

Rare Carnivores And Highways - Moving Into The 21st Century

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Abstract

A serious conservation issue is facing rare carnivores (grizzly bear, *Ursus arctos*; gray wolf, *Canis lupus*; wolverine, *Gulo gulo*; lynx, *Lynx canadensis*; fisher, *Martes pennanti*) is the impacts created by highways. Carnivores are vulnerable to highways because of their large spatial requirements, which require frequent crossings of busy roads. Several carnivores also have low reproductive productivity, which can contribute to their extirpation. Highways are habitat and ecosystem issues. Highways affect carnivores by creating serious habitat fragmentation, increasing direct and indirect mortality, habitat loss, displacement and avoidance, and accelerating associated human developments. The impacts of highways on carnivores are permanent and severe. Rare carnivores face serious threats or eventual extirpation in the lower 48 states and southern Canada if highway issues are not addressed and solved. Presently, little or no emphasis is placed on highway impacts by land management agencies, wildlife agencies, conservation organizations or highway agencies. Suggested priorities for reducing highway impacts on carnivores include: 1. Development and implementation of national policies requiring Federal Highways Administration and land management agencies to address highway impacts on wildlife species - particularly rare carnivores. 2. Better highway planning and coordination standards. 3. Identification and management of critical land corridors. 4. Implementation of highway crossing structures for wildlife. 5. Emphasis on highway research.

Two years ago we met in Orlando, Florida to discuss wildlife and highway issues. Since then, my professional life has been a series of jubilation's and disappointments. I mentioned at the last symposium that why we were meeting was a mystery to most of our peers and employers. This is no longer so, our peers have barely awakened, but the powers that control our highway systems have taken notice. The reaction so far from the highway agencies has not been openness and acceptance - but a dialog is starting. If you are a type "A" person, this is not an area you should work in. Progress has been slow, sometimes almost imperceptible.

The issues of highway effects to wildlife, fish and plant communities have begun to be accepted in the wildlife and fisheries professional communities. And, we now have important environmental group commitment. This is an issue that cannot go away if we are to address some of the most important national and global effects of our burgeoning human population.

You will hear startling information about highway effects to wildlife and fisheries at the symposium. The amount of information can be overwhelming. Where do we start to make a difference? What are the priorities for dealing with an issue that affects nearly all species in every state and province in North America? I suggest that we need to focus on rare and vulnerable species first. Near the top of this list would be the rare carnivores. Rare carnivores include the Florida panther, many of the declining black bear (*Ursus americanus*) sub-populations (Pelton, M., 1986), grizzly bear, wolves, lynx, wolverine, fisher and the rare foxes.

The rare carnivores are inherently vulnerable to highways for the following reasons: 1. They exist in low relative densities. Most

are at the top of food chains and have always existed in low densities. 2. Their productivity is generally low. These species have evolved being long-lived, have high parental involvement with their young, and may not reproduce until several years of age (8 years, or older for grizzly bear). 3. Their home range size is very large - often 25, 50 or even a 100 square miles, or more, in size. Dispersal can involve trips of hundreds of miles - sometimes, single animals will make these treks several times during their lives. These animals must roam far and wide to sustain themselves and survive. 4. Carnivore populations require large, interconnected areas for long-term persistence and viability. 5. They are poorly adapted to threats like increased mortality, habitat loss, human disturbance and habitat fragmentation.

Highways are serious habitat and ecosystem issues that effect wide-ranging species, like carnivores, in almost all aspects of their lives from feeding, breeding, dispersal, and mortality.

Although covered in my presentation at the 1996 highway mortality symposium, I would like to briefly cover *how* highways affect carnivores. This is critical because these are the factors that must be addressed and corrected if progress is to be made. Highway projects or activities that are impacting rare carnivores, or other species of concern, must clearly address these five factors in state or Federal environmental documents. Also, if the species are listed, proposed or have special agency designation - these are the five factors that should be focused on in the biological assessment or evaluation. I have yet to see a highway project environmental document that deals with these basic cause and effect relationships.

1. Habitat Fragmentation. Is easily recognized if you look at a map of the United States with primary and secondary highways displayed (Figure 2). Rare carnivores are generally present only in locations with the lowest highway densities. Highways, and other human developments tend to create boundaries for both individuals and populations (see Harris & Gallagher 1989; Matthiae & Stearns 1981; Maehr 1984; Noss 1991; Ferreras et al. 1992; Reed et al. 1996; Boecklen & Gotelli 1984; Harris et al. 1982). An important aspect of habitat fragmentation is that it commonly isolates small populations, subjecting them to demographic and stochastic factors that reduce their persistence.

2. Direct Mortality. This factor is exceedingly difficult to quantify, document and understand. The existing information is imperfect, but points in a singular direction. Carnivores are particularly susceptible to highway mortality because of their large home ranges, low biological productivity and the enormous sized areas required to sustain populations and individuals. Due to the long life spans (over 30 years for grizzly bear), carnivores can continue existing as individuals - without persisting as populations.

An example of how large home ranges affect carnivores relationships with highways can be seen with wolverine in central Idaho, where individual male home ranges extend from south of Stanley north to Highway 12 (Copeland, personal communication). This home range extends entirely across the largest roadless-wilderness complex in the lower 48 states, indicating that even the largest undeveloped areas in the lower 48 states and southern Canada are likely too small for individuals and populations and hence many such areas must be linked together to provide adequate

habitat (Paquet 1995). This requires that individual carnivores must cross highways to sustain themselves and the populations they are associated with.

Examples of direct mortality are numerous (see Damas and Smith, 1982). In Banff National Park in 1996, there were 11 wolf mortalities caused by collisions with cars, trucks and trains. This was the equivalent of the entire known wolf reproduction for the park and surrounding area. When wolves recolonized NW Montana, the alpha male wolf was killed twice on I-90 (Bangs, personal communication). In Weaver's (personal communication) wolf study in Jasper National Park and Paquet's in Banff National Park, highway and railroad mortality averaged 1-2 per pack per year. Recent pup mortalities on highways has been 1 of 3 young of the year on the Deerlodge-Beaverhead National Forest (Mariani, personal communication). Highway mortality has also occurred in Yellowstone during the first year of wolf relocation (Bangs, personal communication). Mech (1977) noted that roadkills constituted a third important cause of death for the population of wolves that he studied in Minnesota.

Examples of other carnivore highway mortality are sporadic, but increasing as awareness of the concern heightens. Dave Lewis (Western Forest Carnivore Committee, 1996), has recently observed wolverine mortality on highways and railroads in British Columbia (1 of 13 radio-collared wolverine was killed on a highway and 1 killed on a railroad). A recent lynx translocation in the Adirondack's of New York was foiled largely due to highway mortalities (Brocke et al. 1991). Fisher highway mortality has been observed in Alberta, Canada during a recent translocation effort on roads that would be characterized as "low traffic density" (Western Forest Carnivore Committee, 1995). In another Fisher study conducted in Maine 4% of the study population was killed by collisions with automobiles (Krohn et al. 1994).

Ferreras et al. (1992) studying Iberian lynx (*Felis pardina*) in southwestern Spain found that the second most important cause of mortality was road traffic. Florida panthers (*Felis concolor coryi*) have been particularly vulnerable to direct mortality from road traffic. Harris & Gallagher (1989) have found that 65% of known Florida panther deaths since 1981 have been roadkills, while Maehr (1991) calculated road mortality at a slightly more conservative figure of 49% of all documented panther deaths.

Gibeau (1993) studying coyote (*Canis latrans*) use of urban habitats had 21 study animals killed on highways between July 1991 and March 1993. This constituted a 35% highway mortality rate. Gibeau & Heuer (1996) have compiled data for roadkills for various carnivores on the Trans-Canada Highway in the Bow River Valley.

In Texas, the major cause of mortality for the ocelot (*Felis pardalis*) population has been ocelot-automobile collisions (Jenkins 1996).

Information from Florida on black bear road kills suggests that while vehicle use of highways in the study area increased by 100% (to 24,000 vehicle trips per day), black bear road kills went from less than five to over 90 in the same period (Gilbert & Wooding, 1996).

Indirect mortalities occur from highways from people shooting animals. Wolves have recently been shot from highways near Pinedale, Wyoming and Eureka, Montana (Bangs, personal communication).

3. Direct Habitat Loss. This is an obvious impact that is rarely documented. The cumulative effects of habitat loss must be staggering across North America and other continents. A 300 foot cleared right-of-way would consume 5.7% of each section it crosses. Indirect habitat loss due to displacement or avoidance (Harting 1987; Paquet & Callaghan 1996) is unclear, but likely averages 1 kilometer on each side of a highway in heavily forested or vegetated areas to 3 kilometers on each side in open habitats (Weaver, personal communication). This loss should be considered permanent and significant on a cumulative basis.

4. Displacement and Avoidance. While the impacts of forest roads on carnivores have been studied for decades, information on

highways is much less documented. Recent information has evolved from Yellowstone National Park (Mattson, et al, 1987) and Banff National Park (Paquet, 1993) that suggests wolves and grizzly bears are displaced by highways and generally avoid crossing them. Paquet & Callaghan (1996) concluded that, "wolves have been physically displaced, partially alienated, or blocked from using a minimum of 92 km² of the Bow River Valley's montane, i.e., 62% of the best wolf habitat in the Bow River Valley. Much of the problem is the result of disruption from the Trans-Canada Highway." This can result in a number of biological concerns from disproportionate use of habitat, to fragmentation of populations. Copeland (Western Forest Carnivore Committee, 1994) and others (Gibeau & Heuer 1996) have noticed that wolverine and other carnivores home ranges tend to be along highways, rather than crossing them.

5. Associated Human Development. As access increases, the amount of associated development increases also. Land values reflect ease of access. In the Yaak area of NW Montana, the paving of what is now State Highway 508 and the increased ease of access has resulted in subdivisions, and increased seasonal and year-long human use of a once remote valley. The Yaak River valley is home to grizzly bear, black bear, wolves, mountain lion (*Puma concolor*), lynx, wolverine, fisher, American marten (*Martes americana*) and other carnivores. Whether or not these animals can persist along with the increased human use and development remains to be seen. This impact is severe and permanent for carnivore communities.

The severity of the above five factors must be also addressed. These impacts are permanent and cumulatively can and do extirpate individuals, populations and species. Highways present one of the major challenges to conservation of large and mid-sized carnivores in North America and elsewhere. We must begin to deal with the problem soon.

The issues have now been expressed. So, where do we go from here? What do we need to do in the 21st century to ensure our natural heritage is passed on to future generations?

1. Improve National and Agency Policies. At the present time, highway planning, construction and related activities like right-of-way management and future developments are dealt with piece-meal, and with cursory concern for issues like conservation of carnivores. Important highway legislation like ISTEA (Intermodal Surface Transportation Efficiency Act) provide almost no mention of how highway systems should interface with natural environments or ecosystems. The emphasis in ISTEA is cost efficiency (putting down a maximum amount of highway for the least cost), moving vehicles from point A to point B, human safety and providing construction jobs and revenue. Ecological factors must be given greater consideration if highway departments are to give wildlife and fisheries habitat adequate protection.

There is a confusing arrangement of agency policies and jurisdictions that make accountability of serious environmental issues nearly impossible. For example, whose responsibility is it to address listed species on highways crossing Federal lands? Is it Federal Highways Administration? Is it the land management agencies like the Forest Service, Bureau of Land Management and Park Service? Is it the state DOT's? Or, the state wildlife agencies? Where do agencies like the US Fish and Wildlife Service and National Marine Fisheries Service fit in? Who's accountable? Who pays the costs of highway coordination with rare species? The answers to these questions will largely determine how issues like rare carnivores are addressed – or, even if they will be addressed. The confusion over jurisdiction and funding has resulted in interagency infighting and important environmental issues such as wide-ranging carnivore habitat to be avoided.

The quality of biological input to highway environmental documents needs improvement. As previously mentioned, it is uncommon that species like rare carnivores are adequately addressed in Federal or state highway project NEPA documents, or that the five factors important to carnivore conservation are accurately portrayed.

Coordination with Federal land management and state wildlife biologists is inconsistent and needs improvement. Section 7 (Endangered Species Act) consultation on highway projects has occurred with ambivalence from both action agencies and regulatory agencies. In spite of the fact that listed species are commonly killed on highways and serious habitat fragmentation is evident, I have never seen an "incidental take statement" for a highway project – nor "terms and conditions" to avoid such taking. Effective mitigation measures are absent in all but a few high profile situations like the Florida panther.

Mitigation for serious highway environmental effects caused is optional at the present time. Highways receive preferential treatment compared to other major construction projects of similar magnitude and impact. Reservoirs must provide wildlife and fisheries compensations for habitat that is lost or severely impacted. For some habitats like wetlands, mitigation is required. Serious and permanent habitat loss and degradation is occurring to wildlife and fisheries habitat caused by the impacts of highways. Until there are National Policies requiring mitigation of serious ecological impacts, such as loss of habitat on public lands, mortality of listed, proposed, candidate and sensitive species, displacement and habitat fragmentation, these impacts will continue.

2. Better Highway Planning and Coordination Standards. Broad-scale "ecosystem" level planning is needed to identify priority species, to identify priority habitats and ecological areas, to establish effective mitigation measures and provide an ecological context for highway projects to evolve from (Smith, D.J.; Harris, L.D.; and F.J. Mazzotti, 1996). Most highway projects are accomplished in segments consisting of a few miles here and there. The cumulative effects of many such projects – or the existing facility are never addressed. Federal land management planning routinely addresses land allocations and coordination of other kinds of projects but almost never includes standards for highways beyond providing recreation sites and visual quality objectives.

At the project level, there needs to be "biological standards" for highways to conform to. Such standards are routine for other projects like timber sales, forest roads, range allotments and recreation sites. An interagency "Wildlife and Fisheries Highway Coordination Handbook" would help standardize biological standards, effects analysis and mitigation measures and procedures. A handbook or guide would legitimize many of the concerns being expressed at this symposium. Dealing with serious wildlife and fisheries concerns remain optional for many highway projects.

3. Identification and Management of Critical Land Corridors. This should be part of "broad-scale highway planning", however since broad-scale planning has not occurred most places, it needs to be mentioned. There are two reasons why this is important. First, is so that strategic areas can be identified for highway crossings. These might be for carnivores or many other wildlife or fish species. Second, important land corridors that are on private lands should be identified for conservation easements or acquisition. In most of the United States and southern Canada, there are only a few potential areas left where habitat connectivity can be maintained. From a biological perspective these are critical areas that need to be identified and protected. (see Forman, R.T.T., and A.M. Hersperger. 1996, Leeson, B.F. 1996, Ratcliffe, E.J. 1974, and Woods, J.G., and R.H. Munro., 1996).

An outstanding example of how this can be done is on the Flathead Indian Reservation in NW Montana. Tribal biologists have identified an important wildlife corridor along Highway 93 between Missoula and Polson. The tribe has acquired lands, moved some permanent residences, and provided protective land management restrictions.

Another example is a recently completed "draft" set of maps for Montana, Idaho and Wyoming that provides important highway segments for carnivore habitat connectivity in the Northern Rockies. It also provides areas where critical public land corridors are fragmented with private lands. We are currently developing a similar map for Oregon and Washington.

At a finer scale, I recently worked with the Beaverhead-Deerlodge National Forest, University of Montana, and Montana Department of Transportation on potential crossing areas for lynx, wolverine, wolves and bears in the Pioneer Mountains of Montana. Unfortunately, there is no assurance that either the broad-scale state maps, or the Pioneer Mountain maps will be used to provide highway crossings for carnivores.

4. Implementation of Highway Crossing Structures. Providing safe and effective areas for carnivores and other wildlife to cross highways is a concept that needs greater attention and implementation. The location of wildlife crossing structures is critical, as is the their design. Associated land uses need to be compatible, as does associated human activity levels. The objective should be to make highways "permeable" to wildlife, providing adequate crossing structures throughout highway corridors for back and forth movements. The number of highway crossing structures should be determined by on-site analysis, knowledge of wildlife movement patterns, location and size of land corridors, and wildlife preferences and behavior patterns. For large animals like elk, bears, wolves, wolverine, lynx, fishers crossing densities should be approximately one per mile, or less. (see Foster, M.L., and S.R. Humphrey, 1995; Land, D., and M. Lotz, 1996; Leeson, B.F. 1996; and Sanderson, K. 1983).

5. Increased Emphasis on Highway Research. One of the factors exacerbating effective highway coordination is the small amount of scientific resources available to guide impact appraisal and mitigation. Correcting this problem is important on two fronts. First, it is important for biologist credibility that there be biological data to back up impact claims and proposed mitigation. Second, we all want proposed mitigation measure to be effective. The cost of some mitigation measures is hundreds of thousands or millions of dollars. Agency leaders are reluctant to spend this amount of money for projects that are of "experimental design."

However, research into highway impacts and cures should not be in lieu of going forward with mitigation measure immediately. We cannot wait for long term research in many situations. We must begin implementing mitigation measures that potentially improve serious problems. Most of time our attempts to mitigation problems will be helpful. We will learn quickly what is working and what is not if we focus research on reviewing and improving highway mitigation measures.

In conclusion, we have made progress in the last year or two. The biological, environmental, engineering communities largely realize there is a serious and growing environmental problem associated with highways. The agencies have not caused this problem, it is caused by the increasing number of people and vehicles on our planet.

As a society, we must decide to either deny or ignore the problem, or recognize it and begin solving it. There will be people among us that will claim there is not a problem. There will be those who will want to ignore it. Many will say the solutions are too expensive. Others will brand the messengers of the problems as "unreasonable", obstructionists or political naives. A few will likely resort to intimidation or ridicule.

But the cat's out of the bag. That cat is the Florida panther, the lynx and the ocelot. And they represent a multitude of other species that face serious decline or extirpation unless highway environmental effects are recognized, displayed to the public and dealt with. In the end, it will be the public that will demand that we have both Florida panthers and highways. They will require public agencies to accept the challenge and move forward with creative and effective solutions.

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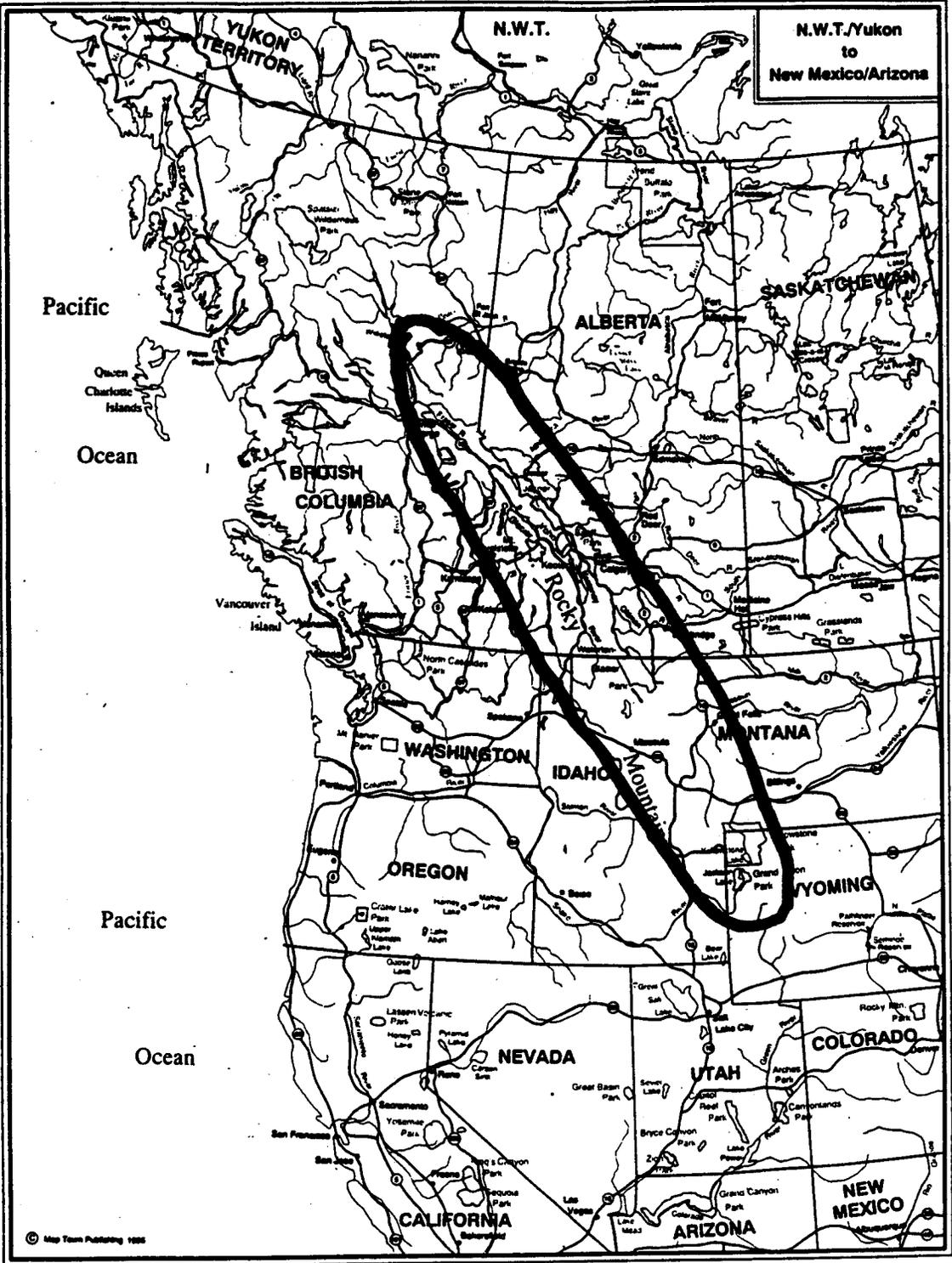


Figure 1
The proposed focal region for the strategy extends along the Rocky Mountain Cordillera from Northwestern Wyoming to Northeastern British Columbia.

United States Primary and Secondary Highways

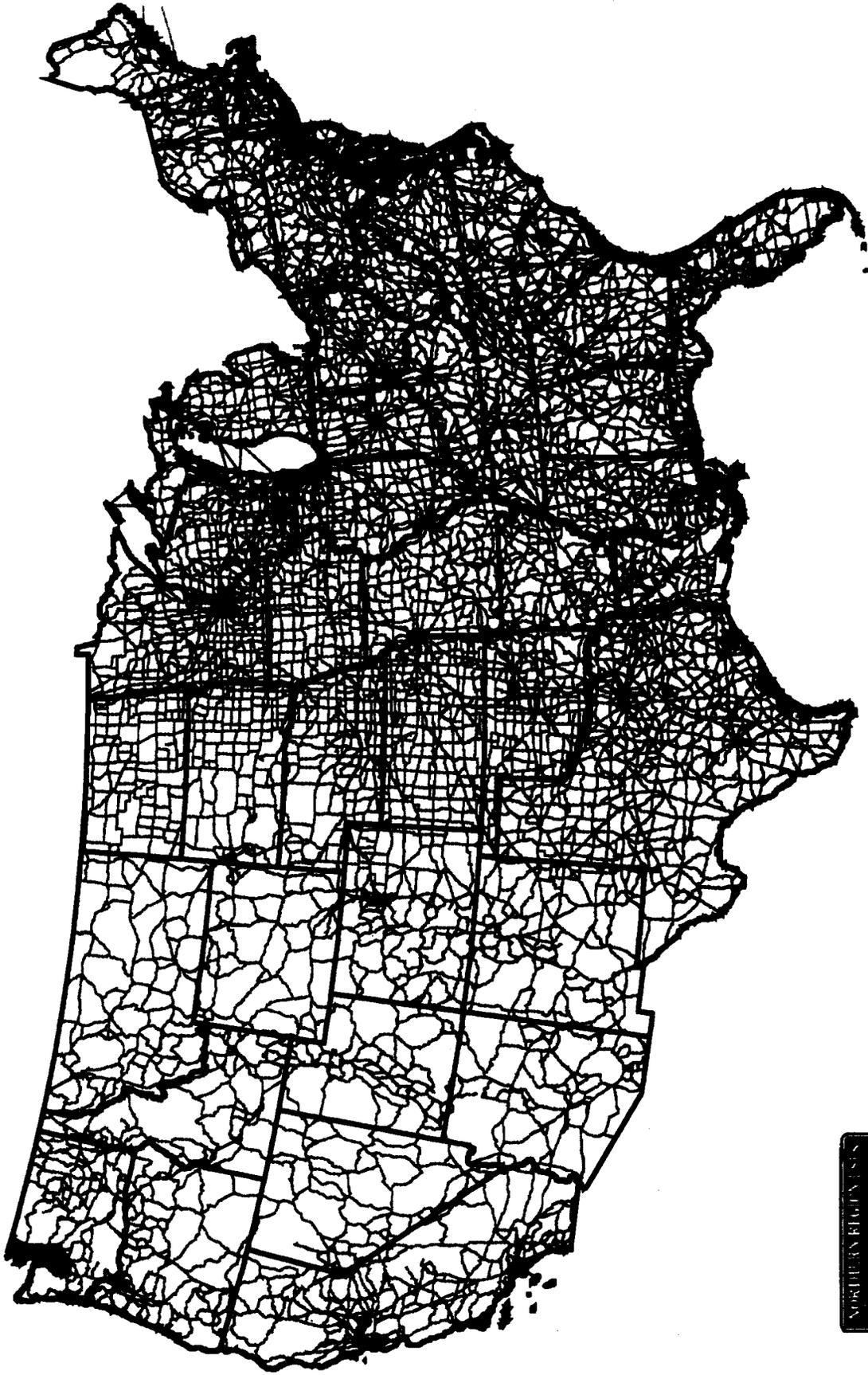


Figure 2

