aquatic habitat restoration. Stream channels are often altered predictably by roads, mining, and logging activities. Streams in roadless areas are used as the standard against which to measure success for restoration of impacted reaches. Abiotic aquatic indices and success criteria for impacted stream bodies include fluvial geomorphologic measurements such as stream type, embeddedness, sinuousity, width to depth ratio, channel bed material, channel gradient, pool type (e.g., scour pools vs. plunge pools), flood plain connectivity and width. Biotic indices include benthic insect diversity and abundance, and riparian vegetation condition, species and structural diversity.

In New Mexico, the Environmental Protection Agency has identified many stream reaches that have been negatively impacted by roads and other human developments that are contributing to non-achievement of national Clean Water Act and New Mexico Water Quality Act standards. Watershed Restoration Action Strategies (WRAS) are being prepared for impacted priority watersheds and stream reaches in New Mexico, such as Comanche Creek in the Valle Vidal Unit of the Carson National Forest, and Las Huertas Creek, which originates in the Sandia Mountain Wilderness of the Cibola National Forest. WRAS development and implementation generally includes design and success criteria adopted from similar upstream reference reaches in unroaded or Wilderness settings.

As evidence of their scientific contributions, more than 400 scientific journal articles have been published about research and restoration activities conducted in roadless areas during the past 30 years (Loomis and Richardson 2000).



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Enhanced Opportunities for Human Solitude in Roadless Areas

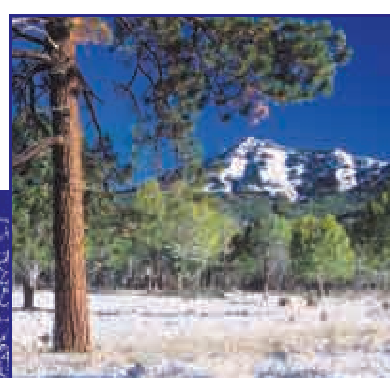
Many New Mexicans, whether hunters, anglers, hikers or birdwatchers, retain or develop a sense of fascination and wonder with wild places. Whether this appreciation is inherent or is acquired through learning and sharing with others, we appreciate and nurture this sometimes profound connection to wild places. Not only are these wild places more complex than we understand, they are more complex than we can understand. This complexity may be in part what attracts us to these places and causes an understanding of the need to protect these areas for future generations. These social, educational, scientific, and spiritual values, however, are hard to explain, and therefore remain undervalued and under appreciated in a society that is increasingly mechanized and developed.

"It is inconceivable to me that an ethical relation to land can exist without love, respect, and admiration for land, and a high regard for its value. By value, I of course mean something far broader than mere economic value; I mean value in the philosophical sense".

Aldo Leopold 1949

In an effort to identify some of these social values, surveys have been conducted at national and regional levels. Among members of the public surveyed, one of the most commonly mentioned social values of remaining wildlands is the contribution of roadless areas to overall quality of life for local residents and visitors alike. People state that they value these areas as places to escape from modern pressures, to experience natural grandeur, and to experience the solitude and natural quiet to be found within them. Others emphasize the multitude of irreplaceable non-monetary values and healthy ecosystems which, they say, roadless areas provide. Some state that human survival and modern society depends on these values, yet they are taken for granted (USFS 1999).

People also comment on the spiritual values they associate with roadless areas, from the perspective of both traditional institutional religious tenets and more general non-denominational beliefs of spiritual connection and renewal. These respondents state that their religious faith demands careful stewardship and protection of the natural environment, and that protecting IRAs best embodies this imperative (USFS 1999).



The effects of population growth and urban sprawl are topics of comment among many survey respondents who discuss social values of roadless areas.

Respondents assert that roadless areas provide an important counterbalance to continued urbanization and development of private lands. According to some, roadless areas provide an important back country recreation outlet for growing metropolitan areas and can take the pressure off overused wilderness areas. Some state that intact roadless areas are a vital component of the true American or western experience and provide critical freedom values to an increasingly rule-bound society (U.S. Fed Reg. 2002).

Recent national surveys have found that a majority of the American public supports environmental protection and believes environmental issues should be a high social priority (Ladd and Bowman 1995 in USFS 1999). Literature suggests that healthy forest ecosystems contribute substantial values because they provide unique benefits such as solitude, clean water, diversity of wildlife and fish, and old growth forests, as well as products for human use (Fan and Bengston 1997).

In New Mexico, a 2004 public survey

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found that 91.6% of respondents found it moderately to extremely important for the New Mexico Department of Game and Fish to conserve New Mexico's biological diversity, and 94.9% of respondents thought it moderately to extremely important to protect and improve lands and waters used by fish and wildlife (Teel and Dayer 2005). In New Mexico in 2001, 671,000 people spent more than $558 million on wildlife viewing, and 45% of New Mexico residents older than 16 participated in wildlife associated recreation. Total wildlife expenditures in New Mexico in 2001, including in- and out-of-state permits for hunting, fishing, and trapping, exceeded 1 billion dollars (USFWS 2002).

These values are important to people for a variety of reasons such as the satisfaction associated with knowing that resources exist, assurance that these resources will exist for future generations, and protection of future options for use of these resources (Vincent *et al*. 1995 in USFS 1999).

Roads also affect many less measurable attributes of the national forests, including passive-use values, which people hold for things they may not expect to use themselves but believe should exist for future generations. Building roads in roadless areas may reduce passive-use value significantly. Decommissioning of roads may increase such value (Gucinski *et al*. 2001).

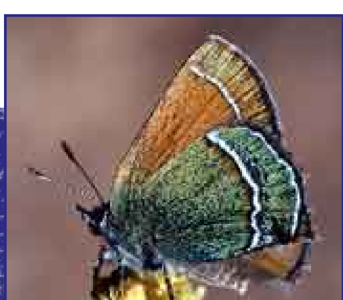
Summary: Roadless Areas Ensure Quality of Life

Inventoried Roadless Areas of our National Forest System are a valuable natural resource that provides multiple ecosystem services such as clean water, clean air, healthy soils, multiple recreational opportunities, and core habitat areas for native fish and wildlife populations.

Inventoried Roadless Areas are critical for providing a source of clean water to many towns and communities across the nation.

Inventoried Roadless Areas provide secure and necessary habitats and refugia for hundreds of species of imperiled and at-risk terrestrial and aquatic wildlife. IRAs are a stronghold of native species biological diversity. Because of the general lack of habitat fragmentation, they are resistant to invasion by non-native plant species.

Building roads within these IRAs has a high potential for adversely affecting the functions of these watersheds, important wildlife habitats, and havens of human recreation, solitude and reflection.



If road building were to occur in Inventoried Roadless Areas, the series of cascading human impacts will be difficult, if not impossible to reverse.

The national trend of increasing use of off-road vehicles is quickly exceeding the ability of public lands and wildlife managers to protect other public natural resources. The cascading effects from increased roads and traffic also overwhelms the ability of intact roadless areas to provide the level of ecosystem services that we have come to expect, but often take for granted.

Roadless areas provide solitude and quality of life values to many people in New Mexico and nationally. Experiencing and appreciating these values is considered by some to be unrivaled in any other area.

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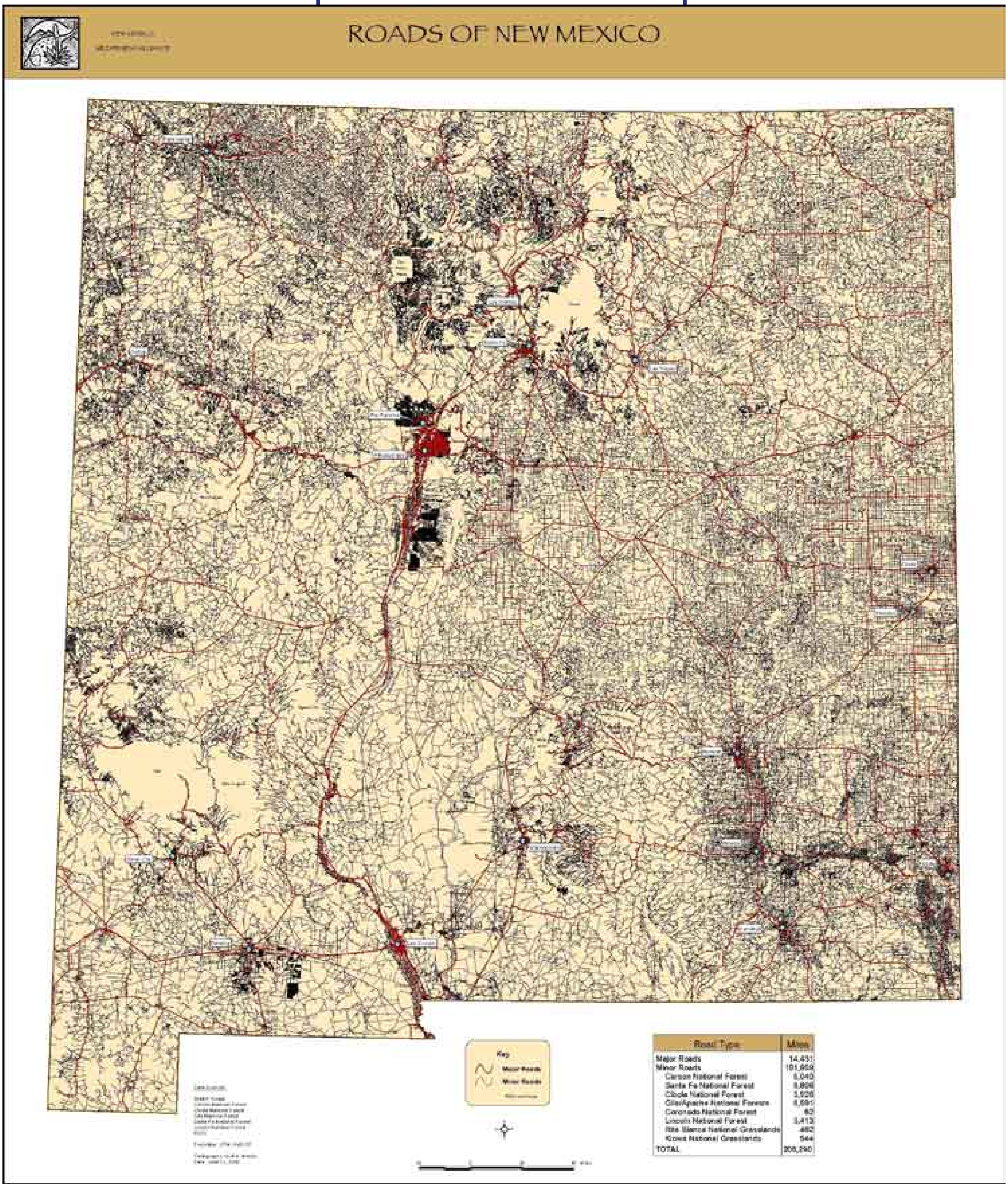

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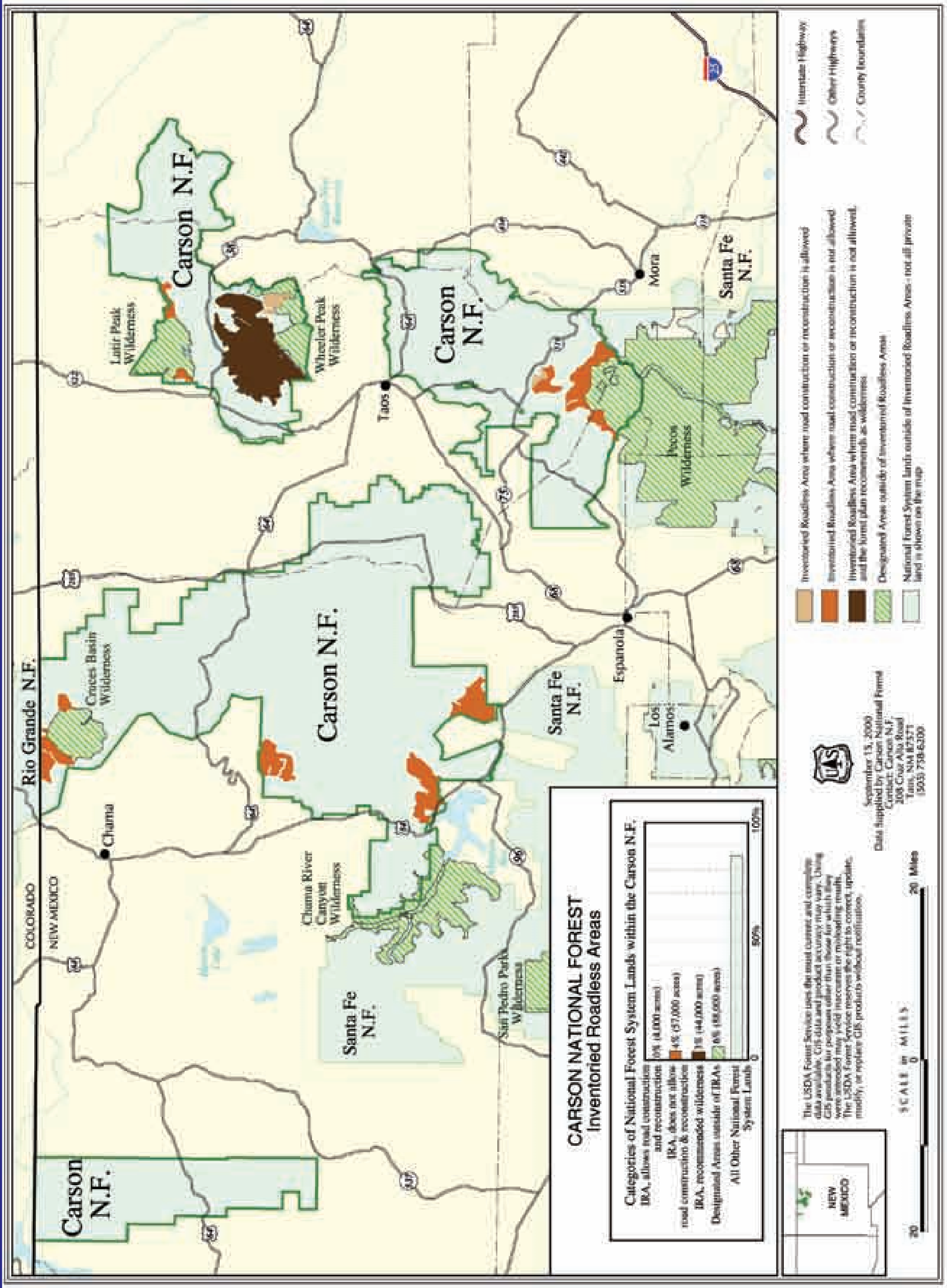

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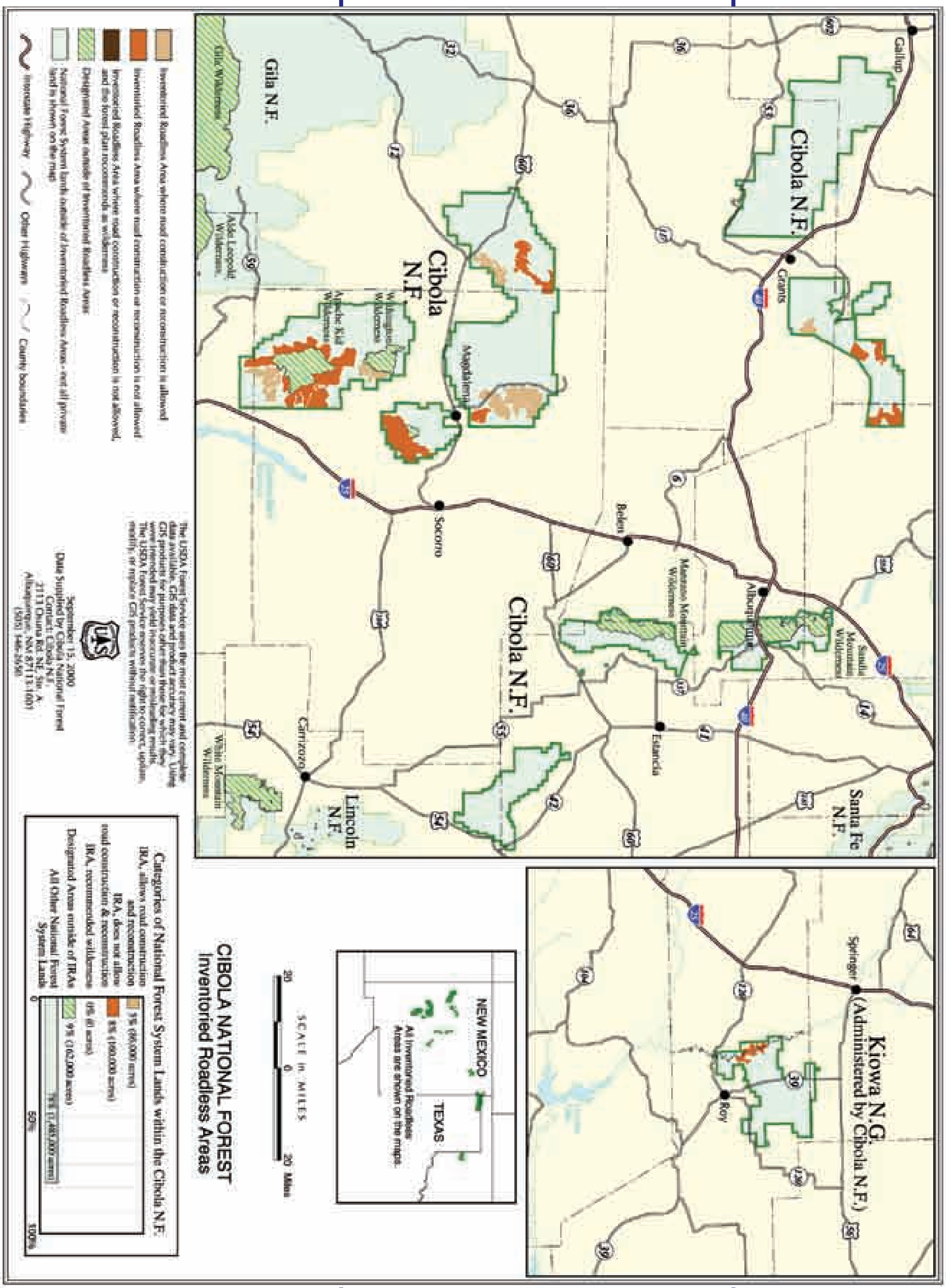

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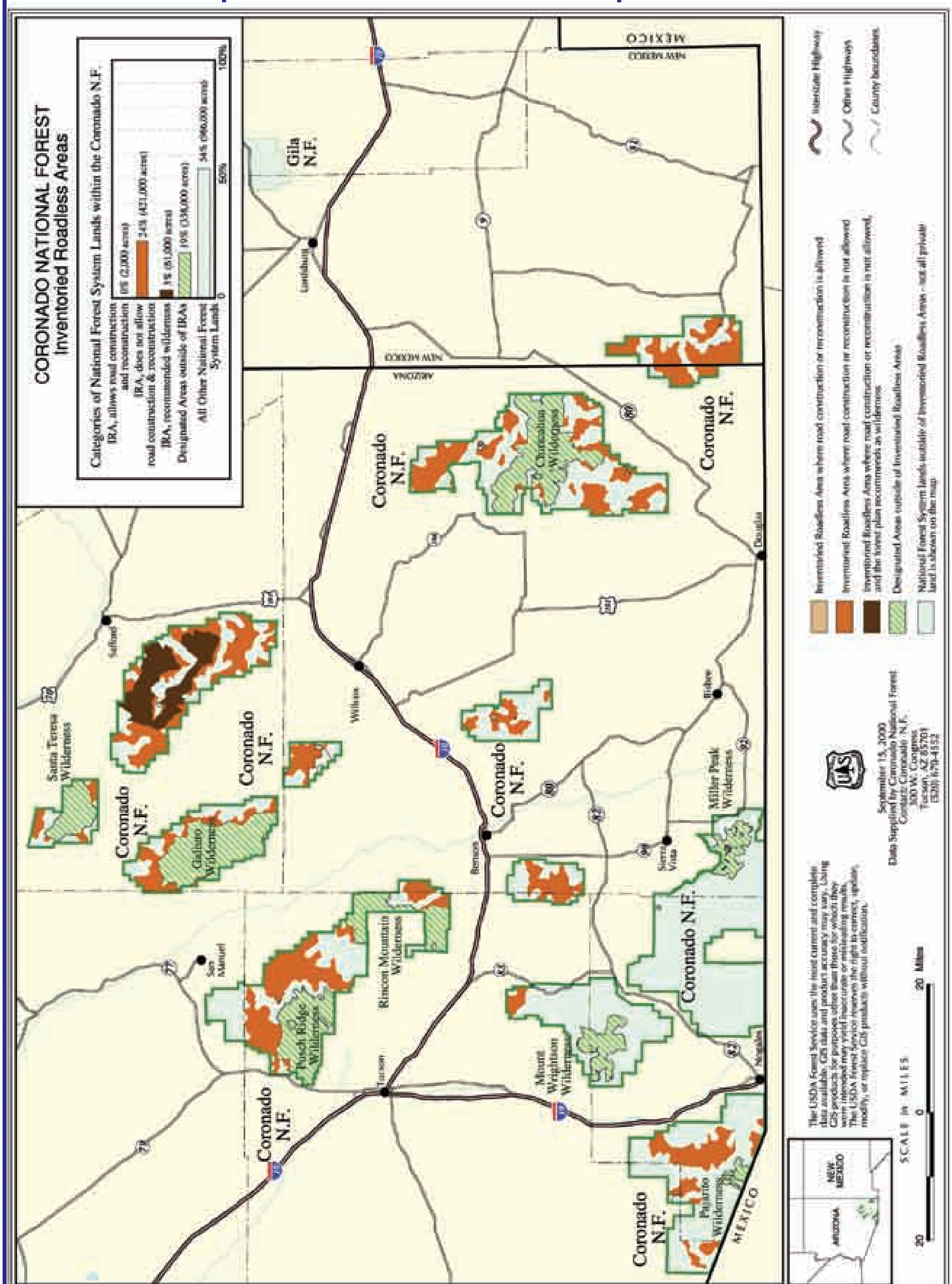

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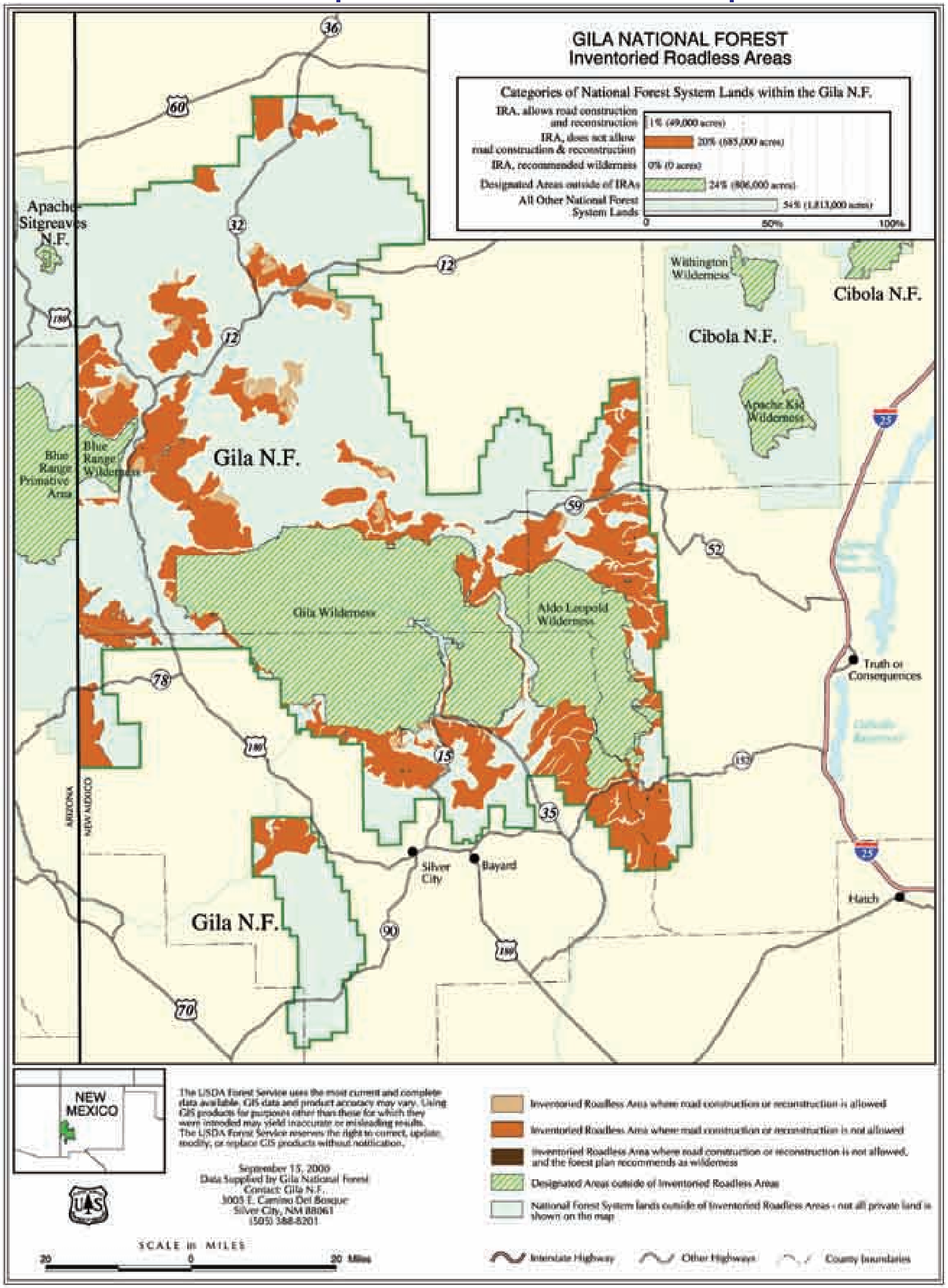

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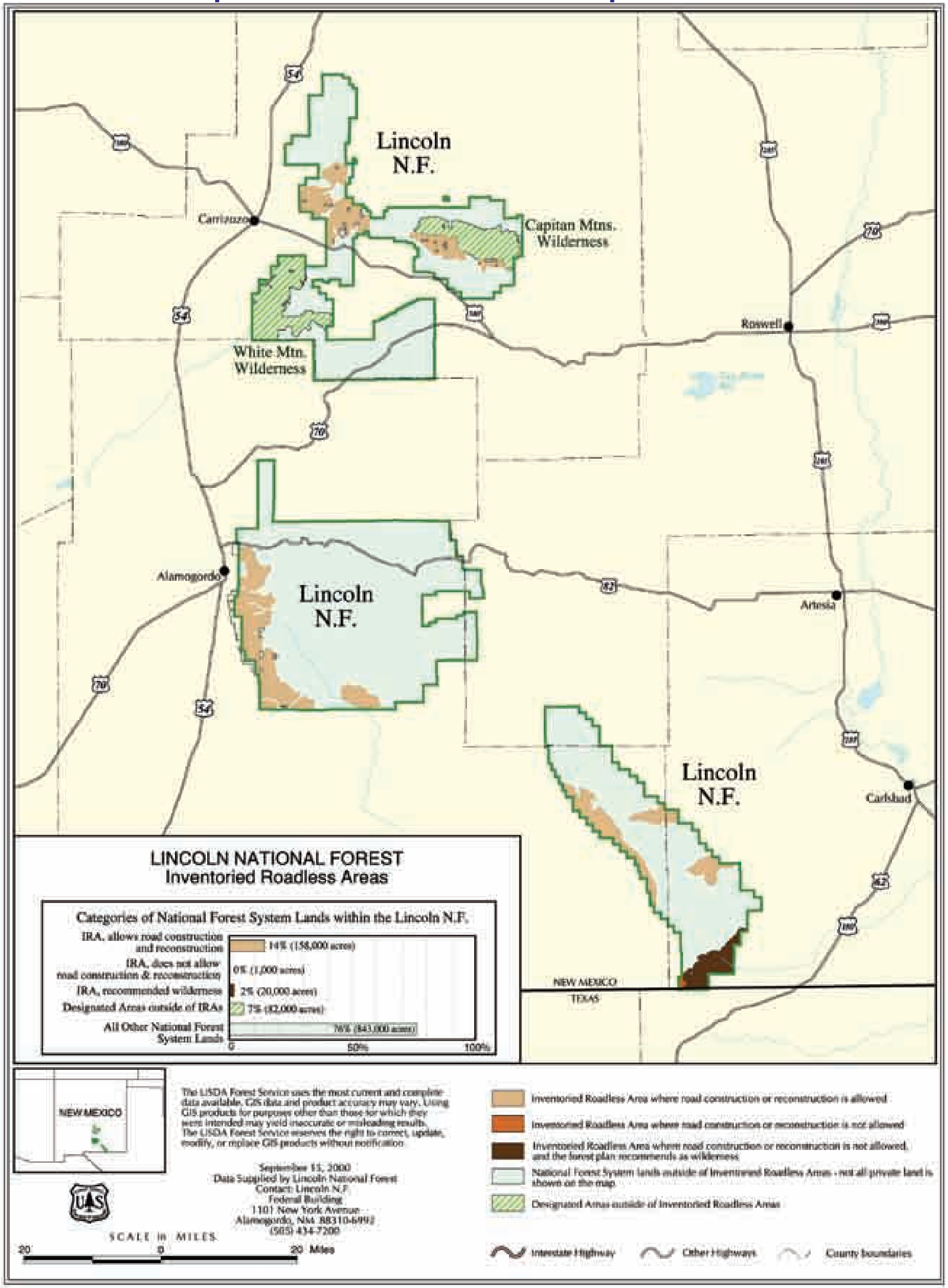

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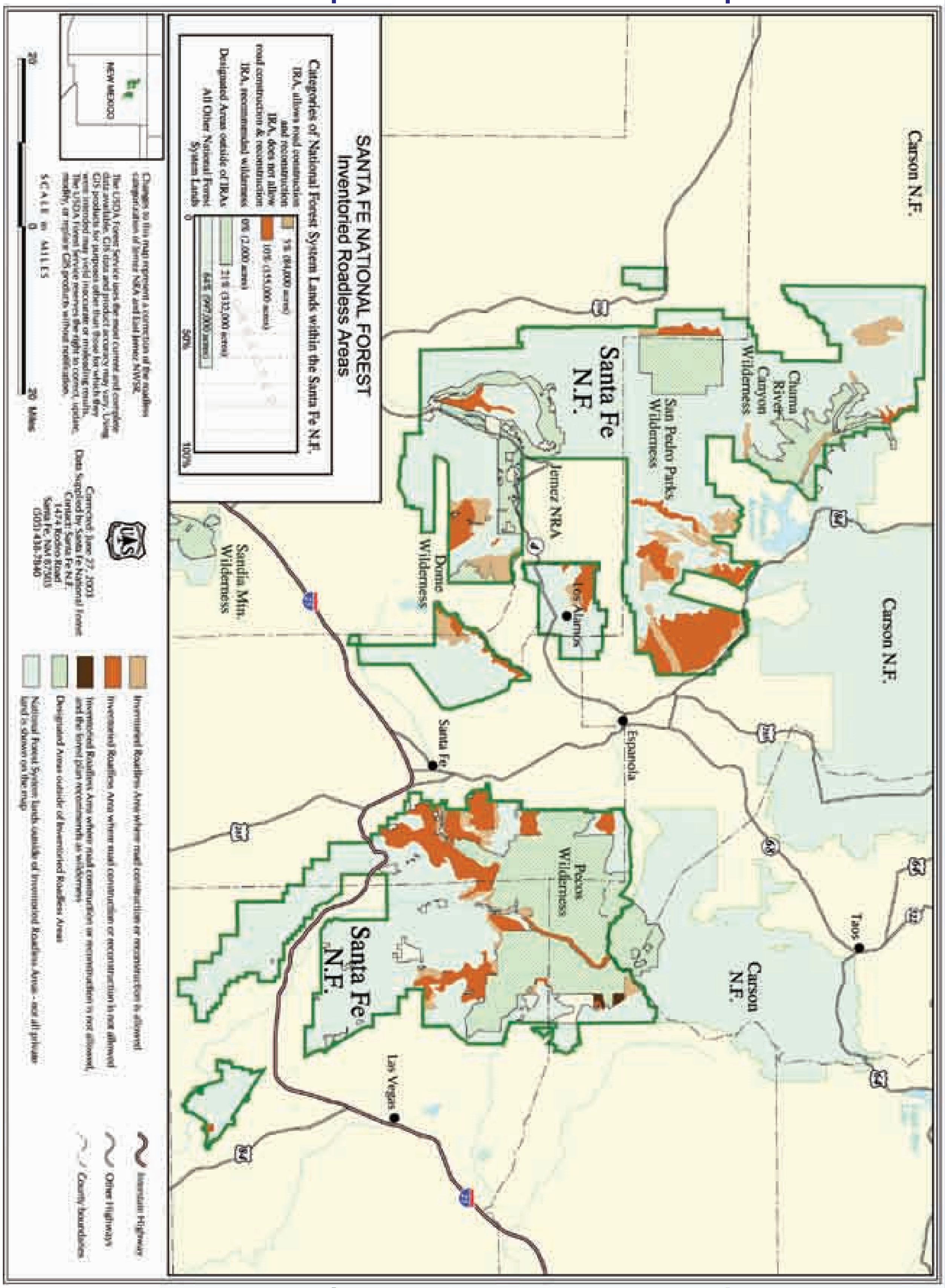

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