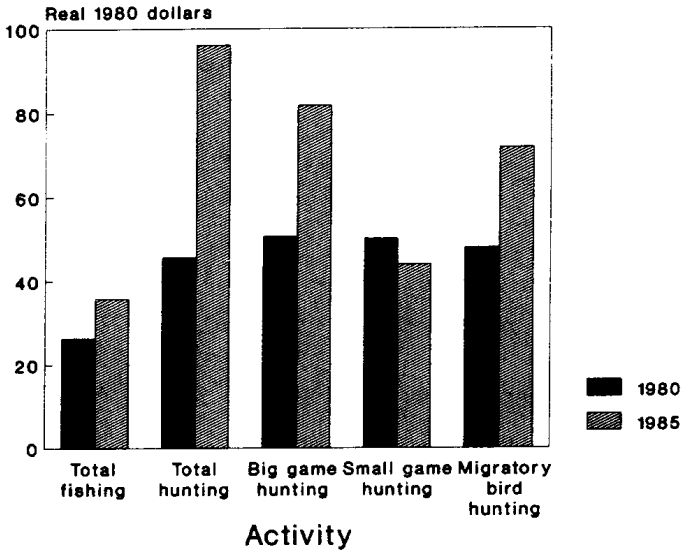
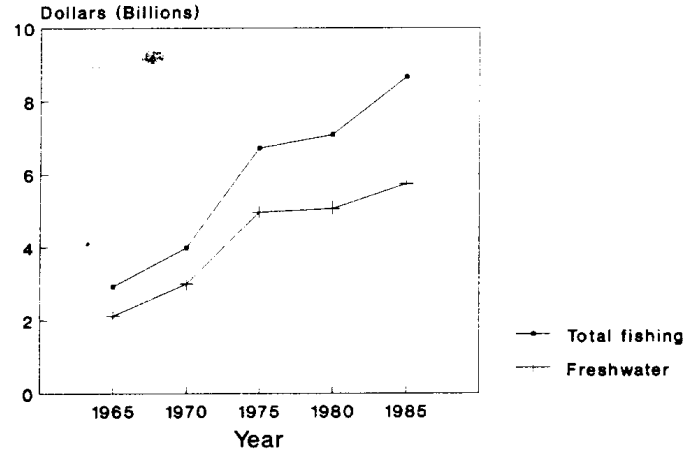


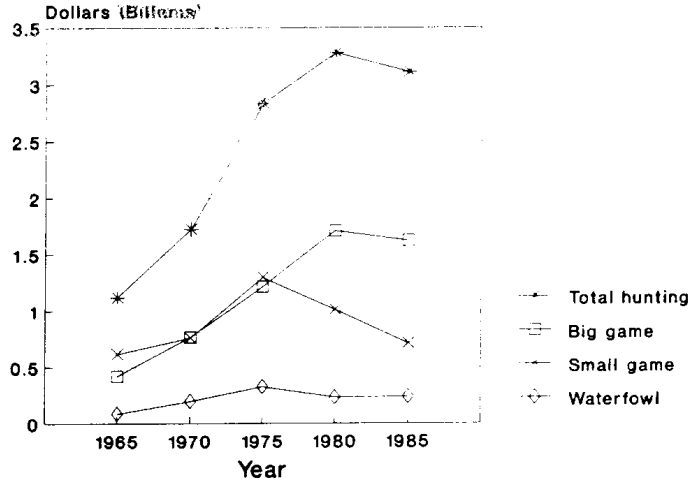
Source: USDI, Fish and Wildlife Service (1988b)

Figure 57.—Trend in private access fees (dollars per individual) for fishing and hunting.



Source: USDI, Fish and Wildlife Service (1988b)

Figure 58.—Trends in gross expenditures for fishing from 1965–1985.



Source: USDI, Fish and Wildlife Service (1988b)

Figure 59.—Trends in gross expenditures for hunting from 1965–1985.

expenditures for primary nonresidential recreation declined from $1.58 billion in 1980 to $1.34 billion in 1985 (in constant 1965 dollars).

Given the recreation use projections in chapter 2, gross expenditures for fishing could increase in response to increased participation. Expenditures associated with primary nonresidential nonconsumptive trips could also increase since the number of recreationists engaging in this activity is expected to increase substantially (154%) by 2040. Hunting-related expenditures could decline as total participation drops. If restrictive regulations are implemented to bring resource use in line with future resource inventories, then the expected increase in fishing expenditures would be dampened while the decline in hunting expenditures would be accentuated.

The effect of future declines in hunting-related expenditures goes beyond the direct impact on support businesses (e.g., those businesses providing lodging, food, equipment, etc.). An input-output model has been developed to track the expenditure effects throughout a regional economy (Alward and Palmer 1983). In a case study of how changes in big game hunting regulations affect the Colorado regional economy, Alward et al. (1984) showed that reduced expenditures not only affected direct support services but also affected wages and employment throughout the majority of industrial sectors comprising the regional economy. Although the greatest impact of reduced hunting expenditures would be to local areas that provide support services to this recreational activity, in the longer term substitute spending patterns would likely result in a restructuring of the regional economy rather than a total reduction in economic activity (Alward et al. 1984).

Declines in the number of hunters and declining expenditures also would impact state wildlife and fish agency budgets. The majority of funds available to state agencies are derived from hunters and anglers either through licence fees or excise taxes on equipment that are authorized under the Pittman-Robertson, Dingell-Johnson, and Wallop-Breaux Acts. State managers have expressed concern that revenues have not kept pace with inflation as many wildlife and fish agencies have experienced substantial declines in real revenue from license sales (Anderson et al. 1985). To maintain wildlife and fish programs, states have had to increase license fees or seek alternative funding sources.

Between 1979 and 1986, state agencies have witnessed shifts in the relative contributions from various funding sources (fig. 60). The most significant change in funding source was the increase from general state revenues. The proportional contribution of licence revenues has declined along with federal payments. The decline in the proportional contribution from federal payments would have been greater had it not been for the Wallop-Breaux program which tripled revenues into the Dingell-Johnson program (The Wildlife Conservation Fund of America 1987).

Anticipating further declines in hunter participation and the potential need for restricted access and use, state agencies will continue to face fiscal challenges and may have to restructure programs and funding sources (see for example Executive Task Force on the Future of Wildlife 1987, Van Vleck 1984). One potential opportunity for increasing state revenues concerns the nonconsumptive user. Although states have taken important steps towards integrating nongame programs into the management of wildlife and fish resources (45 states had recently allocated funds for nongame and endangered wildlife programs), the programs remain severely underfunded (Cerulean and Fosburgh 1986). In 1986, nongame programs represented less than 5% of the total budget in 29 states (Audubon Activist 1987). The nongame income tax check-off program, which is now in use in over 30 states, has witnessed significant declines as other checkoff options have been added to state income-tax forms (Shelton 1987). Harpman and Reuler (1985) concluded that although check-off programs were successful in the short-term, they should not be considered a stable, long-term source for funding nongame wildlife and fish programs.

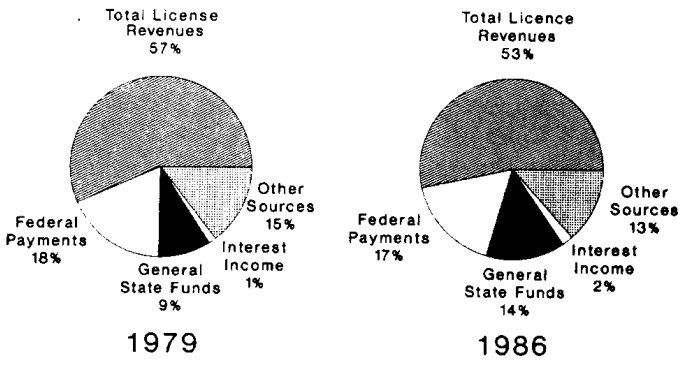
ENVIRONMENTAL IMPLICATIONS

Evaluating environmental implications of the wildlife and fish use and inventory projections requires understanding ecological systems and society's values for the mix of outputs that can be produced from the environment.

Society's values related to the environment have changed over time. The "exploitation era" of the 1800's was driven by strong commercial values (Poole and McCabe 1987). The abundance of natural resources on the North American continent appeared boundless. However, after a century of market hunting, trapping, clearing of forests for agriculture, fuel, and wood products, and plowing of native prairie, some Americans reconsidered the ability of the environment to support the rate of resource exploitation witnessed during the early 1900's (Kimball and Johnson 1978). As wildlife and fish resources became scarce, society's values changed. Notable declines, and in some cases the extinction, of wildlife and fish species stimulated a new emphasis on resource conservation. A series of protective laws was passed and wildlife and fish management became a profession entrusted with the responsibility of ensuring that wildlife and fish resources would be available to future generations.

Despite the growing support for wildlife and fish conservation and the mounting success stories attributable to wildlife and fish management, rising human populations will continue to encroach on remaining wildlife and fish habitat. In addition, continued demand for timber, domestic livestock, and crops will conflict, in many instances, with wildlife and fish resources. The challenge for future wildlife and fish management involves how to balance these multiple resource demands within the constraints defined by the environment. Failure to do so will result in unfavorable environmental alterations for wildlife and fish.

Demands for wildlife and fish resources are also expected to increase in the future, although the relative importance of various recreational activities is expected to change. Hunting-related demands are expected to become relatively less important than fishing and nonconsumptive recreation. Similarly, the American public increasingly pressures management agencies to maintain the integrity of ecological systems (Russell 1987) as evidenced in the passage of laws such as the Endangered Species Act and a number of other federal laws directed at maintaining habitat and species diversity (Bean 1977, Lund 1980). Consequently, more people demanding more wildlife and fish recreation opportunity indirectly demand more vigorous habitat and population management on a dwindling land base. The environmental implications of this assessment involve both habitat and species population considerations.



NOTE.--Other sources includes tax checkoffs

Source: Wildlife Management Institute. Outdoors News Bulletin 41(20).

Figure 60.—Sources of funds for fish and wildlife management in 1979 compared to 1986.

Implications for Wildlife and Fish Habitat

In recent history, the amount and quality of wildlife habitat has been changing. Additional changes are expected in the future, including a decline in forestland area, an increase in rangeland acres (expected under

the Conservation Reserve Program), and continued increases in urbanization. The "Swampbuster" and "Sodbuster" provisions of the 1985 Food Security Act could slow the rate at which wetlands are drained and highly erodible rangeland is converted to crop production. Acreage of open water habitats is projected to increase with farm pond and reservoir construction, and water quality is expected to improve as a result of the 1985 Food Security Act conservation programs and compliance with clean water legislation. In addition to these habitat composition changes (i.e., the amounts of land in various land-use types), future habitats will likely become more fragmented and insular in nature.

In this scenario, the composite national land area available for suitable wildlife habitat is likely to decline. This, coupled with a general increase in the number of wildlife and fish recreationists, will result in more crowded conditions.

Increased density of outdoor recreational use has been shown to cause vegetation trampling, changes in vegetation composition, soil compaction, and increased erosion (Cole 1986, Vaske et al. 1983), all resulting in degraded terrestrial and aquatic habitats. Washburne and Cole (1983) have reported that recreational use of wilderness areas (a portion of which is related to wildlife and fish use) has caused vegetation problems in 71% of all wilderness areas, soil impacts in 61%, and water pollution in 18%. Similar recreation impacts have also been noted in some riparian forests in the eastern United States (Cole and Marion 1988).

Although such impacts can be attributed to both consumptive and nonconsumptive activities, they appear to be especially common among nonconsumptive uses because of the significant increase in participants. Wilkes (1977) has stated that the term "nonconsumptive" has been detrimental to land-use planning because it projects a notion that such activities are benign in terms of environmental impacts, when in fact there are some very real and important impacts that must be addressed to preserve wildlife and fish habitat.

Implications for Wildlife and Fish Populations

As the amount and quality of habitats change, so will the distribution and abundance of wildlife and fish species. Wildlife and fish are critical components of ecosystems and perform various important functions such as pollination, dispersal and germination of seeds, soil and nutrient cycling processes, herbivory, predation, parasitism, and competition (Prescott-Allen and Prescott-Allen 1987). As these roles interact over time, they influence the distribution and abundance of species, the composition of functioning biotic communities, and thus ultimately determine the biotic diversity of animal communities (Harris 1988, Talbot 1987).

Based on the recent historical and future land base trends, faunas could become less diverse as human use of the land intensifies—a concern that is both national and global in scope (Norton 1986, Schonewald-Cox et al. 1983, Wilson 1988). Based on our current understanding, the effects of land-use intensification on biotic diversity can be grouped into four categories (Harris 1988): (1) loss of large, wide-ranging species, (2) loss of area-sensitive or interior species that require large tracts of contiguous habitat, (3) loss of genetic integrity, and (4) increased abundance of habitat generalists characteristic of disturbed environments. Ultimately, these four impacts result in the loss of species that give different communities their unique and distinguishing faunal characteristics while species already widespread and common among many regions are becoming more prominent.

Concern for declining diversity in natural communities is a concern for increasing species rarity and, in the extreme case, a concern for species extinctions. Species associated with old-growth or mature forests, native prairie, and wetlands seem destined to become rarer. Apart from these general perceptions, no one can predict with certainty how many additional species will become threatened or endangered with extinction. However, as land uses intensify, the potential exists for a higher proportion of the fauna to be threatened with extinction. In the United States, less than 10% of the vertebrate fauna is threatened or endangered. In West Germany, where intensive land use has a much longer history, 41% of the vertebrate fauna is endangered or threatened (The Conservation Foundation 1984).

Two direct consequences of increasing species rarity are prominent. First, genetic diversity declines which may ultimately affect the survival or recovery of a species. Loss of genetic diversity permanently eliminates opportunities to study how animals relate to their environments and their potential utility to human (Ehrlich 1988, Schonewald-Cox 1986). A second consequence of rarity is that species' distributions become restricted to isolated areas. Although protection of special habitats has been important in the preservation of some species, Russell (1987) has expressed the view that the ecological legacy that the public wishes to leave to future generations is not one of open zoos in a few isolated areas of natural habitat, but one of healthy ecological systems in a common setting with human populations.

Increasing species rarity within a community is often accompanied by increasing abundance of common, widespread species with general habitat requirements. As was noted in chapter 1, downward trends in breeding nongame bird populations was accompanied by increases in species adapted to urban environments. In addition, Degraaf (1986) found that the habitat generalists dominating urban bird communities were often exotic species. Exotics are anthropogenically displaced species that have not been subjected to the coevolutionary processes important in the original formation of existing biotic communities and therefore violate the community's natural history.

Expression of reduced biotic diversity through dominance of a few abundant species can also lead to important economic costs associated with crop losses, reduction in timber regeneration, or livestock losses. In 1980, estimated losses of property to wildlife exceeded $8.6 million, and the Animal Damage Control Program (then under the Fish and Wildlife Service) spent $17.6 million in wildlife damage control efforts (USDI Fish and Wildlife Service 1981b). Overabundant wildlife usually generates concern for human health. Excessive populations of some furbearers has contributed to near epidemic levels of rabies throughout much of the East (Burridge et al. 1986), and increasing deer populations in the suburban Northeast are raising concern for the spread of Lyme disease.

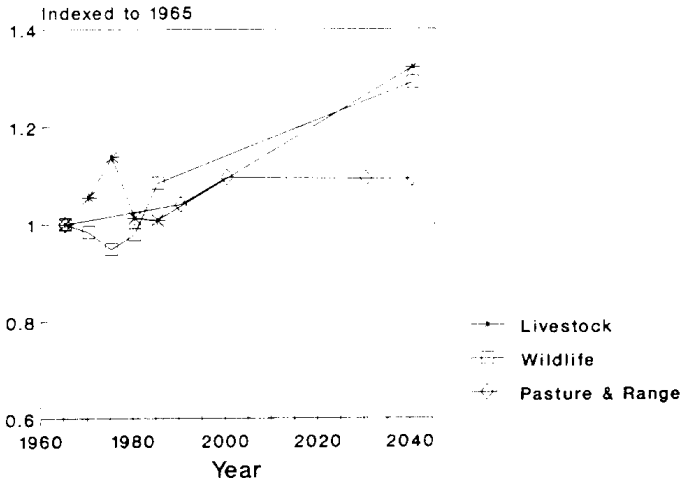
In addition to concerns for reduced biological diversity stemming from land-use intensification, use of wildlife and fish resources in excess of what inventories can support also has important implications to certain wildlife and fish populations. Despite declining dockside prices, commercial salmon harvests were the highest ever in 1985; the salmon population probably cannot sustain such harvest rates (Weber 1986). Illegal duck harvest in one Gulf coast state has been estimated to exceed four times the legal harvest, a situation an already declining duck population cannot withstand (Anderson 1988). Negative impacts associated with excessive use of wildlife and fish, however, are not restricted to consumptive activities. Nonconsumptive recreational activities have also been implicated in the displacement and even the death of wildlife (Cole 1986, MacArthur et al. 1982, Ream 1979, Stalmaster and Newman 1978, Vaske et al. 1983).

Environmental Implications from other Resource Demands

Clearly, public demands for resources other than wildlife and fish are an important consideration in identifying environmental implications. Demands for timber, range, and agricultural goods affect the kinds, amounts, and quality of wildlife and fish habitat. Increasing demands for timber products will likely have to be met with more intensive timber management (Haynes in press). Similarly, livestock forage demand is anticipated to increase which will require implementation of rangeland improvements to meet that demand (Joyce in press). The anticipated needs for more intensive management actions, in response to future demands for a single resource, carry with them multiple resource consequences (Hof and Baltic 1988, Risser et al. 1984).

The wildlife projections provided by state wildlife agencies did not explicitly consider these other resource demands on the land resource base and their resultant influence on wildlife and fish populations. Considering multiple demands for the resources jointly produced from any land type is necessary to avoid unanticipated resource management conflicts in the future.

As an example of the potential conflicts that can result, future wildlife demands for forage were compared to livestock demands for forage. Big game (deer, elk, and pronghorn) population projections from the state wildlife agencies were converted to AUM requirements and compared to projected livestock AUM's for the western United States (fig. 61). From 1985 to 2040, big game AUM's are projected to increase 19%; livestock AUM's are projected to increase 32%. Yet, the rangeland base is only expected to increase 10%. Although the degree of direct competition between wildlife and domestic livestock will depend on the species mix (wild and domestic) in any given area, the projections indicate that grazing pressure on western rangelands will intensify to a much greater degree than that implied by separate wildlife or livestock projections.



Source: Historical data: Livestock: USDA [various years], Joyce [in press], Wildlife: State Wildlife Agencies: 12 of 15 western states

Figure 61.—Indexed trends in livestock and wildlife AUM's and pasture- and rangeland area in the western United States.

SUMMARY

The wildlife and fish use and inventory projections imply certain economic, social, and environmental consequences that can occur if resource use and inventories are not balanced. The social values associated with fish and wildlife resources range from those held by Native Americans for subsistence and religious values, to rest, relaxation, and personal camaraderie resulting from recreational experiences dependent upon wildlife and fish. Declining future inventories or restricting opportunities to enjoy wildlife and fish not only infringes on the lifestyles of certain cultural segments of society, but also reduces or eliminates a recreational outlet for which few substitutes exist.

The economic costs associated with increasing scarcity of wildlife and fish resources can be grouped into direct effects on the "prices" paid by consumers and indirect effects on local economies and resource management budgets. Direct effects on consumers are most

obvious with commercial species such as salmon and furbearers. Concerns have been raised over the need to preserve minimum levels of salmon stocks, the loss of wetland habitats for furbearers, and a growing public sentiment against trapping. Under such restrictions in future supplies, consumers can expect to pay more for these products.

A similar situation holds for wildlife and fish recreation. Although not normally bought or sold under a market structure, wildlife and fish will "cost" recreationists more in the future. As habitat is lost or made unavailable to the recreating public, and as expanding human populations result in more crowded conditions, future recreationists may have to travel greater distances to find suitable recreation sites, or may have to pay access fees which may limit participation to the more affluent of society.

Restrictions on commercial harvests and projected declines in hunting also have indirect economic impacts on income, employment, and state resource management budgets. Employment and income impacts have important consequences in fishing communities such as coastal Alaska where other opportunities are limited. Declining hunter participation and associated expenditures could impact local areas that provide support services for this recreational activity. State wildlife and fish management agency budgets, for which funds are derived primarily from licence fees and excise taxes on equipment, would also be affected.

Growing human populations will continue to encroach on the remaining wildlife and fish habitat. In addition, continued demand for timber, livestock, water, and agricultural crops will conflict, in many instances, with wildlife and fish resources. The challenge for future wildlife and fish management involves how to balance these multiple resource demands within the constraints defined by the environment.

The more crowded conditions suggested by comparisons of future demands and supplies indicate that vegetation impacts, soil compaction, water pollution, disturbance of wildlife, and other environmental problems will increase. Although such impacts can be attributed to all forms of wildlife and fish recreation, these impacts are of particular concern with the fishing and nonconsumptive recreating public because of the magnitude of projected increases.

As the amount and quality of habitats change, so will the distribution and abundance of wildlife and fish. The growing pressures on wildlife and fish are likely to be especially significant for endangered and threatened species and those species with the potential to become so. As the biotic diversity of the nation's wildlife and fish communities diminishes, the nation loses part of its natural heritage and future options for study and other interactions.

The specific resource management issues that stem from the social, economic, and environmental impacts discussed here were identified by state and federal resource managers. Chapter 6 summarizes these issues and reviews the management opportunities that exist to address them.

CHAPTER 6: MANAGEMENT ISSUES AND OPPORTUNITIES FOR IMPROVING THE WILDLIFE AND FISH RESOURCE SITUATION

Wildlife and fish resources were once perceived to have unlimited capacity to support human use (Kimball and Johnson 1978, Schmidt 1978, Taber 1983). With unregulated exploitation of wild populations and habitats, the fact became apparent that conservation of the nation's flora and fauna would require management—willful and informed manipulation by human beings.

Regulating the exploitation of wildlife and fish resources was the first and most important conservation concern in the early history of wildlife management. However, simply regulating the take of game populations failed to control the decline of many animal populations. Growing human populations and the attendant intensified land-use has reduced the availability of suitable wildlife and fish habitats. Human beings have expanded their niche at the expense of other animals (Brokaw 1978). The implication is that conservation of wildlife and fish resources, in light of what are often conflicting human demands for natural resources, will require improved wildlife and fish management (Taber 1983).

WILDLIFE AND FISH MANAGEMENT ISSUES

Management issues were identified by state agencies responsible for wildlife and fish management, National Forest System biologists, and Bureau of Land Management biologists. These agencies provided a priority listing of the most important management issues for each of eight species groups. These groups included big game, small game, waterfowl, anadromous fish, resident coldwater fish, resident warmwater fish, nongame, and threatened and endangered species. Within each species group, management issues were split into four categories: habitat, population, user, and planning-related issues.

Issues Perceived by the States

States are entrusted with the stewardship of wildlife and fish resources; and as resource trustees, they have a major responsibility for wildlife and fish management. Federal agencies also have wildlife and fish stewardship obligations for migratory birds, marine animals, and for animals and habitats on federal lands. However, the federal stewardship role has, in general, been one of cooperation with states to facilitate their management goals (Lund 1980). Under the state ownership doctrine, the state wildlife agencies must hold a comprehensive view of wildlife and fish resources within its boundaries. Consequently, the state biologists' perceptions of the important wildlife and fish management issues presumably represent a composite across all land ownerships.

Information provided by state agencies was summarized by examining the mean priority ranking (where "1" represents an issue of greatest concern) across states and the frequency with which an issue was cited. The overall importance of an issue was assumed to be a function of its mean rank and its frequency. An index of relative importance was calculated using the following method:

1. Divide the mean rank of each management issue by the frequency. The management issue with the lowest quotient is interpreted to be the most important.
2. Calculate an "index of importance" for each issue relative to the most important management issue. This was accomplished by dividing the quotient of the most important issue identified in step one into the quotient associated with each management issue. Thus, the most important issue has an index of importance equal to 1.0.
3. Sort the scores of relative importance calculated in step two in ascending order. The result is a list of management issues from the most important to the least important.

Summary Across Species Groups

State wildlife and fish biologists identified 30 management issues (table 51). At the national level, seven issues appeared to be particularly important to current resource managers. These issues are evenly distributed across the major management categories of habitat, population, user, and planning.

Habitat ranked as the most important management issue identified. Habitat area loss and habitat quality degradation were the two most frequently cited problems and were the greatest concern of all identified management issues. As human populations expand and land uses intensify, the amount and quality of wildlife and fish habitats suffer. Habitat is in many ways the most fundamental management issue now confronting state agencies, for landscapes lacking in suitable wildlife and fish habitats will no longer support animal populations to monitor or uses to regulate. Although states hold wildlife and fish resources in trust, they have no habitat management authority on private lands unless landowners request assistance or enter into habitat management agreements.

The third and fourth most critical management issues concerned aspects of wildlife and fish populations. Inventory information on wildlife occurrence, population

Table 51.—Management issues for all species groups identified by state wildlife and fish management agencies in order of national priority (rank of 1.0 represents issue of greatest concern).

	National			North			South			Rocky Mountain			Pacific Coast		
Management issue	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank
Habitat loss	1.0	142	1.6	1.0	54	1.6	1.0	38	1.7	1.0	42	1.6	1.5	8	1.6
Habitat degradation	1.6	117	2.1	1.9	37	2.1	2.4	24	2.6	1.1	45	1.9	1.0	11	1.5
Lack population information	2.0	98	2.2	1.4	43	1.8	3.7	15	2.5	2.1	32	2.5	2.6	8	2.8
Population low/unoccupied habitat	3.3	57	2.1	4.0	21	2.5	2.6	14	1.6	2.8	18	1.9	4.2	4	2.3
Restricted access	3.3	71	2.6	3.1	29	2.7	4.3	15	2.9	3.1	22	2.6	2.6	5	1.8
Lack info. on public/public support	3.3	70	2.6	3.0	29	2.6	4.5	13	2.6	2.5	26	2.5	11.0	2	3.0
Multiple resource conflicts	3.7	60	2.5	2.5	28	2.1	4.7	11	2.3	5.4	17	3.5	2.4	4	1.3
Lack habitat info. (requirements/inventory)	5.3	37	2.2	4.2	12	1.5	9.5	8	3.4	3.9	15	2.2	5.5	2	1.5
Excessive demand	6.3	42	3.0	4.6	22	3.0	9.6	7	3.0	6.1	13	3.0	.	.	.
Pollution	7.0	33	2.6	4.4	19	2.5	7.5	6	2.0	12.4	7	3.3	22.0	1	3.0
Limited resource planning	9.2	25	2.6	8.8	10	2.6	6.1	7	1.9	12.8	7	3.4	7.3	1	1.0
Population too high	12.2	8	1.1	6.8	5	1.0	16.8	2	1.5	26.3	1	1.0	.	.	.
Habitat management constrained/ineffective	12.4	20	2.8	67.5	1	2.0	7.0	9	2.8	8.8	9	3.0	7.3	1	1.0
Increased human populations	13.0	15	2.2	30.4	3	2.7	4.2	8	1.5	35.0	3	4.0	7.3	1	1.0
Enforcement of regs./inadequate regs.	14.5	19	3.1	12.2	10	3.6	13.4	5	3.0	17.5	3	2.0	7.3	1	1.0
Interspecific competition	15.1	17	2.9	59.1	2	3.5	33.5	2	3.0	11.8	8	3.6	2.1	5	1.4
Barriers to migration	17.8	8	1.6	9.5	5	1.4	27.9	2	2.5	26.3	1	1.0	.	.	.
Hunter ethics	18.9	15	3.2	25.3	4	3.0	50.3	2	4.5	12.4	7	3.3	7.3	2	2.0
Insufficient/inadequate harvest	23.7	9	2.4	50.6	2	3.0	8.4	4	1.5	39.4	2	3.0	29.3	1	4.0
Excessive harvest	24.1	7	1.9	25.9	3	2.3	9.7	3	1.3	52.5	1	2.0	.	.	.
Illegal harvest	25.3	13	3.7	23.6	4	2.8	22.4	4	4.0	26.3	4	4.0	36.7	1	5.0
Declining/low demand	29.3	10	3.3	59.1	2	3.5	33.5	2	3.0	17.9	5	3.4	22.0	1	3.0
Population distribution inadequate	33.0	7	2.6	25.3	2	1.5	27.9	2	2.5	52.5	2	4.0	14.7	1	2.0
Habitat diversity loss	39.9	4	1.8	22.5	3	2.0	22.4	1	1.0	.	.	.	.	.	.
Disease/parasites	53.3	5	3.0	59.1	2	3.5	.	.	.	45.9	2	3.5	7.3	1	1.0
Other population-related problems	53.3	5	3.0	33.8	3	3.0	.	.	.	39.4	2	3.0	.	.	.
Political constraints	68.0	3	2.3	67.5	1	2.0	.	.	.	32.8	2	2.5	.	.	.
Predation	79.9	3	2.7	.	.	.	.	.	.	23.6	3	2.7	.	.	.
Excessive access	155.3	2	3.5	.	.	.	.	.	.	78.8	1	3.0	29.3	1	4.0
Other habitat-related problems	266.3	1	3.0	.	.	.	67.1	1	3.0	.	.	.	.	.	.

Note: f = Frequency.

levels, and population parameters (e.g., natality and mortality rates) are difficult to obtain. Considerable research has been devoted to developing both theory and techniques for monitoring wildlife and fish populations: however, for large scale assessments there is a need for practical techniques that provide information at the regional and state levels of geographic resolution (Hawkes et al. 1983, Moyle et al. 1979, Sanderson et al. 1979). Although the importance of population inventory deficiencies varies across species groups, it represents the third most important management issue when summarized across all species groups. The fourth most important management issue involved low population levels. In some cases, this management issue is ultimately related to low habitat quality. In other cases, wildlife and fish population levels have not reached the carrying capacity of the habitat, or suitable habitat remains unoccupied.

Issues related to resource use are another important component of wildlife and fish management. Regulating the number of consumptive users, hunting and fishing season lengths, and harvest quotas are important responsibilities of state agencies. The amount of forest and rangeland environments has not changed dramatically in the recent past, nor is it expected to change dramatically in the future (Bones in press). However, the availability of land for wildlife and fish recreation has become an important concern. Although certainly related to habitat loss, restricted access is an equally important factor contributing to the declining availability of land for recreation. This is of particular interest in areas of the country with little public land. The problem is not restricted to these areas since access to public land is often controlled by private landowners and trespass privileges are not always granted.

Another important issue related to use of wildlife and fish resources concerns the lack of comprehensive information on attitudes about wildlife and fish resources and their management. There are two points of reference in this management issue. State agencies lack information on the public attitudes and values held for wildlife and fish resources, and the public lacks information on the justification for specific management actions implemented by state agencies. Ultimately, both translate into a concern for public support of wildlife and fish management. As summarized by Peek (1986), wildlife managers need more than ever to ensure public understanding of how proposed management activities will benefit the resource, or run the risk of declining support stemming from a misinformed public.

Because the nation faces increased competition for resources produced from a finite land base, multiple resource conflicts are an important concern of state wildlife and fish managing agencies. More intensive agricultural practices and timber management, competition with livestock, mineral development, water withdrawals for consumption or irrigation, and wildlife damage to crops all serve to illustrate that wildlife and fish management is much more complicated than direct habitat improvement, manipulating animal populations, or regulating use. Resource planning that acknowledges and addresses wildlife and fish in a multiple resource context is critical if future supplies of wildlife and fish habitats and populations are going to be available to commercial, subsistence, and recreational user groups. Although widely recognized as an important planning objective, the integration of wildlife and fish programs into other land management activities remains a notable shortcoming (Peek 1986).

These major issues tended to be consistent across each assessment region though the rank order varied (table 51). There were only a few cases where the most important regional issues were absent from the national list. In the South, a general concern for increasing human populations due to increased migration to the sunbelt states was raised as an important issue. In the Rocky Mountains, a lack of habitat inventory information was viewed as a constraint on effective wildlife management. Interspecific competition was the third most important issue in the Pacific Coast, owing to unique problems on the Hawaiian archipelago with exotics.

The summarization across all species groups provides a general picture of the states' perception of important wildlife and fish management issues. However, important issues specific to individual species categories are lost in such a comprehensive summary.

Big Game

A total of 20 big game management issues were identified by state wildlife and fish agencies. Many are the same as those described by Wolfe (1978) and the previous wildlife and fish assessment (USDA Forest Service 1981). The highest ranked big game management issues included habitat loss, habitat degradation, restricted access for users, excessive game populations, multiresource conflicts, and deficient data to quantify wildlife and fish populations (table 52).

The recent historical picture documented in chapter 1 indicates that issues related to big game management exist at several scales. For example, the loss of forestland throughout the nation will, in general, reduce the habitat available to forest big game species. More specifically, the loss of winter range or thermal cover in the North and West could make the habitat remaining for big game species less useful. Human development on winter range and domestic livestock conflicts were important habitat related concerns in the West. In the North, the absence of forest disturbance was an important habitat management issue. Farming and timber harvesting have replaced, in part, the natural role of fire in disrupting and retarding forest succession (Wolfe 1978). However, forest disturbance factors have not kept pace with the forest succession resulting in a deterioration of big game habitat quality in the North.

An issue unique to big game management was that population levels of some species were considered excessive. This was largely an issue related to white-tailed deer in some of the eastern and midwestern states. Although excessive big game populations were not frequently cited, in those states where it was a problem it was the most important big game management issue.

Table 52.—Management issues for big game identified by state wildlife and fish management agencies in order of national priority (rank of 1.0 represents issue of greatest concern).

Management issue	National			North			South			Rocky Mountain			Pacific Coast		
	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank
Habitat loss	1.0	21	1.6	1.0	9	1.8	1.0	5	1.6	1.3	6	1.5	1.3	1	1.0
Habitat degradation	1.6	16	1.9	2.9	4	2.3	3.9	2	2.5	1.0	8	1.6	1.0	2	1.5
Restricted access	2.0	17	2.6	2.1	6	2.5	1.5	5	2.4	3.2	5	3.2	1.3	1	1.0
Population too high	2.1	7	1.1	1.3	4	1.0	2.3	2	1.5	5.0	1	1.0	.	.	.
Multiple resource conflicts	2.3	18	3.1	1.9	8	3.0	3.4	3	3.3	2.8	6	3.3	2.7	1	2.0
Lack population information	2.4	14	2.6	1.7	6	2.0	.	.	.	2.3	6	2.8	2.3	2	3.5
Insufficient/inadequate harvest	3.6	7	1.9	7.5	2	3.0	1.2	4	1.5	5.0	1	1.0	.	.	.
Population low/unoccupied habitat	3.8	8	2.3	3.8	3	2.3	2.4	3	2.3	5.0	1	1.0	4.0	1	3.0
Lack info. on public/public support	4.9	10	3.7	2.3	8	3.6	15.6	1	5.0	15.0	1	3.0	.	.	.
Illegal harvest	5.5	9	3.8	5.0	3	3.0	4.2	3	4.0	10.0	2	4.0	6.7	1	5.0
Hunter ethics	6.1	6	2.8	5.0	1	1.0	.	.	.	4.4	4	3.5	2.7	1	2.0
Excessive demand	7.9	5	3.0	8.8	2	3.5	9.4	1	3.0	6.3	2	2.5	.	.	.
Increased human populations	9.8	2	1.5	10.0	1	2.0	3.1	1	1.0	.	.	.	.	.	.
Enforcement of regs./inadequate regs.	13.1	1	1.0	.	.	.	.	.	.	.	.	.	1.3	1	1.0
Political constraints	13.1	1	1.0	.	.	.	.	.	.	5.0	1	1.0	.	.	.
Habitat management constrained/ineffective	19.7	2	3.0	.	.	.	4.7	2	3.0	.	.	.	.	.	.
Lack habitat info. (requirements/inventory)	23.0	2	3.5	.	.	.	15.6	1	5.0	10.0	1	2.0	.	.	.
Declining/low demand	23.0	2	3.5	20.0	1	4.0	.	.	.	15.0	1	3.0	.	.	.
Excessive access	23.0	2	3.5	.	.	.	.	.	.	15.0	1	3.0	5.3	1	4.0
Interspecific competition	26.3	2	4.0	.	.	.	9.4	1	3.0	25.0	1	5.0	.	.	.

Note: f = frequency.

Restricted access for users was a contributing factor to the excessive population issue since it constrains meeting harvest objectives. Restricted access is also a concern since it prevents satisfaction of the user demand for the resource. The availability of big game hunting recreation on public lands becomes an increasingly important consideration as access is restricted on private lands. The southeastern states were particularly concerned about access to big game ranges.

Alteration of habitat resulting from land use changes, logging or the lack of logging activities, developed recreation areas, disturbance from off-road vehicles, livestock management, and crop damage by big game species were the basis for the multiple resource conflict issue.

Small Game

A majority of the most important issues related to small game management were the same as for big game; however, the order of importance was different. From the states' perspectives, the critical management issues were habitat area loss, restricted access, habitat degradation, multiple resource conflicts, and low populations or unoccupied habitat (table 53).

A prominent small game management issue was low populations of species associated with agricultural habitats. However, inadequate populations of small game can not be discussed independently from habitat degradation and loss. Many small game species require a close juxtaposition of life requisites. Consequently, the trend toward more intensive agriculture (see chapter 1) has reduced the availability of suitable small game habitats. Fortunately, most small game species have a high reproductive potential and can recover quickly from low population levels when suitable habitat becomes available.

Much of the small game resource is produced on private land and related to agriculture forest-range interfaces or early successional forest habitats. Even where quality habitat exists, restricted access to private lands has resulted in populations that are unavailable to the recreating public. This is particularly important to small game recreation since nearly 75% of all small game hunting occurred on private lands in 1980 (USDI Fish and Wildlife Service, and USDC Bureau of Census 1982).

The relative rankings of small game management issues within assessment regions deviated little from the national level. Concerns for habitat loss, habitat degradation, and multiple resource conflicts were well distributed across the country and tended to maintain their relative rankings across regions. Restricted access was generally ranked as a more important issue and was a more wide-spread concern than low population levels. Low small game populations were a prevalent concern in the South.

Waterfowl

Twenty-five issues were identified to be of concern regarding waterfowl management (table 54). Long-distance migration is a distinctive feature of this group. Consequently, management issues raised by individual agencies many times spanned state and national boundaries.

Loss of wetland habitats was clearly the most important national and regional management issue related to this species group. Wetland habitat degradation and isolation resulting from intensive use of surrounding upland environments was also one of the top concerns raised by the state agencies. As reviewed in chapter 1, the major factor contributing to habitat loss and degradation was agricultural development. Although ducks will make use of agricultural grains, they prefer natural

Table 53.—Management issues for small game identified by state wildlife and fish management agencies in order of national priority (rank of 1.0 represents issue of greatest concern).

Management issue	National			North			South			Rocky Mountain			Pacific Coast		
	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank
Habitat loss	1.0	25	1.2	1.0	11	1.2	1.0	7	1.4	1.0	6	1.2	1.3	1	1.0
Restricted access	2.5	19	2.3	2.6	8	2.3	3.5	4	2.8	2.4	5	2.4	1.0	2	1.5
Habitat degradation	3.2	15	2.3	5.3	4	2.3	3.8	4	3.0	1.7	6	2.0	1.3	1	1.0
Multiple resource conflicts	4.3	12	2.5	5.7	4	2.5	2.8	3	1.7	4.4	4	3.5	1.3	1	1.0
Population low/unoccupied habitat	4.6	9	2.0	7.0	3	2.3	2.2	3	1.3	3.8	2	1.5	5.3	1	4.0
Lack population information	6.0	9	2.6	4.6	4	2.0	.	.	.	5.0	3	3.0	2.0	2	3.0
Lack info. on public/public support	6.3	7	2.1	8.3	3	2.7	.	.	.	2.3	4	1.8	.	.	.
Increased human populations	6.9	6	2.0	.	.	.	2.2	3	1.3	8.8	2	3.5	1.3	1	1.0
Hunter ethics	11.7	5	2.8	27.5	1	3.0	20.0	1	4.0	6.3	2	2.5	2.7	1	2.0
Lack habitat info. (requirements/inventory)	12.5	5	3.0	9.2	2	2.0	8.8	2	3.5	20.0	1	4.0	.	.	.
Habitat management constrained/ineffective	15.6	4	3.0	.	.	.	.	.	.	3.8	4	3.0	.	.	.
Habitat diversity loss	15.6	2	1.5	6.9	2	1.5	.	.	.	.	.	.	.	.	.
Excessive demand	17.5	5	4.2	8.7	4	3.8	.	.	.	30.0	1	6.0	.	.	.
Declining/low demand	31.3	2	3.0	.	.	.	7.5	2	3.0	.	.	.	.	.	.
Insufficient/inadequate harvest	46.9	2	4.5	.	.	.	.	.	.	25.0	1	5.0	5.3	1	4.0
Limited resource planning	62.5	1	3.0	27.5	1	3.0	.	.	.	.	.	.	.	.	.
Predation	62.5	1	3.0	.	.	.	.	.	.	15.0	1	3.0	.	.	.

Note: f = frequency.

Table 54.—Management issues for waterfowl identified by state wildlife and fish management agencies in order of national priority (rank of 1.0 represents issue of greatest concern).

Management issue	National			North			South			Rocky Mountain			Pacific Coast		
	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank
Habitat loss	1.0	27	1.4	1.0	12	1.2	1.0	6	1.5	1.0	7	1.7	1	2	1
Multiple resource conflicts	3.2	11	1.8	2.0	6	1.2	12.0	1	3.0	8.2	2	4.0	1	2	1
Population low/unoccupied habitat	3.7	10	1.9	8.3	4	3.3	1.3	3	1.0	1.4	3	1.0	.	.	.
Habitat degradation	4.4	11	2.5	10.0	2	2.0	3.8	4	3.8	1.9	4	1.8	2	1	1
Restricted access	5.0	12	3.1	11.0	3	3.3	4.4	3	3.3	2.3	5	2.8	6	1	3
Lack population information	6.3	8	2.6	5.7	3	1.7	6.0	2	3.0	6.2	2	3.0	8	1	4
Excessive demand	7.1	9	3.3	20.0	2	4.0	2.6	5	3.2	6.2	2	3.0	.	.	.
Population distribution inadequate	7.7	5	2.0	7.5	2	1.5	5.0	2	2.5	.	.	.	4	1	2
Habitat management constrained/ineffective	8.5	5	2.2	20.0	1	2.0	12.0	1	3.0	5.1	2	2.5	2	1	1
Pollution	9.2	8	3.8	12.3	3	3.7	5.0	2	2.5	6.5	3	4.7	.	.	.
Lack info. on public/public support	13.5	4	2.8	12.5	2	2.5	.	.	.	6.2	2	3.0	.	.	.
Population too high	19.3	1	1.0	10.0	1	1.0	.	.	.	.	.	.	.	.	.
Increased human populations	19.3	2	2.0	.	.	.	4.0	2	2.0	.	.	.	.	.	.
Interspecific competition	21.2	3	3.3	50.0	1	5.0	.	.	.	12.4	1	3.0	4	1	2
Predation	24.1	2	2.5	.	.	.	.	.	.	5.1	2	2.5	.	.	.
Excessive harvest	28.9	2	3.0	15.0	2	3.0	.	.	.	.	.	.	.	.	.
Political constraints	28.9	2	3.0	20.0	1	2.0	.	.	.	16.5	1	4.0	.	.	.
Illegal harvest	33.8	2	3.5	.	.	.	16.0	1	4.0	12.4	1	3.0	.	.	.
Declining/low demand	33.8	2	3.5	.	.	.	.	.	.	16.5	1	4.0	6	1	3
Limited resource planning	38.6	2	4.0	40.0	1	4.0	.	.	.	16.5	1	4.0	.	.	.
Hunter ethics	43.4	2	4.5	.	.	.	20.0	1	5.0	16.5	1	4.0	.	.	.
Habitat diversity loss	57.9	1	3.0	30.0	1	3.0	.	.	.	.	.	.	.	.	.
Other population-related problems	57.9	1	3.0	.	.	.	.	.	.	12.4	1	3.0	.	.	.
Lack information (requirements/inventory)	77.1	1	4.0	.	.	.	16.0	1	4.0	.	.	.	.	.	.
Enforcement of regs./inadequate regs.	96.4	1	5.0	.	.	.	20.0	1	5.0	.	.	.	.	.	.

Note: f = frequency.

foods that grow in or near water (Bellrose 1976). Geese, on the other hand, are more adaptable and will feed readily on green vegetation or waste grains on upland sites (USDI Fish and Wildlife Service 1987a). Agricultural crops are the mainstay of migrating and wintering goose populations (Bellrose 1976). Based on these differing habitats, state concerns for habitat loss and low waterfowl populations were, in general, related to ducks rather than geese.

Because of the close association between waterfowl habitat and agriculture development, multiple resource conflicts also ranked as an important waterfowl management issue. Multiple resource conflicts, however, are not restricted to agricultural land uses but also include timber, range, and water management interactions.

Another correlate of wetlands in agricultural environments is concern over the availability of the resource to the recreating public. Nearly three-quarters of the

nation's remaining wetland habitat is privately owned and restricted access for waterfowl hunters is a problem cited in all regions of the country. Although hunter lease agreements may provide incentive to landowners to provide access and preserve wetland habitats, participation in waterfowl hunting may become limited to that clientele who can afford to pay for the privilege to hunt on private land. In a survey asking state agencies to rank those species most important in hunter lease arrangements, Wiggers and Rootes (1987) found that waterfowl was the most frequently cited species category, followed by white-tailed deer, wild turkey, and bobwhite quail.

Two issues that were of regional importance, primarily in the East, were inadequate waterfowl population distribution and the use of lead shot. Although of low national priority, some southern states are concerned that waterfowl populations are being held farther north during the fall migration which effectively limits the availability of waterfowl for southern hunters. This alteration of migration chronology has been documented for both snow and Canada geese in response to agricultural development and associated reservoir construction in the Midwest (Batemen et al. 1988, Simpson 1988). Lead poisoning in ducks that ingest lead shotgun pellets and secondary poisoning in some raptors that feed on those ducks has been documented (USDI Fish and Wildlife Service 1987a). However, with total conversion to nontoxic steel shot planned by 1991, the lead shot issue should only continue into the short-term.

Anadromous Fish

The most important management concerns related to the anadromous fishery result from the migratory habits of the species comprising this category. These species mature in the ocean and migrate to spawning areas in headwater streams. The number one management issue identified by the states was dams that exist in the east, west, and Great Lakes coastal rivers that serve as migration barriers (table 55). Originally, fisheries biologists thought that providing upstream passage for adults would be sufficient to maintain anadromous fishery stocks. However, research has shown that fish can suffer high mortality as they encounter dams during juvenile downstream migration (Northwest Power Planning Council 1987). The concern associated with juvenile migration to the ocean is further confounded by water storage facilities designed to increase the generating capacity of mainstem hydroelectric dams. These storage facilities decrease water flows over spillways and force passage through the turbines where mortality can be as high as 15% to 20% per dam (Phinney 1986). Consequently, the cumulative impacts associated with passage through multiple hydroelectric facilities can be high, particularly during low flow years (Phinney 1986).

Although considerable progress has been made in the installation of fishways, additional installations, and improved operation of fishways formed the basis for concern with returning adult spawners. Inadequate flows at fishways have resulted in ineffective use of these facilities by migrating salmon and steelhead (Northwest Power Planning Council 1987).

Additional management issues of primary concern included: (1) habitat degradation associated with sedimentation, and the loss of within stream and streamside cover; (2) low populations of certain species including the Atlantic salmon and striped bass; (3) both point and nonpoint sources of pollution; (4) multiple resource conflicts with agricultural development, increased sediment and loss of streamside cover associated with timber harvesting and road development, and livestock conflicts associated with grazing on riparian areas; and (5) excessive harvest. Continual excessive harvests could have the greatest long-term effect on the anadromous fishery but also have the best opportunity for short-term change.

Resident Coldwater Fish

Primary concerns for coldwater fishery management included the loss and degradation of habitat (table 56). Fewer miles of coldwater streams resulting from

Table 55.—Management issues for anadromous fish identified by state wildlife and fish management agencies in order of national priority (rank of 1.0 represents issue of greatest concern).

Management issue	National			North			South			Rocky Mountain			Pacific Coast		
	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank
Barriers to migration	1.0	8	1.6	1.0	5	1.4	2.5	2	2.5	1	1	1	.	.	.
Habitat degradation	1.2	8	1.9	1.3	5	1.8	2.0	1	1.0	4	1	4	1	1	1
Population low/unoccupied habitat	2.5	4	2.0	5.4	2	3.0	1.0	2	1.0	.	.	.	.	.	.
Pollution	3.3	3	2.0	3.6	2	2.0	4.0	1	2.0	.	.	.	.	.	.
Multiple resource conflicts	3.4	5	3.4	3.6	3	3.0	6.0	1	3.0	5	1	5	.	.	.
Excessive harvest	3.8	2	1.5	.	.	.	2.0	1	1.0	2	1	2	.	.	.
Habitat loss	5.0	2	2.0	3.6	2	2.0	.	.	.	.	.	.	.	.	.
Lack population information	5.0	1	1.0	3.6	1	1.0	.	.	.	.	.	.	.	.	.
Excessive demand	5.0	2	2.0	3.6	2	2.0	.	.	.	.	.	.	.	.	.
Enforcement of regs./inadequate regs.	7.5	2	3.0	14.3	1	4.0	4.0	1	2.0	.	.	.	.	.	.
Other population-related problems	7.5	2	3.0	10.7	1	3.0	.	.	.	3	1	3	.	.	.
Disease/parasites	15.0	1	3.0	10.7	1	3.0	.	.	.	.	.	.	.	.	.

Note: f = frequency

Table 56.—Management issues for resident coldwater fish identified by state wildlife and fish management agencies in order of national priority (rank of 1.0 represents issue of greatest concern).

Management issue	National			North			South			Rocky Mountain			Pacific Coast		
	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank
Habitat degradation	1.0	18	1.4	1.0	7	1.3	1.2	2	1.0	1.2	7	1.7	1.0	2	1.5
Habitat loss	1.8	11	1.5	4.8	3	2.7	1.0	3	1.3	1.0	5	1.0	.	.	.
Population low/unoccupied habitat	2.7	11	2.3	2.0	6	2.2	2.9	2	2.5	3.8	3	2.3	.	.	.
Restricted access	2.8	12	2.6	2.3	7	3.0	4.6	1	2.0	2.5	4	2.0	.	.	.
Pollution	3.4	8	2.1	2.2	5	2.0	6.9	1	3.0	5.0	2	2.0	.	.	.
Lack population information	4.1	10	3.2	3.1	4	2.3	3.3	3	4.3	5.5	3	3.3	.	.	.
Multiple resource conflicts	4.1	5	1.6	4.0	2	1.5	2.3	1	1.0	5.0	2	2.0	.	.	.
Excessive demand	5.5	7	3.0	4.0	4	3.0	.	.	.	5.0	3	3.0	.	.	.
Interspecific competition	6.0	6	2.8	10.8	1	2.0	.	.	.	4.4	4	3.5	1.3	1	1.0
Lack info. on public/public support	6.9	6	3.2	8.1	2	3.0	11.5	1	5.0	4.5	3	2.7	.	.	.
Excessive harvest	9.6	2	1.5	5.4	1	1.0	4.6	1	2.0	.	.	.	.	.	.
Habitat management constrained/ineffective	12.9	2	2.0	.	.	.	6.9	1	3.0	5.0	1	1.0	.	.	.
Other population-related problems	19.3	2	3.0	8.1	2	3.0	.	.	.	.	.	.	.	.	.
Limited resource planning	25.7	1	2.0	.	.	.	.	.	.	10.0	1	2.0	.	.	.
Illegal harvest	25.7	1	2.0	10.8	1	2.0	.	.	.	.	.	.	.	.	.
Disease/parasites	28.9	2	4.5	21.5	1	4.0	.	.	.	25.0	1	5.0	.	.	.
Other habitat-related problems	38.6	1	3.0	.	.	.	6.9	1	3.0	.	.	.	.	.	.
Enforcement of regs./inadequate regs.	64.3	1	5.0	26.9	1	5.0	.	.	.	.	.	.	.	.	.

Note: f = frequency.

impoundments, siltation of spawning beds, point and nonpoint sources of pollution, water withdrawals, and increased temperature associated with low flows and low streamside cover all interact to eliminate or significantly reduce the quality of coldwater fish habitat.

As with other groups, habitat management issues have an associated concern for multiple resource conflicts. Agricultural land uses can increase sediment loads and pollution; timber harvesting and associated road-building can alter protective streamside vegetation and also increase the amount of sediments reaching coldwater streams; and cattle grazing in riparian zones can significantly alter vegetation and stream bank structure which are important cover components of fish habitat.

In addition to habitat issues, insufficient information on population status, population parameters, and harvest were also cited as an important deficiency constraining effective management. Potential productivity and harvest pressure can vary considerably from one water body to the next, and detailed inventory information is required to plan for a balanced and efficient use of coldwater fishery resources.

Restricted access was also identified as a management issue constraining efficient use of resident coldwater fishery resources. Access was a particularly important problem in the North where the proportion of public land is low. Access was less of a concern in the South, presumably because public land access is available in the few locations where coldwater habitats occur.

Of the 18 coldwater fisheries issues identified by the states, no identifiable regional profile emerged, suggesting that the issues are generally consistent throughout the nation.

Resident Warmwater Fish

Of the 17 management issues identified for warmwater fisheries, habitat degradation was the most frequently cited and had the highest management priority (table 57). Warmwater habitats are frequently associated with many of the most intensive human uses of the environment, and pollution and other forms of habitat degradation are a significant consequence. While significant progress has been made in improving the nation's warmwater rivers and streams in recent years, water quality was still the number one issue with state agencies. Excessive nutrients from point and nonpoint pollution sources stimulates high phytoplankton blooms causing dissolved oxygen levels to drop below threshold levels needed to sustain the fishery (Boyd 1979). As reviewed by Fajen (1981), other important factors contributing to habitat degradation involve stream channelization which eliminates alternating pool and riffle zones, floodplain development which destablizes the floodplain, and water withdrawals resulting in low instream flows. Loss of important wetland spawning and nursery habitats affects many fish, such as the pikes.

Management concerns related to excessive demand and restricted access are frequently correlated. Accessible warmwater fishing areas are often forced to sustain excessive levels of use that could be alleviated with increased area of fishable water open to the public. Both fish populations and recreational satisfaction are diminished under crowded conditions.

As was the case for coldwater fisheries, inadequate information on populations and harvests of warmwater species is also a major concern. Resource decision-making

Table 57.—Management issues for resident warmwater fish identified by state wildlife and fish management agencies in order of national priority (rank of 1.0 represents issue of greatest concern).

Management issue	National			North			South			Rocky Mountain			Pacific Coast		
	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank
Habitat degradation	1.0	23	2.0	1.0	7	2.0	1.0	6	2.0	1.0	10	2.0	.	.	.
Habitat loss	1.8	13	2.0	1.8	5	2.6	1.7	3	1.7	1.6	5	1.6	.	.	.
Excessive demand	2.1	12	2.2	1.1	6	1.8	6.0	1	2.0	2.6	5	2.6	.	.	.
Lack population information	2.2	12	2.3	1.0	7	2.0	3.8	2	2.5	5.0	3	3.0	.	.	.
Pollution	2.3	9	1.8	1.3	5	1.8	1.5	2	1.0	6.3	2	2.5	.	.	.
Restricted access	3.1	10	2.7	2.0	4	2.3	6.0	2	4.0	4.5	3	2.7	2	1	2
Population low/unoccupied habitat	4.4	7	2.7	5.3	2	3.0	.	.	.	2.6	5	2.6	.	.	.
Multiple resource conflicts	5.8	2	1.0	3.5	1	1.0	3.0	1	1.0	.	.	.	.	.	.
Lack info. on public/public support	6.4	5	2.8	2.7	3	2.3	.	.	.	8.8	2	3.5	.	.	.
Interspecific competition	7.7	3	2.0	.	.	.	9.0	1	3.0	10.0	1	2.0	1	1	1
Enforcement of regs./inadequate regs.	8.1	4	2.8	7.0	2	4.0	3.0	1	1.0	10.0	1	2.0	.	.	.
Declining/low demand	9.5	4	3.3	10.5	1	3.0	.	.	.	5.5	3	3.3	.	.	.
Excessive harvest	11.5	1	1.0	.	.	.	3.0	1	1.0	.	.	.	.	.	.
Lack habitat info. (requirements/inventory)	14.4	2	2.5	3.5	1	1.0	.	.	.	20.0	1	4.0	.	.	.
Habitat management constrained/ineffective	14.4	2	2.5	.	.	.	3.8	2	2.5	.	.	.	.	.	.
Limited resource planning	17.3	2	3.0	.	.	.	3.0	1	1.0	25.0	1	5.0	.	.	.
Population distribution inadequate	23.0	2	4.0	.	.	.	.	.	.	10.0	2	4.0	.	.	.

Note: f = frequency.

Table 58.—Management issues for nongame species identified by state wildlife and fish management agencies in order of national priority (rank of 1.0 represents issue of greatest concern).

Management issue	National			North			South			Rocky Mountain			Pacific Coast		
	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank
Lack population information	1.0	25	1.8	1.0	10	1.8	1.1	5	1.6	1.0	9	2.0	2.7	1	2.0
Lack info. on public/public support	1.1	27	2.1	1.3	8	1.8	1.0	7	2.1	1.0	11	2.4	4.0	1	3.0
Habitat loss	1.3	21	2.0	1.6	6	1.7	1.0	7	2.1	1.5	6	2.0	1.3	2	2.0
Lack habitat info. (requirements/inventory)	2.8	10	2.0	6.9	2	2.5	4.2	2	2.5	1.7	5	1.8	1.3	1	1.0
Limited resource planning	2.9	12	2.5	3.2	4	2.3	1.7	4	2.0	3.8	4	3.3	.	.	.
Habitat degradation	3.0	12	2.6	3.3	5	3.0	5.0	2	3.0	3.5	3	2.3	1.0	2	1.5
Population low/unoccupied habitat	6.9	2	1.0	.	.	.	.	.	.	4.6	1	1.0	1.3	1	1.0
Multiple resource conflicts	6.9	4	2.0	2.8	2	1.0	6.7	1	2.0	18.3	1	4.0	.	.	.
Enforcement of regs./inadequate regs.	6.9	6	3.0	4.2	4	3.0	13.3	1	4.0	9.2	1	2.0	.	.	.
Interspecific competition	13.9	1	1.0	.	.	.	.	.	.	.	.	.	1.3	1	1.0
Habitat diversity loss	13.9	1	1.0	.	.	.	3.3	1	1.0	.	.	.	.	.	.
Pollution	17.1	3	3.7	11.1	2	4.0	.	.	.	.	.	.	4.0	1	3.0
Habitat management constrained/ineffective	18.5	3	4.0	.	.	.	10.0	1	3.0	10.3	2	4.5	.	.	.
Increased human populations	20.8	2	3.0	.	.	.	3.3	1	1.0	22.9	1	5.0	.	.	.
Excessive demand	55.6	1	4.0	22.2	1	4.0	.	.	.	.	.	.	.	.	.
Hunter ethics	55.6	1	4.0	22.2	1	4.0	.	.	.	.	.	.	.	.	.
Restricted access	69.4	1	5.0	27.8	1	5.0	.	.	.	.	.	.	.	.	.

Note: f = frequency.

requires population and harvest data to recommend management actions and to evaluate the success of such activities. Currently, this capability appears to be generally lacking with warmwater fish and many other species groups.

Nongame Wildlife

Unfortunately, nongame species individually and collectively enjoy less data accumulation than game species. Therefore, the most important management concerns were the lack of information about nongame population status, habitat requirements, habitat inventories, and public attitudes and use (table 58). Basic information on population trends and habitat needs is required for effective incorporation of nongame wildlife into multiple resource planning. The states cite both as being inadequate at this time. A similar finding, reported by the USDI Fish and Wildlife Service (1982a), revealed that in 31% of the considered cases, reasons for declines among bird species identified as having declining or unstable populations were either unknown or the species were not adequately monitored. The paucity of information regarding nongame wildlife is widely recognized and a number of workshops have been held to improve the information base on regional aspects of nongame communities and their management (DeGraaf 1978, 1979, 1980; Smith 1975). However, the focus of these workshops has been heavily biased toward nongame birds. Information on nongame mammals, reptiles,

amphibians, fish, and invertebrates has been more difficult to obtain. Even for the relatively well studied class of birds, efficient and accurate estimates of populations cannot be accomplished with current methods (Verner 1985).

Existing information about nongame species, however, does suggest that habitat loss is as much of a concern for this group as for others. Forest management practices influence forest succession, which in turn affects the fauna inhabiting a site at any given time. As forests are managed more intensively, the tendency is to shorten the successional process which can effectively eliminate the habitat for species requiring mature forest stands. Intensive, even-aged forest management can simplify stand structure, can reduce or eliminate special habitat components such as snags for cavity-nesting species, and can also affect the landscape diversity of forest types and successional stages.

Similar concerns for nongame wildlife inhabiting rangeland types exist and are associated with agricultural development and livestock management. Cultivation eliminates grassland communities, grazing can alter vegetation composition and impact special habitat components such as riparian areas in arid climates, and the seeding of exotic species can impair native floras. All negatively impact wildlife communities.

Urbanization associated with expanding human populations is a common disturbance factor on both forest and rangeland environments. Urbanization results in the removal or alteration of natural vegetation which can significantly affect the native fauna. The effect of urbanization on nongame bird communities has shown that, overall, species diversity declines with the avifauna becoming dominated by a few common, often exotic, species (DeGraaf 1986, Geis 1974).

The preceding discussion is not meant to imply that forest and rangeland management for timber or livestock is consistently detrimental to nongame communities. Rather, nongame wildlife represents such a diverse array of species that forest or rangeland management that fails to recognize the animals' habitat needs will tend to reduce the natural biotic diversity characteristic to a particular region. Given that information on nongame communities is lacking, no one can ensure that the habitats of all species will be maintained.

Threatened and Endangered Species

Management issues identified by state biologists were pertinent to species on both federal and state endangered species lists. The major concerns of the states for threatened and endangered species were the loss and degradation of habitat (table 59). These issues were consistent with the information provided by the USDI Fish and Wildlife Service's Endangered Species Information System as reviewed in chapter 1. The frequency with which habitat loss was cited, however, is inflated since state lists often include species occurring at the periphery of their ranges. Consequently, habitat may have been historically rare within a particular state as opposed to being recently lost through resource or human development.

Since part of the basis for a species to be considered threatened and endangered is a low population level, finding that states listed this as an important management issue is not surprising. However, population levels of these species have declined to the point where the genetic consequences must now be considered. As populations reach critically low levels, genetic variability is lost which can ultimately reduce the probability of species survival and recovery (Schonewald-Cox et al. 1983).

The other major management concerns for threatened and endangered species were the lack of adequate information about species population levels, habitat requirements, and public attitudes, which in turn limit effective incorporation of threatened and endangered species into comprehensive resource planning efforts. These

Table 59.—Management issues for threatened and endangered species identified by state wildlife and fish management agencies in order of national priority (rank of 1.0 represents issue of greatest concern).

Management issue	National			North			South			Rocky Mountain			Pacific Coast		
	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank	Index of importance	f	Mean rank
Habitat loss	1.0	22	1.9	1.9	6	1.8	1.0	7	1.9	1.0	7	1.9	1.7	2	2.5
Lack population information	1.0	19	1.6	1.1	8	1.4	2.5	3	2.0	1.1	6	1.8	1.0	2	1.5
Lack habitat info. (requirements/inventory)	1.3	17	1.8	1.0	7	1.1	5.5	2	3.0	1.1	7	2.0	2.7	1	2.0
Habitat degradation	2.0	14	2.3	5.7	3	2.7	3.7	3	3.0	1.0	6	1.7	1.7	2	2.5
Lack info. on public/public support	2.5	11	2.3	4.2	3	2.0	2.1	4	2.3	2.8	3	2.3	4.0	1	3.0
Population low/unoccupied habitat	3.6	6	1.8	6.4	1	1.0	7.4	1	2.0	2.8	3	2.3	1.3	1	1.0
Limited resource planning	3.6	7	2.1	4.0	4	2.5	3.7	2	2.0	.	.	.	1.3	1	1.0
Multiple resource conflicts	7.9	3	2.0	3.2	2	1.0	.	.	.	14.7	1	4.0	.	.	.
Enforcement of regs./inadequate regs.	8.9	4	3.0	11.1	2	3.5	11.1	1	3.0	7.4	1	2.0	.	.	.
Disease/parasites	8.9	2	1.5	.	.	.	.	.	.	7.4	1	2.0	1.3	1	1.0
Increased human populations	10.7	3	2.7	9.5	2	3.0	7.4	1	2.0	.	.	.	.	.	.
Habitat management constrained/ineffective	14.8	2	2.5	.	.	.	4.6	2	2.5	.	.	.	.	.	.
Pollution	17.8	2	3.0	9.5	2	3.0	.	.	.	.	.	.	.	.	.
Interspecific competition	20.8	2	3.5	.	.	.	.	.	.	18.4	1	5.0	2.7	1	2.0
Excessive demand	47.5	1	4.0	25.5	1	4.0	.	.	.	.	.	.	.	.	.
Hunter ethics	47.5	1	4.0	25.5	1	4.0	.	.	.	.	.	.	.	.	.
Illegal harvest	59.4	1	5.0	.	.	.	.	.	.	18.4	1	5.0	.	.	.

Note: f = frequency.

issues are related, in part, to the ownership pattern of remaining habitat. Several states claimed that threatened and endangered species management could not be effective on private lands, citing landowners' lack of concern for the species, limited regulatory authority, and inadequate public understanding about the basis for the states' concern for these species.

Issues Perceived on Public Lands

The Forest Service (FS) and Bureau of Land Management (BLM) are responsible for managing wildlife and fish resources on approximately 525 million acres. Although the states technically have the lead responsibility in the management of resident wildlife and fish populations, the FS and BLM are responsible for managing wildlife and fish habitats. However, strict adherence to this division of responsibility would foster inefficient management of wildlife and fish resources. Consequently, wildlife and fish management is, in practice, conducted through cooperation among state and federal agencies.

The FS and the BLM are multiple-use agencies which by definition means that decisions have to be made as to how lands are used among a variety of competing uses. In many cases, the source of the wildlife and fish management issues facing these two agencies can be traced to this multiple resource management responsibility. Biologists from both agencies were asked to provide a priority listing of the major management issues for each species category. Because of the high degree of cooperation between federal and state agencies, many of the issues are similar to those cited by state personnel.

Forest Service

Biologists provided information on the most important management issues facing wildlife and fish resources in their region. As with the state agencies, the issues varied across the species groups.

For big game species, a major habitat management issue concerned the effect of intermingled land ownerships. Big game species range widely and independently of ownership boundaries. Effective management of big game species on national forests was often viewed as being constrained by human development and resource management on surrounding private lands. This was especially a concern in the West where development of private lands is resulting in losses of important winter ranges, and in the East where private ownerships dominate. Other important habitat-related problems included: (1) a noted decline in shade-intolerant timber types (e.g., aspen, jack pine) through natural forest succession which has reduced the amount and quality of deer and moose habitat in the North; (2) reduction in winter thermal cover (lowland conifer and cedar) in the North; and (3) maintenance of a suitable mosaic of old-growth and second-growth stands for species such as Sitka black-tailed deer in Alaska.

Management issues related to the recreational use of big game were also a prominent concern and were largely related to the distribution of that use. In some cases, hunting pressure and excessive access have increased on national forests as hunting opportunities declined on private ownerships. Road development associated with timber harvesting has increased the accessibility of game to the public and in some instances has facilitated the illegal harvest of deer and black bear. Conversely, in some cases restricted access was the concern. For example, private landowners can deny passage through their property to national forest land, and major portions of some national forests remain undeveloped and inaccessible to big game hunters. The composite result of both access issues is an inadequate distribution of big game recreational use.

A final concern for big game management is that multiple uses of national forests often conflict with big game management objectives. This issue translates into a general concern for adequate integration of wildlife into the resource planning process.

Traditionally, small game and waterfowl have received less emphasis in the resource planning process on national forests. The habitat-related concerns that were raised centered around three issues: (1) loss of both early and late forest seral stages, (2) livestock grazing impacts on riparian and other wetland habitats, and (3) declining quantity and quality of wetland habitats on public and private lands. Other management problems associated with small game and waterfowl derived from the low priority that these species have received in the past. These included a general lack of population and habitat inventory information. In some regions, biologists felt that the resource was underutilized by the public.

Approximately 50% of salmon and steelhead spawning and rearing habitat occurs on national forests in Oregon, Washington, and Idaho; in Alaska the estimate is 27% (Barton and Fosburgh 1986). However, biologists have noticed fewer spawners returning to the headwaters on national forests resulting in an underutilization of available habitat. FS biologists also noted habitat degradation problems associated with livestock grazing, sedimentation from timber harvesting and road development, lack of overhead cover resulting in high water temperatures, and low pH in some eastern streams. Other management issues that constrain effective planning for anadromous fish included inadequate information on habitat condition, the cumulative impacts of forest management, and the economic benefits and levels of recreational use of the fishery.

Resident cold- and warmwater fishery resources share many habitat concerns with the anadromous fishery. In the West, habitat management issues focused on the loss of streambank structure and vegetation due to livestock grazing and poor implementation of recommended streamside silvicultural practices. In the East, habitat concerns involved low streamside cover which elevates water temperature, low pH, and nuisance aquatic vegetation which promotes stunting among panfish populations and hinders fishing. Stunted panfish was also the result of inadequate predators. As with anadromous fish, an important management issue was the lack of adequate

information on habitat, populations, factors limiting productivity, and the effectiveness of direct habitat improvements.

The National Forest Management Act of 1976 (NFMA) mandated the FS to maintain a diversity of plant and animal communities and to ensure viability of all animal species inhabiting the NFS. Consequently, wildlife and fish management and planning must consider the animal community in its entirety, including nongame species which constitute the majority of species found on national forests. A frequently cited nongame management issue raised by FS biologists related directly to the viability requirement. Insufficient information on nongame population status and habitat requirements confound their responsibility to demonstrate that viability of species will be assured. A contributing factor to the inventory problem is the implied number of wildlife and fish species that must be monitored. The NFMA recognizes this concern and requires the designation of species which "indicate" the trends of other species with similar habitat requirements. However, the basic assumption underlying this approach (i.e., that the status of one species is representative of the status of several species) has been challenged (Block et al. 1987, Landres 1983, Mannan et al. 1984, Szaro 1986, Verner 1984). As a result, considerable uncertainty exists in the selection and use of indicator species in resource planning for nongame species.

In addition to concerns stemming from the requirement for maintaining viable populations, important nongame management issues involved quantity and quality of habitat. In particular, the disappearance of old-growth forests, poor distribution of age classes, and loss of bottomland hardwoods were of concern in the East. Key issues raised in the West were provision of adequate habitat for cavity-nesting species, maintenance of old-growth forest habitats for such species as the spotted owl, loss of aspen communities to succession, and the degradation of riparian habitats from livestock grazing practices.

A particularly important subset of nongame wildlife and fish are those species that are currently listed as threatened and endangered. The FS consults with the Fish and Wildlife Service to ensure recovery of listed species. Species of particular concern include the grizzly bear, California condor, red-cockaded woodpecker, Kirtland's warbler, woodland caribou, bald eagle, peregrine falcon, Puerto Rican parrot, Lahontan cutthroat and greenback cutthroat trout, and the gray, Indiana, and Virginia big-eared bats. By definition, concern for low populations and maintenance of habitat are of primary concern for these species. However, other management issues included the lack of comprehensive information on the distribution of all threatened and endangered species on national forests, intermingled ownerships hindering effective management and limiting the recovery of some species, and conflicts between public use in areas with high access and species requiring limited human disturbance.

Bureau of Land Management

BLM biologists from western states provided information on wildlife and fish management issues of primary importance to the agency. In general, the management issues identified are consistent with those issues identified by FS and state biologists. The discussion here will focus on those issues emphasized as particularly important on BLM lands.

Without question, the most important wildlife and fish management issue cited by BLM biologists was the effect of livestock grazing. BLM lands have a history of overgrazing, and although range conditions have improved somewhat, the majority of the public range is still seriously deteriorated and producing far below its potential (Barton 1987). Degraded rangeland condition particularly affects big game winter ranges, which are prevalent on BLM lands, and small game habitats.

Another important issue related to grazing was the impact of livestock on riparian communities. Riparian areas are critical to wildlife and fish, particularly in arid climates. In the West, riparian systems support a disproportionate number of wildlife species when compared to adjacent upland ecosystems (Ohmart and Anderson 1986). Livestock also make disproportionate use of riparian systems, and BLM biologists cited maintenance and recovery of riparian ecosystems more frequently than any other management issue across all species groups.

Other habitat-related issues included adequate distribution of water, conflicts with mineral development, unoccupied desert bighorn sheep habitat, noxious weed infestation, and encroachment of undesirable woody species.

Intermingled ownerships were also cited as a hindrance to effective wildlife and fish management. Instances exist where key habitat features exist on private ownerships and therefore are beyond the management jurisdiction of the BLM; access to BLM lands is often restricted under such ownership patterns; and intermingled ownerships also result in ineffective resource planning unless there is a high degree of cooperation among all land owning parties.

Throughout much of its existence, the BLM lacked the authority and funding to manage its lands (Barton 1986). The agency's mandate to manage for multiple uses is relatively recent. As a consequence of this history, BLM biologists have cited limited inventory information on the amounts and quality of wildlife and fish habitats, the status of wildlife and fish populations, ecological relationships between animals and their habitat, and the distribution of threatened and endangered species as restrictions on effectual multiple use planning.

WILDLIFE AND FISH MANAGEMENT OPPORTUNITIES

Wildlife and fish management has been defined as the art and science of "changing the characteristics and interactions of habitat, wild animal populations, and men in order to achieve specific human goals" (Giles 1969:1). As defined by Poole and Trefethen (1978),

the primary goal of wildlife and fish management is to maintain animal populations at levels that are consistent with the capacity of the ecological system and the social, economic, and cultural needs of the public. Failure to manage wildlife and fish resources would almost certainly lead to the domination of generalist species rather than a balanced interacting fauna (Bolen and Rodiek 1986, Lyle 1985). Berryman (1983:473) asked the questions: "Do we want only to preserve islands of habitat, only remnants of fish and wildlife populations? Or do we want fish and wildlife resources to remain as a part of the fabric of our total landscape and environment?" The management opportunities discussed here are in the spirit of the latter; however, the former is a possible future for some species and communities.

The management issues identified by state and federal agencies were classified into four categories: habitat, population, user, and planning-related issues. This categorization is also appropriate for discussing future wildlife and fish management opportunities. The order in which these aspects of wildlife and fish management are listed is not arbitrary. Habitat is often the factor most limiting to wildlife and fish species, and it makes little sense to consider population manipulations if the habitat does not exist. By the same logic, regulation of users becomes unnecessary when wild populations are not present to be enjoyed by the recreating public. Planning is listed last as it involves all aspects of wildlife and fish management, and in a world of competing uses, must also consider aspects of management across multiple resource areas.

Habitat Management Opportunities

Management issues related to wildlife and fish habitat focused on two aspects. The first was a concern for the loss or total removal of certain habitat types from the landscape. The second was a concern for degradation or the reduced quality of habitats and was usually associated with multiple resource conflicts.

The most obvious management opportunity involves the outright purchase of land. This gives the resource managing agencies control over land-use activities that would otherwise jeopardize the existence of the habitat. Probably the best example where acquisition has been critical to the preservation of a habitat type is the protection of wetland habitats under the National Wildlife Refuge System. Under such programs as the Migratory Bird Hunting and Conservation Stamp, the Wetlands Loan Act, and the Land and Water Conservation Fund, the Refuge System has grown to 90 million acres (Office of Technology Assessment 1984). The Endangered Species Act also authorizes the purchase of land for the protection of critical habitat.

Another important land acquisition opportunity exists through established natural area programs. State (Schwegman 1983), private (Cantera 1983) and federal (Burns 1983) natural area programs have all contributed to an extensive network of protected plant and animal communities. As of 1983, the Fish and Wildlife Service had designated 194 natural areas followed by the FS (148), National Park Service (64), and the BLM (23) (Burns 1983). The BLM also has special authority to designate and protect Areas of Critical Environmental Concern (ACEC). Protection of rare floras and faunas is a prominent objective of this program. The BLM now has approximately 300 ACEC's that cover over 5 million acres (Almand, pers. comm., 1988).

Coordination and cooperation among private, state, and federal programs will be critical to the effective management of these lands in the future (Harwell 1983). Consideration must be given to the size, shape, distribution, and linkages among communities of the same type if the goal of preserving natural diversity is to be attainable. As noted by Hoose (1983), the effect that large-scale disturbance factors such as acid rain, global warming, depletion of aquifers, and air and water pollution will have on the viability of some natural area communities remains unknown. Similarly, protected communities may lose integrity at their borders as private land uses intensify. The implication is that the management of natural areas will have to become more intensive and involve considerations on a broader landscape scale. For example, corridors of habitat to connect nature reserves have been proposed as being important in facilitating gene flow to maintain the ecological integrity of rare and isolated communities (Harris 1984, Office of Technology Assessment 1987).

Protection through purchase is in most cases limited by inadequate funds. The partial purchase of property rights through conservation easements, long-term leasing agreements, or management agreements with landowners have been used effectively in wildlife and fish habitat protection as alternatives to purchase (Gilbert and Dodds 1987). Private landowner incentive programs offer still another habitat protection opportunity that can range from wildlife habitat management assistance to preferential tax treatment for landowners who preserve wildlife habitat. The Sodbuster, Swampbuster, and conservation easement provisions of the 1985 Food Security Act (see chapter 3) provide examples of where such wildlife habitat protection opportunities have recently been implemented.

Protection, through purchase or otherwise, of wildlife and fish habitats is rarely sufficient to maintain the quality of the habitat into the future. The majority of the nation's wildlife and fish habitats exist under a resource management environment of competing uses for the land. Consequently, the general situation facing wildlife and fish managers is that the creation and enhancement of wildlife and fish habitats must be coordinated with other land and resource uses.

Reduced to its most fundamental principles, all forms of habitat restoration or enhancement involve the manipulation of wildlife and fish food, cover, and water in both time and space. The specific habitat management activities that are implemented depend on management objectives; however, some examples of habitat management opportunities are discussed below.

Restoration of degraded ecosystems has a relatively short history in the United States and probably saw its

beginnings with the restoration efforts of prairie ecosystems initiated by Aldo Leopold (Jordan et al. 1987). Out of those initial efforts grew an understanding of fire's role in prairie ecosystems. Since that time, research has demonstrated the important role that fire plays in the maintenance of many range and forest communities. Since the 1970's, many national parks and wilderness areas have been managed under a "let it burn" policy, but this may change as we learn about the consequences of such a policy. Passive management of fire, however, is not always feasible and deliberate controlled burns are a valuable wildlife management tool for improving habitat for wild ungulates (Scotter 1980) and other game and nongame species associated with or dependent on early successional stages (Landers 1987, Peek 1986).

Wildlife and fish restoration may also take the form of simply removing or more effectively controlling disturbance factors. In some cases, resting riparian areas from livestock grazing has been shown to be effective in restoring streamside vegetation communities (Kauffman and Krueger 1984) with associated benefits to both terrestrial and aquatic animals. Wetlands can sometimes be restored by eliminating cultivation and rendering drainage systems ineffective (Office of Technology Assessment 1984). Control of point and nonpoint sources of pollution will allow aquatic ecosystems to recover. Reductions in the use of certain pesticides has helped in the recovery of some raptor populations (Evans 1982). Removal of barriers to migrating anadromous fish represents an opportunity to significantly increase the production on spawning habitats. The Northwest Power Planning Council (1987) is examining a number of structural modifications to fishways that will increase the number of returning adult spawners and reduce mortality to juveniles during downstream migration.

More intensive restoration efforts could involve the direct manipulation of food and cover through seeding, planting, or chemical applications to control noxious or undesirable plants. Aquatic habitat developments also represent an intensive form of restoration management that includes the creation of wetland habitats, water facilities for wildlife in arid climates, structures to enhance the within-stream cover, and small ponds for warmwater fish habitat.

Habitat restoration through direct manipulation of food, cover, and water for the sole purpose of enhancing wildlife and fish habitat is often prohibitively expensive. More efficient habitat management can be attained through the integration of habitat management considerations into the management of other resources. Fundamentally, incorporating wildlife and fish habitat concerns into multiple resource management systems entails ensuring that habitat diversity is maintained. Three aspects of habitat diversity are important. The first aspect is vertical diversity, or the number of vegetation layers present within a given plant community. However, wildlife and fish are mobile resources and therefore require consideration of a horizontal diversity component to habitat as well. The size, shape, and distribution of vegetation types and successional stages in a given area and through time are important to the maintenance of the regional animal community. The final aspect of wildlife and fish habitat diversity is the presence of special habitat components including snags, caves, talus slopes, cliffs, and dead and down woody material. The absence of such special components will result in some species being absent from the community.

Timber and livestock management practices can all be modified to ensure that these aspects of habitat diversity are provided. Wildlife and fish can benefit from timber and livestock management, but only if planned for in advance. Timber harvesting methods, harvest rotations, and intermediate silvicultural treatments can be used to enhance or maintain, rather than limit the quantity and quality of wildlife and fish habitat (Everest et al. 1987, Harris 1984, Thomas 1979). Similarly, grazing systems, season of use, multiple species grazing, and livestock improvement practices (e.g., water facilities, control of noxious plants, fire) can be used to minimize impacts to riparian systems or even enhance habitat quality for wild ungulates on winter ranges (Joyce in press, Scotter 1980). Although integration of wildlife and fish management into timber and range management may carry costs (no single resource output is maximized), it will ensure that certain values, some of which are difficult to quantify, will not be excluded.

Integrated wildlife and fish management certainly represents a viable management opportunity under public lands with multiple use objectives. However, it should not be assumed that integrated resource management is not feasible on private lands. Opportunities exist for state and federal agencies to provide technical assistance to private landowners who desire to manage wildlife and fish habitats on their lands. Opportunities to assist private landowners could be expanded in the future. Under the 1985 Food Security Act, substantial acreage of highly erodible cropland will be planted to permanent cover which, if appropriate species are chosen, can provide high quality habitat for wildlife and improve fish habitat by reducing soil erosion into aquatic ecosystems. In addition, private landowners, including large industrial timber companies, are now entering into lease agreements with hunters and anglers or charging access fees for the privilege of using their lands. McKee (1987) showed that net revenues from the joint production of wildlife and timber under fee hunting situations in the South were greater than revenues generated from maximizing timber production. Such economic incentives may provide the motivation for active wildlife and fish management on private lands, and state and federal agencies have the opportunity to assist in guiding that management.

Population Management Opportunities

Although habitat management may provide the greatest opportunities for improving future wildlife and fish resources, in some cases actual manipulation of populations is required to address certain management issues. Wildlife managers can often manipulate animal numbers

through properly planned harvests more effectively than manipulating environmental factors to improve habitat (Scotter 1980). Under these situations, the goal is one of preventing habitat deterioration stemming from overly abundant wildlife. One of the more important management problems noted by the states was excessive populations of some big game species. Number of licenses, hunting season lengths, and either-sex regulations can all be adjusted to balance big game populations with the environment's capacity. The states have the primary authority for the setting of harvest regulations for resident game populations and population management through exploitation will continue to be an important responsibility of state agencies.

Another management issue raised by state and federal agencies was the prevalence of unoccupied habitat. Transplanting of wild stock offers an opportunity to hasten colonization of suitable habitat—assuming that the disturbance factor responsible for the species displacement has been removed (e.g., competing species). This technique was used effectively in reestablishing white-tailed deer (Downing 1987) and wild turkey (Lewis 1987) populations in the East. Transplanting animals into suitable habitat represents one of the most important opportunities for maintaining threatened and endangered species. Captive breeding programs and subsequent reintroduction into suitable habitat are critical to the restoration of such species as the peregrine falcon, red wolf, California condor, Puerto Rican parrot, greenback cutthroat trout, and black-footed ferret.

Aquaculture, the propagation of aquatic species in controlled environments, represents a general management opportunity that has both recreational and commercial application (Parker and Stevens 1988). Fish hatcheries, although important in the restoration of some endangered fishes, have their greatest utility in supplementing heavily exploited fish populations. A significant portion of the commercial and recreational harvest of sport fish is produced in hatcheries. However, artificial propagation should not be considered a substitute for natural reproduction (Everhart and Youngs 1981).

Given expected demand increases for commercial fish products and recreational fishing, aquaculture will likely become a more prominent management practice used to meet these rising demands on the nation's fishery resources. It has been estimated that aquaculture in the United States will produce 2 billion pounds of fish by the year 2000 (Parker and Stevens 1988). Stock-enhancement through aquaculture will also continue to be important in maintaining recreational fishing opportunities, particularly in and around high population centers.

Increased production from aquaculture can be accomplished through improved propagation practices which increase survival, increasing the capacity of existing facilities, and the building of new rearing facilities. For example, the Northwest Power Planning Council (1987) has found that acclimation ponds can improve survival of released fish and is recommending the development of low-cost, small-scale hatcheries. Smaller scale hatcheries have the advantage of smaller water supply requirements and they are readily adaptable to an individual drainage which facilitates the preservation of gene pools.

Other management opportunities that involve the direct manipulation of populations include the removal of pest or competing species. For example, certain bird species have a long history of damaging crops and causing health problems. When populations become excessive, intensive measures to control their numbers may have to be implemented. However, Dolbeer and Stehn (1979) pointed out that such measures may only be temporary solutions and recommended that studies be initiated to determine the cause for population increases so that longer term solutions can be achieved. In the case of interspecific competition, removal of the competing species may be the only possible solution to the management problem and has been an important management practice in the protection of threatened and endangered species such as the Kirtland's warbler (Walkinshaw and Faust 1974) and Hawaiian birds (Scott and Sincock 1985).

User and People Management Opportunities

Management issues related to use of wildlife and fish resources focused mainly on concerns for access. The states control use through restrictions on the number of licenses available or through special regulations that attempt to control the distribution of user pressure within the state. However, if access to land or water supporting wildlife and fish is limited, regulations to control use can be ineffective and recreationists can become dissatisfied. From the state's perspective, restricted access was the fifth most important management issue across all species groups. The reasons for closing lands are varied and include concern for liability, property damage, interference with other activities, and disturbance of privacy. Another major factor is that the landowners have traditionally received little or no economic return for allowing hunting or fishing on their lands. Evidence reviewed in chapters 2 and 5 showed that economic return to private landowners stemming from wildlife and fish recreation has been increasing and will probably continue to increase in the future. Consequently, opportunities exist for state and federal programs to promote and assist landowners in establishing such businesses. A more active policy for lease hunting and fishing could put wildlife and fish agencies in a stronger position to take an active role in shaping lease agreements and ultimately provide an opportunity to work more closely with private landowners in the management of habitats (Wiggers and Rootes 1987).

On public lands, both restricted and excessive access were important management concerns. Opportunities to increase access to public lands involve adjustments to ownership patterns through land exchanges, acquisition, or easements. Solution of the restricted access problem must, in part, address concerns for excessive access by helping to redistribute use. Road closures in high use

areas provide one opportunity for controlling the potential detrimental impacts on the land, and wildlife and fish populations.

Another important management concern was an uninformed public. As competition among land uses intensifies, wildlife and fish managers will require that the public have a complete understanding of the management problems and the justification for proposed management activities. Without public acceptance, wildlife and fish management will be ineffective. Public information and education programs are an obvious opportunity for gaining public confidence and support for wildlife and fish management on private, state, or federal lands.

The concern for user information, however, does not stop with educating the public. Managing agencies must educate themselves on public attitudes and values. Such information can be useful in establishing the priority that should be assigned to various management activities. The clientele has changed and will continue to change in the future. The future demands for wildlife and fish recreation, based on the results presented in chapter 2, are expected to shift from hunting to fishing and nonconsumptive activities. Managing agencies will need to respond to these shifts or risk failure in fulfilling the stewardship obligations entrusted to the resource managing agencies.

Planning Opportunities

Planning involves the specification of objectives, implementation of management strategies, and an evaluation of how well objectives were met. Four factors cited as contributing to ineffective decision-making were: (1) inadequate cooperation among agencies, (2) poorly coordinated planning among resource areas, (3) inadequate information on population and habitat status, and (4) limited capability to predict animal response to resource management activities.

Cooperative and Coordinated Planning

Cooperative planning is particularly important for mobile resources such as wildlife and fish. Political and administrative boundaries have been defined without respect to ecological systems. Wildlife and fish planning and management under multiple and intermingled land ownerships can be futile for wide-ranging species or species inhabiting aquatic systems unless habitat conditions across all ownerships are considered. Cooperative planning across land managing agencies, landowners, and user groups has been recognized in the National Recreational Fisheries Policy (USDI Fish and Wildlife Service 1988c) as being critical to effective and efficient management of the nation's fishery resources.

Opportunities to improve the planning environment include consolidation of land ownerships through purchase or land exchange. In the FS, purchase and exchange of lands are authorized under the 1911 Weeks Act, the 1922 General Exchange Act, the Federal Land Policy and Management Act, and a number of laws authorizing the purchase or exchange of lands for specific purposes including the Wilderness Act of 1964, the Eastern Wilderness Act of 1975, the Endangered Species Act of 1973, the Wild and Scenic Rivers Act of 1968, and the Sikes Act of 1967. While the authority exists, proposals for large land exchanges between agencies have met with resistance. The 1985 proposal to exchange 35 million acres between the FS and BLM was delayed because interest groups felt that such land swaps should be evaluated on a case-by-case basis (Barton and Fosburgh 1986). While focus on smaller land units and the "politics" involved may engender a perception that land purchase and exchanges are ineffectual, it appears to be an unavoidable consequence of the process.

Coordinated planning among resource areas, as reviewed under habitat management opportunities, probably represents the single greatest opportunity for improving the future wildlife and fish resource situation. Leopold (1933) noted that wildlife and fish management is essentially the "favorable alignment" of timber, agriculture, and livestock activities. Despite the history behind the concept, and the acceptance of its importance in wildlife and fish management, it has been difficult to integrate wildlife and fish management into comprehensive land use plans (Peek 1986). Part of the difficulty stems from incomplete information on how wildlife and fish respond to various timber, livestock, and water management activities. Knowledge gaps defined by the state and federal agencies help define the future research needs related to effective planning and management.

Research Needs

The information needs identified by the state and federal agencies fell into three broad categories: (1) species-habitat relationships, (2) population inventories, (3) public attitude about wildlife and fish values. Species-habitat relationship information is basic to any management plan. Additional research on species-habitat relationships is important for at least two reasons. First, basic knowledge of species life requisites is necessary before we can manage existing systems in a manner that maintains the biological diversity typical of a given community. Second, such knowledge is important to restoration efforts of those habitats that have become rare including old-growth forests (Nyberg et al. 1987), wetlands (Pearce 1985), tallgrass prairie (Platt 1983), and riparian systems (Platts 1986).

Apart from providing a knowledge base from which to recommend management and restore communities, species-habitat relationship information is also important in the development of resource planning models. Since the last national assessment of wildlife and fish (USDA Forest Service 1981), researchers have expended considerable effort to develop quantified characterizations of wildlife and fish habitat in the form of species-habitat relationship models (Fausch et al. 1988, Verner et al. 1986). One objective of these habitat models is to aid planners in assessing the impacts from multiple resource management on wildlife and fish resources. The

value of these models is as a tool to explore potential outcomes based on what biologists believe to be the habitat requirements of modeled species (Starfield and Bleloch 1986). Research has provided the resource planner with a diversity of habitat modeling approaches; however, model development has exceeded model validation and testing of basic assumptions. The research challenge now is not to develop new techniques for modeling wildlife and fish habitat but to rigorously explore the basic underlying assumptions and to test the performance of extant modeling approaches (Fausch et al. 1988, Sweeney and Wolters 1986).

Another area of future research concerns the application and testing of wildlife and fish habitat models at larger scales. Most habitat modeling efforts have focused on site-specific studies, but policy and management decisions are being made at regional scales. There is increasing recognition that informed resource planning decisions cannot be made exclusively at the site-level (Risser et al. 1984) and that more emphasis needs to be placed on analyses that explicitly address large geographic areas (Gall and Christian 1984, Sanderson et al. 1979). As reviewed in chapter 3, the use of wildlife and fish habitat models to evaluate the impacts from timber management and land-use change represented the first time that regional wildlife and fish models were linked to regional timber inventory and land use models (USDA Forest Service 1988). The conceptual framework for regional multiple resource analyses has been described (Joyce et al. 1986) and applied in the South (Flather et al. 1989, Flebbe et al. 1988). Further research on regional multiple resource modeling is needed in the areas of: rigorous evaluation of model performance, extending the methodology to other regions of the country, and incorporating wildlife and fish, forage, and water feedbacks that alter timber management and land use decisions.

Apart from being used to predict wildlife and fish response to land management activities, an additional use of habitat models is to support wildlife and fish population monitoring. Habitat characteristics are easily inventoried relative to wildlife and fish populations. The basic assumption of this application is that changes in habitat amounts and quality can be used to predict changes in animal population levels. Recent research has shown, however, that this assumption does not hold for some species (Rotenberry 1986, Van Horne 1983), and that other factors (interspecific interactions, weather, disease, mortality on wintering habitat, etc.) must be considered when explaining variation in population levels. Additional research is needed to characterize those kinds of species where the assumption of population levels tracking habitat condition is and is not valid.

The implication of the uncertainty associated with the habitat-population relationship is that inventories of habitat alone will not be sufficient to ensure that community diversity and viable populations will be maintained. Both state and federal agencies expressed concern that information on population status and important population parameters was inadequate to manage the resource effectively. This was more of a concern with nongame species than for game species. Inventory information was available for some game mammals and birds, and some nongame bird species, yet generally absent for small mammals, fish, amphibians, reptiles, and invertebrates. Although local inventories of such species may be available for a specific site, systematic and comprehensive approaches to monitoring wildlife and fish populations are lacking. Existing methods are, in general, too expensive and of questionable accuracy. Recent suggestions to use indicator species or guilds to monitor wildlife and fish communities have potential shortcomings (Verner 1986). Future research directed at developing wildlife and fish monitoring techniques applicable across a variety of scales (site, management unit, region) is not only important for providing baseline information on population status, but it is also important in evaluating the predictive accuracy of species-habitat relationship models.

The final area of needed research, as reflected by state and federal agencies, is in characterization of the public attitudes and values held for wildlife and fish resources. Because state and federal management agencies are public agencies, they need to know who the public is, what the public desires, what the public is willing to pay, and the factors responsible for changes in these components (Lyons 1987). The attitudes and wants of consumptive wildlife and fish recreationists have been studied to a much greater degree than either nonconsumptive users or nonusers. Such information is critical if management agencies are to respond and adjust their programs to satisfy the public demands. Failure to do so will only result in an eroding of public support and declining funding levels.

Characterizing the client is but one important component of research addressing the human dimension of wildlife and fish resource management. Another important component concerns estimating the economic value of wildlife and fish resources. Such information is not only important to setting wildlife and fish management priorities, but it is also critical if wildlife and fish are going to compete on a commensurate basis with other resources under multiple use management. Although a number of techniques have been developed to estimate nonmarket wildlife and fish resource values, additional research is needed to test model assumptions and validate methodologies. There is also a need to extend the user projection analysis used in chapter 2 to more accurately examine the relationship between wildlife and fish resource inventories and participation in wildlife and fish related recreation (Lyons 1987). Finally, the growing prevalence of fee-hunting in the United States offers an opportunity to further study the economic value of wildlife and fish resources and its role in private land-use management decisions.

OBSTACLES TO IMPROVING WILDLIFE AND FISH RESOURCES

Obstacles are those factors that prevent implementation of effective management opportunities. Unmet management goals and objectives can lead to a dissatisfied clientele or deterioration of the resource itself. The

most common obstacles identified by state and federal agencies were lack of knowledge, inadequate or unstable funding levels, and inadequate staffing and qualified personnel.

Insufficient knowledge has two aspects. The first is that research is required to add to the information base on wildlife and fish management. The research needs discussed above in the areas of habitat relationships, population monitoring, and public attitudes and values address this aspect of insufficient knowledge.

The other aspect concerns increased information exchange between researchers and managers. An efficient system is needed to transfer knowledge from those solving management problems to those who have the responsibility of implementing these solutions. (Seitz et al. 1987). As described by Naisbitt (1982), the United States is evolving into an information based, high technology society. The wildlife and fish profession needs to take advantage of information transfer technology to ensure that managers are applying state-of-the-art techniques and researchers are informed of the evolving problems facing managers.

Concern for sufficient funding was by far the most frequently cited obstacle. As reviewed in chapter 5, many state agencies have experienced substantial declines in real spending power. Similar declines have been noted in federal agency budgets. Between 1980 and 1985, in constant dollars, the FS budget declined by 16%; funding for wildlife and fish habitat management on national forests declined by 9%; wildlife and fish research funding declined by 9%; and funding for the State and Private Forestry Program which provides technical assistance to private landowners declined by 38% (Barton and Fosburgh 1986). Similarly, funding appropriations for wildlife habitat management on BLM lands declined by 22% from 1981 to 1986 (Barton 1987).

Adequate staffing is not unrelated to agency budgets. However, number of personnel is only part of the concern. As resource management problems become more complex, the qualifications for addressing the problems change. Education of existing personnel and the training of new professionals must evolve with these changes to ensure that resource professionals can be effective. Recommendations for improved curricula and continued training include: (1) explore new approaches to motivate the work force to continue formal education opportunities (Hamilton et al. 1987); (2) increase the opportunities for participation in continuing education programs (Cross 1987), with increased employer responsibility to do so (Nielsen 1987); and (3) revision of natural resource curricula to include not only a biological background, but also an increased emphasis on courses in law, communications, political processes, economics, long-range planning, information management and computer science, and human resource management (Knuth 1987, Streeter 1987).

SUMMARY

An important component of national resource assessments is to explore the management issues and attendant management opportunities that exist for minimizing the social, economic, and environmental costs associated with future imbalances in anticipated resource use and inventories. Management issues and opportunities were categorized into four areas: habitat, population, user, and planning.

Priority management issues were identified from responses provided by state and federal biologists. At the national level, and for all species groups covered in this assessment, habitat loss and habitat degradation were ranked as the two most important wildlife and fish management issues. Habitat is the most fundamental management issue now confronting resource managing agencies, for landscapes lacking in suitable wildlife and fish habitats will no longer support animal populations.

Management concerns related to wildlife and fish populations were ranked as the third and fourth most critical national issues. Inadequate population inventory information was cited as hindering effective management of wildlife and fish. A general concern for low populations of some species groups was viewed as an area for potential future improvement.

User-related issues were also a prominent concern of wildlife and fish resource management agencies. Restricted access to both public and private lands has resulted in an inadequate distribution of recreation use and managers felt they had insufficient information on public attitudes and values held for wildlife and fish. The latter was emphasized as particularly important since it ultimately affects public support for management activities.

The final issue of national concern was related to multiple resource planning. More intensive agricultural practices and timber management, competition with livestock, mineral development, water withdrawals for consumption or irrigation, and wildlife damage to crops all serve to illustrate that wildlife and fish management is much more complicated than direct habitat improvement, manipulating animal populations, or regulating use.

The specific management opportunities addressing habitat-related issues included:

- Protection of key habitats (including wetlands, native grasslands, old-growth forests, fish spawning areas, and critical habitat for threatened and endangered species) through public purchase, easement, leasing agreement, or establishment of natural areas.
- Increasing the size, diversity, and distribution of key habitat tracts to preserve the natural diversity characteristic of a given region.
- Restoration of degraded ecosystems through: 1) direct manipulation of vegetation and water through seedings, plantings, physical or chemical treatment, creation of wetlands, and development of water facilities and stream structures, or 2) removal or effective control of disturbance factors including control of point and nonpoint sources of pollution, removal of barriers to migrating fish, controlling livestock access to riparian areas, and removal of wetland drainage systems.

Opportunities for direct management of wildlife and fish populations included:

- Manipulation of populations through appropriate harvest strategies to ensure that populations remain within the productive capacities of their habitat.
- Increasing the reintroduction of species into areas where they have been displaced from suitable habitat or where suitable habitat has been developed.
- Increasing fish hatchery production through improved propagation practices, increasing the capacity of extant facilities, and the building of new facilities.
- Control or removal of pest or competing species.

Opportunities for user and people management included:

- Improving access to private lands by promoting programs that would assist landowners in establishing wildlife and fish-related businesses.
- Increasing the use of land acquisition and user management programs to increase the amount of habitat available to recreationists and to better distribute use across suitable sites.
- Implementing programs to educate the public about the need for and objectives of wildlife and fish management.
- Implementing techniques to monitor public attitudes and values associated with wildlife and fish resources to better address the public's needs and wants.

Opportunities to improve resource planning include:

- Increasing interagency cooperation among the many agencies that have responsibility for management of habitat, wildlife and fish populations, and hunting and fishing.
- More fully integrating wildlife and fish management objectives into the management of forest and range lands for multiple resources.
- Through research, improving the information base (e.g., habitat inventories, population inventories, habitat-population relationships, valuation of wildlife and fish resources) needed to effectively manage the wildlife and fish resource.

This review of important management problems, potential management opportunities, and obstacles to effective management indicates that improving the future wildlife and fish resource situation will become an increasingly difficult task. Human populations are expanding and land use is intensifying, yet declining funds for wildlife and fish management is an increasing concern. Unless these trends change, the wildlife and fish profession is faced with the challenging task of solving increasingly complex management problems with a shrinking monetary and personnel resource base. The wildlife and fish management issues and opportunities that could be addressed by future FS programs are discussed in chapter 7.

CHAPTER 7: IMPLICATIONS FOR FOREST SERVICE WILDLIFE AND FISH PROGRAMS

LEGISLATIVE EVOLUTION OF RPA AND THE ASSESSMENT-PROGRAM RELATIONSHIP

The Forest Service (FS) is one of the largest land-managing agencies in the federal government and the natural resources on the lands it administers are important national assets. National forests provide approximately 15% of the total wood volume harvested nationwide, 5% to 10% of the nation's livestock forage, a portion of the nation's energy and mineral resources, 43% of the total recreation visitor-days spent on federal lands, and habitat for approximately 3,000 species of wildlife and fish including critical habitat essential to the survival and recovery of many threatened and endangered species (Barton and Fosburgh 1986, Joyce in press, USDA Forest Service 1987).

Although the multiple benefits associated with FS lands are widely appreciated, the authority to manage the full variety of natural resources on national forests was not legally explicit until 1960 when the Multiple-Use Sustained Yield Act was passed. This Act established the policy that national forests shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes. While the resources to be considered were made explicit, the statute was criticized for being vague on how to reconcile conflicting resource uses (Bean 1977).

The Sikes Act Extension of 1974 further defined the authority to manage wildlife and fish on public lands by directing the Secretaries of Agriculture and the Interior to develop comprehensive plans for the conservation and rehabilitation of wildlife and fish resources in cooperation with state agencies. While the Act facilitated the execution of wildlife and fish management programs, it did little to change the "unlimited discretion" that the FS exercised in fulfilling its multiple use mandates (Bean 1977).

The dispute surrounding multiple use and the allocation of resources was eventually addressed explicitly in the Forest and Rangelands Renewable Resources Planning Act of 1974, as amended by the National Forest Management Act of 1976. These Acts defined a framework to guide long-term planning of natural resources on the nation's forest and rangeland base and required the preparation of a comprehensive *Assessment* that addressed the status and needs of forest and range resources; a *Program* outlining resource management levels and budget requests based on the findings of the assessment; and detailed *Resource Management Plans* for the national forests. The assessment is intended to be the factual and analytical basis for the FS Program. The Program specifies the resource goals "...to enable public and private initiative to meet the full range of opportunities that would secure for our people the benefits..." from the nation's forest and rangelands (Wolf 1982: 139). These goals are to be realized through resource management on national forests, by assisting states and the private sector through forestry assistance programs, and by conducting and promoting research within and outside the FS.

The 1985 Program (USDA Forest Service 1986b) specified the primary agency goal for wildlife and fish management as follows:

> Assure a diverse, well-distributed pattern of habitats for viable populations of wildlife and fish species in cooperation with states and other agencies. Provide technology and manage habitat to help recover threatened and endangered species, and to increase the productivity for native game and nongame species consistent with other resource uses, values, and user demands.

This goal reflected a considerable broadening of the traditional FS wildlife and fish management focus and was a response to increased public interest in wildlife and fish resources. The findings of this wildlife and fish assessment do not suggest that the FS should deviate from this goal. Rather, this assessment emphasizes the need for the agency to promote this broader ecological approach to wildlife and fish management on FS lands.

This chapter summarizes the broad implications of this assessment to the major FS Program areas as they affect wildlife and fish resources.

MAJOR FOREST SERVICE PROGRAMS

The wildlife and fish assessment has direct implications for three FS Program areas:

National Forest System.—Includes the administration and multiple-use management of national forests and national grasslands.

State and Private Forestry.—Includes programs that extend financial and technical assistance to states and private landowners.

Research.—Includes the development of scientific and technical knowledge to enhance the economic and environmental value, and the management of the nation's forest and range resources.

The expenditures and workforce in each of these program areas is concentrated in the National Forest System (NFS) (fig. 62). In fiscal year 1986, the NFS accounted for 83% of the $2.1 billion FS budget and employed over 92% of the FS workforce (USDA Forest Service 1987). The State and Private Forestry Program accounted for just over 3% of the budget and only 0.5% of the workforce. FS Research spent approximately 6% of the budget and employed 7% of the workforce. The broad FS Program implications of the wildlife and fish assessment will be discussed for each of these major program areas.

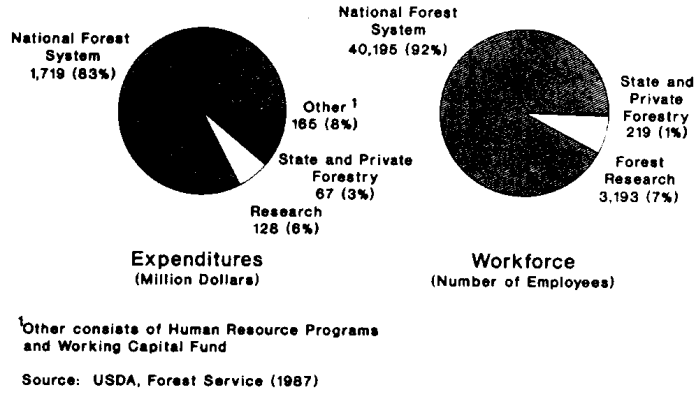


Figure 62.—Expenditures and workforce by major Forest Service program areas.

NATIONAL FOREST SYSTEM

The FS is responsible for the administration of 191 million acres, including 156 national forests (186.4 million acres), 19 national grasslands (3.8 million acres), and a number of smaller land units (275,000 acres) including land-utilization projects, research and experimental areas, and purchase units. Within the lands administered by the FS, wildlife and fish resources are managed primarily through manipulation of habitat while state agencies primarily manage populations and regulate harvests. As implied by the Sikes Act Extension, however, efficient management of wildlife and fish resources requires a close working relationship among agencies with wildlife and fish management responsibility.

The wildlife and fish assessment has implications to the NFS Program in four general areas. These four areas, stated as assessment findings, include:

1. The demand for wildlife and fish recreational activities is expected to increase in the future resulting in a shift in the relative importance of various activities demanded by the public.
2. NFS lands are expected to become more important in: (a) the protection and preservation of certain wildlife and fish species, (b) the preservation and protection of vegetation communities that define important wildlife and fish habitats, and (c) providing wildlife and fish recreational opportunities.
3. As demands for all natural resources increase, integration of wildlife and fish management considerations into comprehensive land management plans will become increasingly important.
4. Because wildlife and fish are mobile resources, the purchase and exchange of land that will consolidate land ownership patterns will promote more efficient management of the resource.

Changing Demands for Wildlife and Fish

The national wildlife and fish recreational user projections showed that the relative importance of various activities to the outdoor recreating public is expected to shift. While the number of people participating in nonconsumptive activities, coldwater fishing, and warmwater fishing is expected to increase, participation in big game hunting and small game hunting is expected to decline (see fig. 46). Although participation in all types of wildlife and fish recreational activities is expected to increase on national forests, a similar shift in relative importance is expected. Nonconsumptive recreation and total fishing showed the greatest increases in future use (see table 36). The FS's wildlife and fish habitat management program should acknowledge these findings by shifting priority to management actions that will address those activities demanded by the public.

Increased Importance of National Forest System Lands

As land use intensifies on private lands, NFS lands will become more unique with respect to biotic community composition. Some of the unique wildlife and fish habitats associated with national forests include:

Old-growth forests.—More than half of the remaining old-growth in the Pacific Coast occurred on national forests in 1977; most of the old-growth in the Rocky Mountains occurs on FS lands; current trends indicate that much of the old-growth pine forests in the

South will only be found on national forests or other public ownerships in the future.

Wetlands.—Twenty-five percent of the remaining wetland habitats are under public ownership. The FS has management responsibility for 23% of the federally owned wetlands. Included in the definition of wetland are riparian areas which are a critical wildlife and fish habitat component particularly in arid rangeland ecosystems.

Fish spawning habitat.—Approximately 50% of the anadromous fish spawning and rearing habitat in California, Oregon, Washington, and Idaho is on national forests. In Alaska, 27% of the anadromous fish spawning and rearing habitat is on national forests.

With expanding human populations and increasing demands for multiple resource products from a finite land base, the pressure for intensive management of timber, range, and agricultural resources will remain strong. Consequently, management to conserve these habitat types on national forests will become increasingly important.

Correlated with the uniqueness of certain national forest wildlife and fish habitats are unique faunas. Of particular importance is the maintenance of biotic diversity on national forests (see Norse et al. 1986). The biological diversity issue is, in part, concerned with maintaining the number and kinds of species that exist or have existed on national forests in the recent past. Although maintaining biotic diversity is laudable, methods to quantify, monitor, and anticipate changes in biotic diversity in response to various management activities have not been developed. National forests should establish a process for quantifying and evaluating biological diversity that will permit incorporation of specific diversity objectives in National Forest Plans.

Threatened and endangered species are a special consideration in maintaining diversity. The current distribution of some vanishing species is becoming increasingly associated with NFS lands. Recent estimates indicate that 155 threatened or endangered species occur on national forests, of which 81 have approved recovery plans. However, because of budget and personnel constraints, national forests have emphasized recovery efforts on 13 high-priority species including the grizzly bear, California condor, red-cockaded woodpecker, Kirtland's warbler, woodland caribou, bald eagle, peregrine falcon, Puerto Rican parrot, Lahontan cutthroat and greenback cutthroat trout, and the gray, Indiana, and Virginia big-eared bats.

National forests are also expected to become increasingly important in providing wildlife and fish recreational opportunities. One of the most commonly cited management issues related to recreational use of wildlife and fish was restricted access to private lands (see chapter 6). This has resulted in emphasizing the importance of NFS lands in providing such outdoor recreational opportunities. Specifically, the recreational use projections reviewed in chapter 2 showed that, relative to private lands, national forests are expected to become more important in providing opportunities to hunt big game and small game species.

As national forests become increasingly distinctive with respect to habitat, faunal, and recreation opportunities, wildlife and fish management must intensify to ensure that the wildlife and fish goal, as outlined in the 1985 FS Program, is met. The FS manages habitat in two ways: directly, through specific habitat improvement practices, and indirectly, through coordination and mitigation measures in projects designed primarily for other resources. Direct habitat management, in many cases, offers the only approach to improve habitat for fish, threatened and endangered species, and waterfowl (USDA Forest Service 1985b). Some of the opportunities to directly improve wildlife and fish habitats on national forests to meet future demands include:

1. Expand programs to improve wildlife and fish habitats by increasing food supplies and suitable cover, improving water quality and availability, and improving the distribution of habitat.
2. Apply silvicultural and range management practices to emphasize management of indicator species.
3. Preserve and enhance waterfowl nesting, migration, and wintering habitat.
4. Reintroduce displaced or extirpated species into areas where suitable habitat exists or has been developed.
5. Increase efforts to define, protect, and improve essential habitats of threatened and endangered species.
6. Remove natural and man-made barriers to fish migration.

Wildlife and Fish Coordination

The second major approach to wildlife and fish habitat management on national forests is through coordination with management for other resources. In part, these activities are intended to minimize adverse impacts on wildlife and fish habitat from timber harvesting, road building, grazing, mineral development, and other resource projects. However, mitigation is not the only objective of integrating wildlife and fish resource considerations in other resource management activities. When feasible, wildlife and fish coordination efforts are to be designed to generate simultaneous resource benefits. For the wildlife and fish resource, these benefits take the form of indirect habitat improvements.

This assessment, along with associated assessment documents for timber, range, water, recreation and wilderness, and minerals, indicates that there will be increasing demands for multiple resource outputs from national forests. In order to meet these multiple resource demands, coordination among resources must continue as a high priority in wildlife and fish habitat management. Although funding for coordination has commanded the majority of wildlife and fish habitat management budgets in recent years (Barton and Fosburgh 1986), more effective integration of wildlife and fish

resource considerations in multiple use resource plans remains one of the most important management opportunities for wildlife and fish on NFS lands.

One recent advancement directed at improving the integration of wildlife and fish into resource planning is the Wildlife and Fish Habitat Relationships program. The program involves the development of data base management systems and predictive models that permit resource managers to evaluate wildlife and fish responses to a diversity of resource management alternatives. These models have been applied in various situations in providing information for Forest Plans, environmental analyses, and site-specific projects (USDA Forest Service 1987). Further development of the habitat relationships program is required to ensure that the maintenance of wildlife and fish diversity on national forests is considered in the resource planning process.

Consolidation of Land Ownership Patterns

A major management concern for public lands is the difficulty associated with managing a mobile resource over a land base with intermingled and fragmented land ownership (see chapter 6). Most of the larger mammalian and many avian species range widely and independently of ownership boundaries. Consequently, some wildlife and fish resource management can be unsuccessful because of conflicting land uses or conflicting resource management objectives. Potential wildlife and fish management problems associated with NFS lands in a mosaic of state and other federal ownerships can be solved through cooperation among resource managing agencies. However, land ownership patterns characterized by private inholdings, private land surrounding relatively small blocks of national forest, or private ownership of critical habitat components can impede attainment of resource management objectives. In the western United States, land ownership problems tend to be associated with mixed public and private ownership of critical habitat areas. In the East, concern is growing that as private land uses intensify, national forests will become isolated habitat islands with the eventual loss of those species requiring large areas of suitable habitat.

STATE AND PRIVATE FORESTRY

State and Private Forestry provides technical and financial assistance to states to help protect and improve the productivity and management of nonindustrial private forestlands (USDA Forest Service 1987). The Cooperative Forestry Assistance Act of 1978 authorized the Secretary of Agriculture to cooperate with state foresters and provide assistance in a variety of forest-related activities which include fire prevention and control, prevention and control of forest insects and diseases, and forest management and utilization (USDA Forest Service 1987). The latter activity can benefit wildlife through habitat improvement projects.

Private lands have been identified as having considerable potential for wildlife and fish habitat improvement and many investigations have concluded that wildlife and fish resources are considered a primary objective of some private landowners (Barton and Fosburgh 1986). Despite the importance of private lands in providing wildlife and fish habitat and recreational opportunities, the State and Private Forestry Program has recently experienced reductions in funds and personnel. Two findings presented in this assessment suggest that the FS Program should emphasize the importance of the State and Private Forestry activities in promoting effective multiple resource forest management including wildlife and fish resources, particularly in regions dominated by private ownership. These two findings were the projected increase in fee-hunting and the substantial increases in permanent grass and tree cover on private lands associated with the Conservation Reserve Program under the 1985 Food Securities Act.

Fee-hunting and access fees for wildlife and fish recreation on private lands are providing a strong economic incentive for landowners to consider wildlife and fish habitat needs—a consideration that has been absent in the past. Landowners need to be exposed to the full array of products that can be marketed from their land. As reviewed by Sample (1987), the Office of Management and Budget strongly advocates increased efforts to educate landowners about the economic opportunities that exist for their lands, including hunting leases and camping permits. In addition to information on existing markets, landowners need technical assistance on appropriate management practices to improve the quality and sustain productivity of wildlife and fish habitats.

Further support for more intensive education and technical assistance programs stems from the 1985 Food Security Act. Under this Act, substantial acreage of highly erodible cropland will be planted to permanent cover. If planned correctly, these lands can provide high quality wildlife habitat and significantly improve fish habitat through reductions in soil erosion and increased streamside cover. The State and Private Forestry Program has the opportunity to guide and provide assistance on how these lands are managed for multiple forest resources including wildlife and fish. The private landowner has the potential to supplement his income through recreation fees while the nation as a whole can benefit from improved wildlife and fish habitat on lands where there has been a significant eroding of suitable habitat in the recent past.

FOREST SERVICE RESEARCH

The Research Program of the FS is, in general, responsible for the development of scientific and technical knowledge to enhance the economic and environmental values of the nation's forest and rangeland ecosystems (USDA Forest Service 1987). The Program is divided into seven functional areas: Timber Management; Forest Insect and Disease; Forest Products and Harvesting; Forest Fire and Atmospheric Sciences; Forest Environment; Forest Inventory, Economics, and Recreation; and International Forestry. Research in these seven areas is conducted in cooperation with the nation's 61 forestry

schools and through the USDA Cooperative State Research Service.

Today, the dominant authority for Forest Research is the Forest and Rangeland Renewable Resources Research Act of 1978. This legislation revised and consolidated the FS's research authority from several previous Acts. In addition, the Act specifically required that research on natural resources include investigations related to threatened and endangered species and improving wildlife and fish habitat (Barton and Fosburgh 1986). Research related specifically to wildlife and fish is part of Forest Environment Research and is covered under four broad areas: (1) threatened, endangered, and sensitive species; (2) anadromous and coldwater fish habitats; (3) wildlife and fish interactions with livestock; and (4) wildlife and fish interactions with timber management.

In developing future research needs for wildlife and fish, the 1985 Program (USDA Forest Service 1986b) concluded:

> Wildlife and fish habitats will continue to be threatened by urban and suburban development pressures and industrial activities, timber harvesting, livestock grazing, and mining for energy production. Research is needed to: (1) further understand habitat requirements of anadromous and other coldwater fish, determine how their productivity is related to land management, and develop guidelines to integrate production with other resource management issues, and (2) improve wildlife monitoring techniques to measure the response to management.

The knowledge gaps and research needs identified in this assessment support a continuation of this research goal and also suggest a need to broaden future research related to wildlife and fish. As reviewed in chapter 6, information needs identified by federal agency personnel fell into three broad categories: (1) species-habitat relationships, (2) inventory and monitoring techniques, and (3) wildlife and fish values.

Species-habitat relationship research has improved the capability of wildlife and fish resource specialists to understand and predict resource response to land management activities. However, there is a pressing need to test and refine those models that have been developed to ensure that land managers are making reasonable decisions about multiple resource production (Sweeney and Wolters 1986). In addition, new models need to be developed in order for the FS to meet its legislated goal of maintaining biodiversity and habitats capable of supporting viable populations of all native and desired non-native (exotic) species that are found on NFS lands. As the demand for multiple resource outputs from national forests and national grasslands intensifies, accurate representation of wildlife and fish responses to alternative land management strategies will be critical to scientifically-based resource allocation decisions.

Research in the area of improving existing inventory or monitoring methodologies is needed for several reasons. First, inventory information on most of the wildlife and fish species inhabiting national forests does not exist. As discussed in chapter 6, inventory information tends to focus on game animals and selected nongame species of particular concern, yet is generally lacking for all other animal classes. Existing techniques are of questionable accuracy or are too expensive to provide a practicable approach to a comprehensive and systematic inventory of wildlife and fish resources on FS lands. Secondly, further research on population inventory techniques is required to establish the validity of species-habitat relationship models. Although habitat inventories, in conjunction with species-habitat models, may provide great assistance to inventories of the fauna, such faunal inventories will still be required to assess the predictive accuracy of habitat-based models.

A final broad area of research needs concerns the characterization of public attitudes and values held for wildlife and fish resources. The FS must not only monitor the state of wildlife and fish populations and habitat, but it also must monitor the economic values of wildlife and fish. Public demands related to wildlife and fish resources change and methods need to be developed to both measure and anticipate that change. Such information is critical if the FS, or any agency with wildlife and fish stewardship obligations, is to respond to public demands. Quantification of these demands in terms of economic values is critical if wildlife and fish are to compete on an equal basis with other resource elements that are demanded from NFS lands.

In addition to these broad research areas, FS planning requirements under the Renewable Resources Planning Act and National Forest Management Act imply that such research needs to be conducted at a number of geographic scales. These Acts require planning at the national, regional, and national forest level. Research in the areas outlined above must address resource management issues across these planning levels. Risser et al. (1984) summarized the need for multiple-scale resource analyses by concluding that informed resource planning can no longer be based solely at the site level, but must develop methodologies for examining the interaction of resources within landscapes or larger geographic areas. Questions concerning the habitat configurations required by wide-ranging terrestrial species, or the regional ecology of anadromous fish, necessitate an extension of traditional resource management scales to include a landscape ecology research approach.

Some people perceive the FS is at the forefront of fish and wildlife research (Fosburgh 1985b), and this perception should continue in the future by ensuring that the Research Program addresses land management and planning problems facing wildlife and fish resources. Research in the areas outlined above, and across planning scales, will provide a sound basis for meeting the goal of the RPA—namely "... to ensure that the nation achieves the full potential obtainable from its renewable resource base and avoids irreversible crisis in resource use" (Hewett 1982:225).

SUMMARY

The findings of the assessment have wildlife and fish program implications to the NFS, technical and cooperative assistance, and research. Four conclusions have particular importance to wildlife and fish management on national forests. First, the demand for wildlife and fish recreation appears to be shifting away from hunting to fishing and nonconsumptive activities. Such changes should encourage prioritization of those management activities that will address what is demanded by the public. Second, national forests are expected to become more important in the management of certain wildlife and fish habitats and their associated fauna, and in providing wildlife and fish recreational opportunities. For example, old-growth forests are becoming increasingly restricted to national forests; national forests and national grasslands provide critical habitat for threatened and endangered species and they provide increasingly important lands for recreation. Third, as demands for all natural resources increase, integration of wildlife and fish management considerations into the management of other resources will be critical. The wildlife and fish management opportunities considered in conjunction with the opportunities for timber, range, water, recreation and wilderness, and minerals indicate that there will be a need for more intensive and coordinated management if future multiple resource demands are to be met. Fourth, because wildlife and fish are mobile resources, purchase and exchange of land can consolidate land ownership patterns and promote more effective and efficient management of the resource.

This assessment also suggests that the future FS Program should emphasize the importance of technical and cooperative forest management assistance programs in achieving effective wildlife and fish management on private lands. The basis for this conclusion stems from the projected increase in fee-hunting and the substantial increases in permanent grass and tree cover on private lands associated with the Conservation Reserve Program under the 1985 Food Securities Act. Through State and Private Forestry, the FS has the opportunity to guide and provide assistance on how these lands are managed with respect to wildlife and fish resources. The private landowner has the potential to supplement his income through recreation fees while the nation as a whole can benefit from improved wildlife and fish habitat on lands where there has been a significant degradation of suitable habitat in the recent past.

The program implications to NFS's and technical assistance have related implications to wildlife and fish research. The research needs identified in this assessment include development and testing of species-habitat relationship models, improving inventory and monitoring methodologies, and developing techniques to quantify public attitudes and values held for wildlife and fish resources. Research in these areas will improve resource management on both national forests and private lands and will also provide a stronger technical basis for multiple resource planning.

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APPENDIX A: GLOSSARY

Anadromous.—Species of fish that mature in the ocean, and then ascend streams to spawn in freshwater.

Animal unit month (AUM).—The amount of forage required for a 1,000 pound cow, or the equivalent, for 1 month.

Archipelago.—Any large body of water with many islands.

Assessment regions.—Regions used in this and other resource assessment documents and include the:

Northern.—Assessment region encompassing the states of Connecticut, Delaware, Iowa, Illinois, Indiana, Massachusetts, Maryland, Maine, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Wisconsin, West Virginia. This includes Forest Service Region 9.

Pacific Coast.—Assessment region encompassing the states of Alaska, California, Hawaii, Oregon, and Washington. This includes Forest Service Regions 5, 6, and 10.

Rocky Mountain.—Assessment region encompassing the states of Arizona, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, South Dakota, Utah, and Wyoming. This includes Forest Service Regions 1, 2, 3, and 4.

Southern.—Assessment region encompassing the states of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia. This includes Forest Service Region 8.

Big game.—Large wild animals hunted, or potentially hunted, for sport or food including deer, elk, bear, pronghorn, and wild turkey.

Biotic factors.—Environmental influences caused by plants or animals.

Category 1.—Taxa for which the FWS currently has substantial information to support the biological appropriateness of proposing to list the species as endangered or threatened and the development of proposed rules is anticipated.

Category 2.—Taxa for which information now in the possession of the FWS indicates that proposing to list the species is possibly appropriate but conclusive biological data is not currently available to support development of proposed rules.

Coldwater fishing.—Includes freshwater trout, kokanee, and anadromous fishes such as salmon and steelhead.

Commercial timberland.—Forestland which is producing or capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. (Note: Areas qualifying as commercial timberland have the capability of producing in excess of 20 cubic feet per year of industrial wood in natural stands. Currently, inaccessible and inoperable areas are included.)

Commercial value.—Income derived from the sale or trade of wild animals or their products or from direct and controlled use of wild animals and their progeny.

Community.—A group of populations of plants and animals in a given place; ecological unit used in a broad sense to include groups of various sized and degrees of integration.

Critical habitat.—Air, land, or water area which, if destroyed or degraded, would appreciably decrease the likelihood of survival and recovery of a threatened or endangered species or a segment of its population.

Cropland.—Land under cultivation within the last 24 months including cropland harvested, crop failures, cultivated summer fallow, idle cropland used only for pasture, orchards and land in soil improving crops, but excluding land cultivated in developing improved pasture.

Cumulative impacts.—The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time.

Ecological value.—The contribution of wild animals to productive ecosystems.

Ecosystem.—A complete, interacting system of organisms considered together with their environment.

Endangered species.—Any species of animal or plant which is in danger of extinction throughout all or a significant portion of its range. Designated by the U.S. Fish and Wildlife Service.

Estuarine wetlands.—Wetlands found along the U.S. coastline and associated with estuaries or brackish tidal waters.

Existence value.—Valuing an environment regardless of the fact that one may never demand in situ the services it provides.

Exotic.—Foreign; not native.

Flat.—A level landform composed of unconsolidated sediments, usually mud or sand. Flats may be irregularly shaped or elongate and continuous with the shore, whereas bars are generally elongate, parallel to the shore, and separated from the shore by water.

Forest industry lands.—Lands owned by companies or individuals operating wood-using plants.

Forestland.—Land at least 10% stocked by forest trees of any size, or formally having such cover, and not currently developed for other uses.

Forest type.—A category of forest defined by its vegetation (particularly its composition) and/or locality (environmental) factors.

Aspen-birch.—Forests in which aspen, balsam poplar, paper birch, or gray birch, singly or in combination, comprise a plurality of the stocking. (Common associates include maple and balsam fir.)

Elm-ash-cottonwood.—Forest in which elm, ash, or cottonwood, singly or in combination, comprise a plurality of the stocking. (Common associates include willow, sycamore, beech, and maple.)

Fir-spruce.—Forests in which true firs (*Abies* spp.), Engelmann spruce, or Colorado blue spruce, singly or in combination, comprise a plurality of the stocking. (Common associates are mountain hemlock and lodgepole pine.)

Hemlock-Sitka spruce.—Forests in which western hemlock and/or Sitka spruce comprise a plurality of the stocking. (Common associates include Douglas-fir, silver fir, and western redcedar.)

Lodgepole pine.—Forests in which lodgepole pine comprises the stocking. (Common associates include subalpine fir, western white pine, Engelmann spruce, aspen, and larch.)

Maple-beech-birch.—Forests in which 50% or more of the stand is maple, beech, or yellow birch, singly or in combination. (Common associates include hemlock, elm, basswood, and white pine.)

Oak-gum-cypress.—Bottomland forests in which tupelo, blackgum, sweetgum, oaks, or southern cypress, singly or in combination, comprise a plurality of the stocking except where pines comprise 25% to 50% in which case the stand would be classified as oak-pine. (Common associates include cottonwood, willow, ash, elm, hackberry, and maple.)

Oak-hickory.—Forests in which upland oaks or hickory, singly or in combination, comprise a plurality of the stocking except where pines comprise 25% to 50%, in which case the stand would be considered oak-pine. (Common associates include yellow-poplar, elm, maple, and black walnut.)

Oak-pine.—Forest in which hardwoods (usually upland oaks) comprise a plurality of the stocking but in which southern pines comprise 25% to 50% of the stocking. (Common associates include hickory and yellow-poplar.)

Pinyon-juniper.—Forest in which pinyon pine and/or juniper comprise a plurality of the stocking.

Guilds.—A group of species exploiting a common resource base in a similar fashion.

Habitat.—Place where an animal finds the required arrangement of food, cover, and water to meet its biological needs.

Hardwoods.—Dicotyledonous trees, usually broad-leaved and deciduous.

Indicator species.—Any species, groups of species, or species habitat elements selected to focus management attention for the purpose of resource production, population recovery, maintenance of population viability, or ecosystem diversity.

Interspecific competition.—Competition between two or more different species.

Juxtaposition.—The minimum geographic interspersion of habitat requirements that must occur if a habitat is to be barely suitable for a species.

Lacustrine wetlands.—Wetlands and deepwater habitats situated in topographic depressions or dammed river channels. Each area must exceed 20 acres or have depths in excess of 2 meters or have an active wave-formed or bedrock shoreline feature.

Migratory birds.—Birds regularly moving seasonally from one region of climate to another for feeding or breeding.

Minimum viable population (MVP).—The number of individuals required to achieve a specific level of viability.

Nominal dollars.—Value of output in a given period in the prices of that period or in current dollars.

Nonconsumptive use.—Activities which do not result in the death or attempted death of an individual animal.

Nongame.—Native vertebrate species that are not consumptively taken for sport, food, fur, or profit.

Nonpoint source pollution.—Pollution that is diffuse in both origin and in time and points of discharge and depend heavily on weather conditions such as rainstorms or snowmelt. Pollutants can originate on natural source areas or on areas affected by man's activities.

Old-growth.—A stand that is past full maturity and showing decadence; the last state in forest succession.

Palustrine emergent wetlands.—Wetlands dominated by herbaceous vegetation including certain grasses, cattails, rushes, and sedges. Often referred to as "marsh," "wet meadow," "fen," and "inland salt marsh."

Palustrine forested wetlands.—Wetlands dominated by trees taller than 20 feet. They occur mostly in the eastern half of the United States and Alaska and include such types as black spruce bogs, cedar swamps, red maple swamps, and bottomland hardwood forests.

Palustrine nonvegetated wetlands.—Wetlands with little or no vegetation other than aquatic beds.

Palustrine open water wetlands.—Small inland open water bodies which are not part of the lacustrine system.

Palustrine scrub-shrub wetlands.—Wetlands dominated by woody vegetation less than 20 feet tall. Commonly referred to as "bog," "pocosin," "shrub-carr," or "shrub swamp."

Palustrine vegetated wetlands.—Broad categorization of wetlands include emergent, scrub-shrub, and forested wetlands.

Palustrine wetlands.—Interior wetlands which largely consist of freshwater, although inland salt and brackish marshes exist in arid and semiarid areas.

Pasture.—Land which is currently improved for grazing by cultivation, seeding, fertilization, or irrigation.

Pelagic.—Occurring in open water and away from the bottom.

Point source pollution.—Any discernible, confined conduit, including pipes, ditches, channels, sewers, tunnels, vessels, and other floating craft from which pollutants are discharged.

Poletimber stands.—Stands at least 10% stocked with growing stock trees of which half or more is sawtimber and/or poletimber trees with poletimber stocking exceeding that of sawtimber.

Population.—A group of individuals of a single species.

Primary nonresidential.—Trips at least 1 mile from place of residence for the primary purpose of observing, photographing, or feeding wildlife.

Primary residential.—Activities around the residence for which primary purpose is wildlife related.

Proposed species.—Species officially proposed for listing by the Fish and Wildlife Service or the National Marine Fisheries Service as threatened or endangered. Designated by the U.S. Fish and Wildlife Service.

Range condition.—The departure of a site's vegetation composition from that expected under the climax plant community.

Rangeland.—Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs, including land revegetated naturally or artificially that is managed like native vegetation. Rangelands include natural grasslands, savannas, shrublands, most deserts, tundra, alpine communities, coastal marshes, and wetlands that are less than 10% stocked with forest trees of any size.

Real dollars.—Attempts to isolate changes in physical output in the economy between time periods by valuing all goods in the two periods at the same prices, or in constant dollars.

Recreational value.—Benefits of pleasure, adventure, and enhanced physical and mental health from outdoor activities involving the pursuit or sometimes accidental enjoyment of wildlife.

Riparian.—The abiotic and biotic components found within the area defined by the banks and adjacent areas of water bodies, water courses, and seeps and springs the waters of which provide soil moisture sufficiently in excess of that otherwise available locally so as to provide a more moist habitat than that of contiguous flood plains, and uplands.

Saplings.—Live trees of commercial species 1.0 inch to 5.0 inches in diameter at breast height and of good form and vigor.

Sawtimber stands.—Stands at least 10% occupied with growing stock trees, with half or more of total stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

Secondary nonresidential.—Enjoyment from seeing or hearing wildlife on a trip at least 1 mile from place of residence that is taken for another purpose such as camping, driving, or boating.

Secondary residential.—Enjoyment from seeing or hearing wildlife while pursuing other activities around the place of residence.

Seedlings.—Established live trees of commercial species less than 1.0 inch in diameter at breast height and of good form and vigor.

Seedling and sapling stands.—Stands at least 10% occupied with growing stock trees of which more than half of the stocking is saplings and/or seedlings.

Sensitive species.—Species which have been identified by a Forest Service regional forester for which population viability is a concern.

Seral.—Series of stages that follow one another in a usually predictable sequence of ecological succession. Each seral stage is a community with its own characteristics.

Small game.—Smaller-sized wild animals such as rabbits, quail, grouse, and pheasants which are hunted, or potentially hunted, for sport or food. This does not include waterfowl, other migratory birds, and animals generally considered to be pests or varmints.

Snag.—A standing dead tree from which the leaves and most of the limbs have fallen and is more than 20 feet high. Dead trees less than 20 feet are called stubs.

Softwoods.—Coniferous trees, usually evergreen, having needles or scalelike leaves.

Stand-size class.—Classification of forestland based on the predominant size of timber present, that is, sawtimber, poletimber, or seedlings and saplings.

Succession.—Progressive development of a biotic community involving replacement of species and modification of the physical environment until a community with a relatively stable species composition is reached.

Threatened species.—Any species of animal or plant which is likely to become an endangered species within the foreseeable future throughout all or a portion of its range.

User-day.—Any combination of 12 hour days such as one person participating in an activity for 12 hours or 12 persons participating in an activity for 1 hour each.

Urban areas.—Areas within the legal boundaries of cities and towns; suburban areas developed for residential, industrial, or recreational purposes; school yards, cemeteries, roads, railroads, airports, beaches, powerlines, and other rights-of-way, or other land not included in any other specified land use class.

Viability.—The state of being capable of living, growing, or developing.

Warmwater fishing.—Includes largemouth and smallmouth bass, panfish such as bluegill and crappie, walleye, northern pike, muskie, catfish, bullheads, etc.

Wetlands.—Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil, or (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of the year.

Wilderness.—An area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticed; (2) has outstanding opportunities for solitude or a primitive and unoccupied type of recreation; (3) has at least 5,000 acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition, and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value (from Wilderness Act 1964).

APPENDIX B: LATIN NAMES

BIRDS

Bittern, American	*Botaurus lentiginosus*
Bittern, Least	*Ixobrychus exilis*
Bluebird, Eastern	*Sialia sialis*
Bobolink	*Dolichonyx oryzivorus*
Bobwhite, Northern	*Colinus virginianus*
Bobwhite, Masked	*Colinus virginianus ridgwayi*
Bunting, Lark	*Calamospiza melanocorys*
Bunting, Lazuli	*Passerina amoena*
Bunting, Painted	*Passerina ciris*
Canvasback	*Aythya valisineria*
Caracara, Crested	*Caracara plancus*
Cardinal, Northern	*Cardinalis cardinalis*
Chat, Yellow-breasted	*Icteria virens*
Chickadee, Boreal	*Parus hudsonicus*
Chukar	*Alectoris chukar*
Condor, California	*Gymnogyps californianus*
Cormorant	*Phalacrocorax* spp.
Cowbird, Brown-headed	*Molothrus ater*
Crane, Whooping	*Grus americana*
Curlew, Long-billed	*Numenius americanus*
Dickcissel	*Spiza americana*
Dove, Common-Ground	*Columbina passerina*
Dove, Mourning	*Zenaida macroura*
Dove, Rock	*Columba livia*
Duck, American Black	*Anas rubripes*
Duck, Wood	*Aix sponsa*
Eagle, Bald	*Haliaeetus leucocephalus*
Eagle, Southern Bald	*Haliaeetus leucocephalus leucocephalus*
Egret	*Ardeidae*
Egret, Reddish	*Egretta rufescens*
Falcon, Northern aplomado	*Falco femoralis septentrionalis*
Falcon, Peregrine	*Falco peregrinus*
Falcon, Prairie	*Falco mexicanus*
Finch, House	*Carpodacus mexicanus*
Flicker, Northern	*Colaptes auratus*
Flycatcher, Alder	*Empidonax alnorum*
Flycatcher, Olive-sided	*Contopus borealis*
Flycatcher, Scissor-tailed	*Tyrannus forficatus*
Flycatcher, Willow	*Empidonax traillii*
Gadwall	*Anas strepera*
Goldfinch, American	*Carduelis tristis*
Goose, Aleutian Canada	*Branta canadensis leucapareia*
Goose, Cackling	*Branta canadensis minima*
Goose, Dusky Canada	*Branta canadensis occidentalis*
Grosbeak, Black-headed	*Pheucticus melanocephalus*
Grouse, Blue	*Dendragapus obscurus*
Grouse, Ruffed	*Bonasa umbellus*
Grouse, Sage	*Centrocercus urophasianus*
Grouse, Sharp-tailed	*Tympanuchus phasianellus*
Grouse, Spruce	*Dendragapus canadensis*
Gull, Franklin's	*Larus pipixcan*
Harrier, Northern	*Circus cyaneus*
Hawk, Cooper's	*Accipiter cooperii*
Hawk, Ferruginous	*Buteo regalis*
Hawk, Sharp-shinned	*Accipiter striatus*
Heron	*Ardeidae*
Heron, Little blue	*Egretta caerulea*
Ibis	*Threskiornithidae*

BIRDS

Jay, Blue	*Cyanocitta cristata*
Jay, Gray	*Perisoreus canadensis*
Junco, Dark-eyed	*Junco hyemalis*
Kingfisher, Belted	*Ceryle alcyon*
Kinglet, Ruby-crowned	*Regulus calendula*
Kite, Snail	*Rostrhamus sociabilis*
Lark, Horned	*Eremophila alpestris*
Mallard	*Anas platyrhynchos*
Meadowlark, Eastern	*Sturnella magna*
Meadowlark, Western	*Sturnella neglecta*
Merlin	*Falco columbarius*
Mockingbird, Northern	*Mimus polyglottos*
Oriole, Orchard	*Icterus spurius*
Osprey	*Pandion haliaetus*
Owl, Burrowing	*Athene cunicularia*
Owl, Great Horned	*Bubo virginianus*
Owl, Screech	*Otus* spp.
Owl, Spotted	*Strix occidentalis*
Parrot, Thick-billed	*Rhynchopsitta pachyrhyncha*
Parrot, Puerto Rican	*Amazona vittata*
Pelican, Brown	*Pelecanus occidentalis*
Pheasant, Ring-necked	*Phasianus colchicus*
Phoebe, Eastern	*Sayornis phoebe*
Pintail, Northern	*Anas acuta*
Plover, Snowy	*Charadrius alexandrinus*
Prairie-Chicken, Greater	*Tympanuchus cupido*
Ptarmigan	*Lagopus* spp.
Quail, California	*Callipepla californica*
Quail, Gambel's	*Callipepla gambelii*
Quail, Mountain	*Oreortyx pictus*
Quail, Scaled	*Callipepla squamata*
Rail, Black	*Laterallus jamaicensis*
Redhead	*Aythya americana*
Robin, American	*Turdus migratorius*
Sandpiper, Upland	*Bartramia longicauda*
Sapsucker, Yellow-bellied	*Sphyrapicus varius*
Scaup	*Aythya* spp.
Shoveler, Northern	*Anas clypeata*
Shrike, Loggerhead	*Lanius ludovicianus*
Snipe, Common	*Gallinago gallinago*
Sparrow, Baird's	*Ammodramus bairdii*
Sparrow, Black-throated	*Amphispiza bilineata*
Sparrow, Chipping	*Spizella passerina*
Sparrow, Field	*Spizella pusilla*
Sparrow, Grasshopper	*Ammodramus savannarum*
Sparrow, Henslow's	*Ammodramus henslowii*
Sparrow, House	*Passer domesticus*
Sparrow, Lark	*Chondestes grammacus*
Sparrow, LeConte's	*Ammodramus leconteii*
Sparrow, Savannah	*Passerculus sandwichensis*
Sparrow, Song	*Melospiza melodia*
Sparrow, Vesper	*Pooecetes gramineus*
Sparrow, White-throated	*Zonotrichia albicollis*
Starling, European	*Sturnus vulgaris*
Swallow, Barn	*Hirundo rustica*
Swallow, Cliff	*Hirundo pyrrhonota*
Swan, Trumpeter	*Cygnus buccinator*
Tanager, Western	*Piranga ludoviciana*
Teal, Blue-winged	*Anas discors*
Teal, Green-winged	*Anas crecca*

BIRDS

Tern, Gull-billed	*Sterna nilotica*
Tern, Roseate	*Sterna dougallii*
Thrasher, Curve-billed	*Toxostoma curvirostre*
Thrush, Wood	*Hylocichla mustelina*
Titmouse, Tufted	*Parus bicolor*
Towhee, Rufous-sided	*Pipilo erythrophthalmus*
Turkey, Wild	*Meleagris gallopavo*
Veery	*Catharus fuscescens*
Verdin	*Auriparus flaviceps*
Vireo, Bell's	*Vireo bellii*
Vireo, Red-eyed	*Vireo olivaceus*
Vireo, Warbling	*Vireo gilvus*
Warbler, Bachman's	*Vermivora bachmanii*
Warbler, Blue-winged	*Vermivora pinus*
Warbler, Golden-cheeked	*Dendroica chrysoparia*
Warbler, Kirtland's	*Dendroica kirtlandii*
Warbler, Nashville	*Vermivora ruficapilla*
Warbler, Pine	*Dendroica pinus*
Warbler, Prairie	*Dendroica discolor*
Warbler, Prothonotary	*Protonotaria citrea*
Warbler, Tennessee	*Vermivora peregrina*
Warbler, Worm-eating	*Helmitheros vermivorus*
Wigeon, American	*Mareca americana*
Woodcock, American	*Scolopax minor*
Woodpecker, Ivory-billed	*Campephilus principalis*
Woodpecker, Pileated	*Dryocopus pileatus*
Woodpecker, Red-cockaded	*Picoides borealis*
Wood-Pewee	*Contopus* spp.
Wren, Bewick's	*Thryomanes bewickii*
Wren, Cactus	*Campylorhynchus brunneicapillus*
Wren, Carolina	*Thryothorus ludovicianus*
Wren, Sedge	*Cistothorus platensis*
Wren, Winter	*Troglodytes troglodytes*

MAMMALS

Bat, Gray	*Myotis grisescens*
Bat, Indiana	*Myotis sodalis*
Bat, Virginia big-eared	*Plecotus townsendii virginianus*
Bear, Black	*Ursus americanus*
Bear, Grizzly	*Ursus arctos*
Beaver	*Castor canadensis*
Bison also Buffalo	*Bison bison*
Boar, also European wild	*Sus scrofa*
Bobcat	*Lynx rufus*
Caribou, Woodland	*Rangifer tarandus caribou*
Cottontail	*Sylvilagus* spp.
Coyote	*Canis latrans*
Deer	*Odocoileus* spp.
Deer, Black-tailed	*Odocoileus hemionus columbianus*
Deer, Columbian white-tailed	*Odocoileus virginianus columbianus*
Deer, Key	*Odocoileus virginianus clavium*
Deer, Mule	*Odocoileus hemionus*
Deer, Desert Mule	*Odocoileus hemionus crooki*
Deer, Sitka black-tailed	*Odocoileus hemionus sitkensis*
Deer, White-tailed	*Odocoileus virginianus*
Elk	*Cervus elaphus*
Ferret, Black-footed	*Mustela nigripes*
Fox, Gray	*Urocyon cinereoargenteus*

MAMMALS

Fox, Northern Swift	*Vulpes velox hebes*
Fox, Red	*Vulpes vulpes*
Fox, San Joaquin Kit	*Vulpes macrotis mutica*
Goat, Mountain	*Oreamnos americanus*
Gopher, Pocket	*Geomyidae*
Hare	*Lepus* spp.
Jackrabbit	*Lepus* spp.
Jackrabbit, Black-tailed	*Lepus californicus*
Jackrabbit, White-tailed	*Lepus townsendii*
Jaguarundi	*Felis yagouaroundi*
Javelina	*Dicotyles tajacu*
Lion, Mountain	*Felis concolor*
Lynx	*Lynx candensis*
Manatee	*Trichechus manatus*
Marmot, Yellow-bellied	*Marmota flaviventris*
Mink	*Mustela vison*
Moose	*Alces alces*
Mouse, House	*Mus musculus*
Muskrat	*Ondatra zibethicus*
Nutria	*Myocastor coypus*
Ocelot	*Felis pardalis*
Opossum, Virginia	*Didelphus virginiana*
Otter, Sea	*Enhydra lutris*
Panther, Florida	*Felis concolor coryi*
Peccary, Collared	*Tayassu tajacu*
Pig	*Sus scrofa*
Pika	*Ochotona princeps*
Prairie Dog	*Cynomys* spp.
Prairie Dog, Utah	*Cynomys parvidens*
Pronghorn	*Antelocapra americana*
Pronghorn, Sonoran	*Antelocapra americana sonoriensis*
Raccoon	*Procyon lotor*
Rat, Giant Kangaroo	*Dipodomys ingens*
Rat, Kangaroo	*Dipodomys* spp.
Rat, Norway	*Rattus norvegicus*
Ringtail	*Bassariscus astutus*
Sheep, Bighorn	*Ovis canadensis*
Sheep, Dall	*Ovis dalli*
Sheep, Desert bighorn	*Ovis canadensis merriam*
Skunk	*Mustelidae*
Squirrel	*Sciurus* spp.
Squirrel, Fox	*Sciurus niger*
Squirrel, Gray	*Sciurus carolinensis*
Squirrel, Northern flying	*Glaucomys sabrinus*
Wolf, Gray	*Canis lupus*
Wolf, Eastern Timber	*Canis lupus lycaon*
Wolf, Red	*Canis rufus*
Wolf, Texas red	*Canis rufus rufus*
Wolverine	*Gulo gulo*

FISH

Alewife	*Alosa pseudoharengus*
Bass, Largemouth	*Micropterus salmoides*
Bass, Smallmouth	*Micropterus dolomieui*
Bass, Striped	*Morone saxatilis*
Bass, White	*Morone chrysops*
Buffalo	*Ictiobus* spp.
Bullhead	*Ictalurus* spp.
Carp	*Cyprinus carpio*
Catfish	*Ictalurus* spp.

FISH	
Catfish, Walking	*Clarias batrachus*
Chubs	*Coregonus* spp.
Crappie	*Pomixis annularis*
	Pomixis nigromaculatus
Gar	*Lepisosteus* spp.
Paddlefish	*Polyodon spathula*
Perch, White	*Morone americana*
Perch, Yellow	*Perca flavescens*
Pickerel	*Esox* spp.
Pike	*Esox* spp.
Salmon, Chinook	*Oncorhynchus tshawytscha*
Salmon, Chum	*Oncorhynchus keta*
Salmon, Coho	*Oncorhynchus kisutch*
Salmon, Pink	*Oncorhynchus gorbuscha*
Salmon, Sockeye	*Oncorhynchus nerka*
Sauger	*Stizostedion canadense*
Shad	*Alosa sapidissima*
Shad, Gizzard	*Dorosoma cepedianum*
Sheepshead	*Aplodinotus grunniens*
Smelt	*Osmeridae*
Suckers	*Catostomidae*
Trout, Greenback cutthroat	*Salmo clarki stomias*
Trout, Lahontan cutthroat	*Salmo clarki henshawi*
Trout, Steelhead	*Salmo gairdneri*
Tullibee	*Coregonus* spp.
Walleye	*Stizostedion vitreum*
Whitefish	*Coregonus* spp.
REPTILES	
Crocodile, American	*Crocodylus acutus*
Hawksbill	*Eretmochelys imbricata*
Tortoise, Desert	*Gopherus agassizii*
Turtle, Ridley Sea	*Lepidochelys* spp.
Rattlesnake, New Mexico ridge-nosed	*Crotalus willardi obscurus*
CRUSTACEANS	
Crab, Blue	*Callinectes* spp.
Crab, King	*Paralithodes camschatica*
	Paralithodes platypus
	Lithodes acquispina
Crab, Snow	*Chionoecetes bairdi*
PLANTS[1]	
Alder, Red	*Alnus rubra*
Aspen	*Populus* spp.
Beech	*Fagus grandifolia*
Creosote	*Larrea tridentata*
Elm	*Ulmus* spp.
Fir, Douglas	*Pseudotsuga menziesii*
Larch	*Larix* spp.
Maple	*Acer* spp.
Maple, Red	*Acer rubrum*
Mesquite	*Prosopis juliflora*
Pine, Lodgepole	*Pinus contorta*
Pine, Ponderosa	*Pinus ponderosa*
Pine, Western white	*Pinus monticola*
Redwood	*Sequoia sempervirens*
Sweetgum	*Liquidambar styraciflua*
Sycamore	*Platanus* spp.
Tupelo	*Nyssa* spp.

[1]*For a complete list of plants associated with forage and range ecosystems, refer to Joyce (in press).*

APPENDIX C: TRENDS IN WILDLIFE AND FISH POPULATIONS, USE, AND HARVEST ON NATIONAL FOREST SYSTEM LANDS

Table C-1.—Trends in selected big game populations on NFS lands in the North.

Year	Moose	Deer	Gray wolf	Black bear	Turkey
1965	3,920	467,000	900	11,800	38,200
1966	4,100	414,000	620	11,000	20,000
1967	4,300	442,000	800	10,000	21,000
1968	4,200	396,000	360	8,100	24,000
1969	4,000	363,000	360	9,100	29,000
1970	3,800	338,000	450	8,800	18,000
1971	3,800	304,000	450	7,600	21,000
1972	4,800	297,000	520	8,300	31,000
1973	5,100	281,000	480	8,900	29,000
1974	5,200	298,000	480	8,900	28,000
1975	2,200	312,000	420	8,900	29,000
1976	2,500	290,000	600	9,400	30,000
1977	3,000	323,000	580	8,600	33,000
1978	2,710	314,114	574	9,547	42,656
1979	3,320	307,985	322	16,659	44,933
1980	3,245	315,109	378	9,226	50,772
1981	3,780	320,512	347	10,820	50,017
1982	5,485	317,962	348	10,070	39,384
1983	6,978	318,042	348	12,097	39,438
1984	6,589	326,619	345	11,800	34,319

Source: USDA Forest Service (1965–1977, 1978–1985).

Table C-2.—Trends in selected big game populations on NFS lands in the South.

Year	Deer	Turkey	Black bear	Wild (feral) pig
1965	248,000	41,800	3,100	1,300
1966	265,000	52,000	3,800	1,400
1967	277,000	55,000	4,000	1,600
1968	289,000	57,000	4,000	1,600
1969	280,000	59,000	3,400	1,400
1970	284,000	69,000	2,700	860
1971	285,000	74,000	3,100	1,500
1972	303,000	85,000	2,800	2,500
1973	286,000	81,000	2,900	2,400
1974	307,000	85,000	2,500	2,600
1975	306,000	77,000	2,600	2,000
1976	309,000	82,000	2,600	2,200
1977	301,000	86,000	2,800	2,500
1978	303,060	95,382	2,853	2,282
1979	289,280	104,662	3,230	1,522
1980	298,330	111,185	4,015	1,710
1981	279,886	115,866	3,958	1,525
1982	265,164	122,730	2,432	1,684
1983	275,526	124,133	3,027	1,954
1984	280,504	123,187	3,722	2,415

Source: USDA Forest Service (1965–1977, 1978–1985).

Table C-3.—Trends in selected big game populations on NFS lands in the Rocky Mountains.

Year	Moose	Pronghorn	Elk	Peccary	Mountain lion	Turkey	Deer	Mountain goat	Bighorn sheep	Caribou	Bear
1965	12,250	47,100	268,000	24,000		75,400	1,742,100	9,990	11,533	140	44,800
1966	12,400	42,700	266,000	27,000		84,400	1,609,200	10,330	11,343	140	46,105
1967	12,990	40,600	280,000	28,000		81,800	1,642,900	10,490	12,237	100	46,200
1968	12,770	34,900	263,000	22,000		69,000	1,617,600	9,670	10,825	115	44,125
1969	11,450	34,900	270,000	24,000		69,000	1,612,100	9,670	10,825	85	43,930
1970	13,640	32,900	274,000	21,000		66,900	1,595,900	9,720	11,000	85	43,630
1971	13,400	34,900	275,000	21,000		65,300	1,560,900	9,360	11,190	90	43,560
1972	14,020	37,800	276,000	21,000		53,600	1,518,900	9,340	11,480	80	45,390
1973	13,970	34,500	272,300	20,000	5,000	55,200	1,184,700	8,910	11,680	70	43,591
1974	14,820	38,900	282,000	21,000	5,540	56,100	1,352,200	8,640	11,870	60	43,570
1975	15,300	41,500	292,000	21,000	5,390	54,800	1,219,950	8,260	12,900	45	43,025
1976	15,770	39,900	293,000	21,000	5,670	52,400	1,102,930	7,280	13,130	45	43,415
1977	15,700	44,800	323,000	21,000	6,030	52,600	1,120,680	7,900	13,790	40	42,220
1978	16,027	54,789	307,989	20,183	6,288	54,617	1,118,451	8,242	14,334	41	40,840
1979	16,091	43,332	302,443	19,273	6,197	55,205	1,097,746	7,592	15,016	30	41,670
1980	16,640	43,379	298,404	21,277	6,452	57,702	1,099,797	8,067	15,757	30	42,835
1981	16,504	42,747	332,573	22,187	6,776	57,456	1,198,656	8,086	16,936	25	43,931
1982	15,987	45,275	346,783	23,746	7,027	59,105	1,289,533	7,713	17,512	15	41,247
1983	15,722	54,464	362,593	24,701	7,320	61,363	1,238,384	7,650	17,586	20	42,157
1984	15,566	52,704	371,759	25,783	7,608	65,689	1,197,102	7,915	17,658	17	44,552

Source: USDA Forest Service (1965–1977, 1978–1985).

Table C-4.—Trends in selected big game populations on NFS lands in the Pacific Coast.

Year	Moose	Pronghorn	Gray wolf	Elk	Turkey	Deer	Mountain goat	Bighorn sheep	Caribou	Bear
1965	4,515	3,000	1,900	92,820	2,710	1,564,900	21,800	2,015	6	55,301
1966	4,720	3,100	1,800	91,050	3,600	1,511,900	20,400	2,390	10	56,300
1967	3,920	3,000	2,000	94,250	3,400	1,633,100	20,100	3,460	50	54,303
1968	5,020	3,000	2,300	87,540	4,200	1,535,700	21,300	3,500	60	53,404
1969	5,316	3,400	2,100	90,400	4,600	1,436,300	20,800	2,980	75	51,102
1970	6,415	4,000	2,102	87,900	5,000	1,392,000	20,900	2,715	40	52,102
1971	5,615	4,200	2,100	90,500	4,900	1,316,000	20,200	2,440	170	50,002
1972	6,015	4,100	1,400	92,100	5,200	1,172,900	20,000	2,590	200	47,002
1973	5,620	4,700	1,004	93,600	5,300	1,045,600	20,000	2,630	280	43,620
1974	5,400	3,600	804	103,700	4,900	1,035,000	19,000	2,590	300	43,912
1975	4,618	4,300	800	104,700	4,200	972,000	18,100	2,560	355	46,003
1976	4,518	4,700	750	107,900	4,400	999,000	15,900	2,630	355	46,702
1977	4,630	5,300	702	107,190	3,900	980,000	16,300	3,310	355	45,004
1978	4,586	5,181	700	106,931	6,318	1,042,222	16,387	3,412	355	45,289
1979	4,492	5,320	825	102,864	5,773	972,035	13,929	3,236	355	48,149
1980	4,901	5,457	825	96,599	6,514	955,724	13,760	3,279	255	47,052
1981	4,853	5,482	842	95,298	6,798	991,747	14,179	2,937	255	46,956
1982	5,298	5,506	867	100,817	6,934	1,031,711	13,711	3,663	503	48,591
1983	4,925	5,217	767	99,605	7,386	981,992	15,651	3,762	6	40,804
1984	4,091	5,376	817	93,853	8,144	933,556	17,237	2,744	306	46,406

Source: USDA Forest Service (1965–1977, 1978–1985).

Table C-5.—National and regional trends in nonconsumptive user days on NFS lands.

Year	National	North	Rocky South	Pacific Mountain	Coast
1980	1,342,500	120,000	150,800	525,000	546,700
1981	1,550,770	127,100	205,600	633,600	584,400
1982	1,474,500	114,300	194,300	591,900	574,000
1983	1,277,400	115,700	179,900	537,100	444,700
1984	1,277,700	106,400	200,000	536,500	434,800

Source: USDA Forest Service (1980–1985).

Table C-6.—Trends in migratory bird user-days on NFS lands by assessment region.

Year	National	North	South	Rocky Mountain	Pacific Coast
1966	649,000	199,000	113,000	161,000	176,000
1967	614,000	188,000	113,000	158,000	155,000
1968	573,000	188,000	94,000	136,000	155,000
1969	574,000	201,000	94,000	127,000	152,000
1970	585,000	198,000	86,000	129,000	172,000
1971	621,000	232,000	90,000	147,000	152,000
1972	675,000	231,000	96,000	173,000	175,000
1973	657,000	229,000	92,000	163,000	173,000
1974	769,500	242,200	122,800	194,400	210,100
1975	775,300	276,400	117,400	183,100	198,400
1976	757,700	272,300	112,800	160,900	211,700
1977	813,900	232,600	111,700	222,300	247,300
1978	818,100	242,000	111,700	203,500	260,900
1979	801,500	241,800	118,000	209,800	231,900
1980	723,100	226,500	117,100	205,800	173,700
1981	796,700	234,500	123,000	222,200	217,000
1982	757,600	201,800	128,000	215,800	212,000
1983	613,700	198,600	122,700	197,200	95,200
1984	578,800	188,300	100,200	196,300	94,000

Source: USDA Forest Service (1965–1977, 1978–1985).

Table C-7.—Big game user-days on national forests by assessment region.

Year	National	North	South	Rocky Mountain	Pacific Coast
1966	9,916,000	963,000	1,871,000	4,007,000	3,075,000
1967	9,253,000	1,059,000	1,400,000	3,831,000	2,963,000
1968	9,449,000	1,083,000	1,535,000	3,725,000	3,106,000
1969	10,034,000	1,072,000	1,593,000	4,043,000	3,326,000
1970	10,075,000	1,123,000	1,550,000	4,072,000	3,330,000
1971	10,032,000	1,030,000	1,747,000	4,106,000	3,149,000
1972	9,076,000	781,000	1,818,000	3,787,000	2,690,000
1973	9,373,000	889,000	1,836,000	4,012,000	2,636,000
1974	9,742,500	917,100	1,818,000	4,105,200	2,902,200
1975	9,813,400	1,014,400	1,877,600	4,101,400	2,820,000
1976	9,415,300	1,129,300	1,855,500	3,677,200	2,753,300
1977	9,738,000	1,236,500	1,951,900	3,961,200	2,588,400
1978	9,632,700	1,223,500	1,934,200	3,673,000	2,802,000
1979	10,186,400	1,218,500	2,023,000	4,138,900	2,806,000
1980	10,445,800	1,333,400	1,960,600	4,111,600	3,040,200
1981	10,875,200	1,354,400	2,091,000	4,584,600	2,845,200
1982	10,875,900	1,296,500	2,120,800	4,520,300	2,938,300
1983	11,148,100	1,345,000	2,130,100	4,697,900	2,975,100
1984	10,612,000	1,222,500	2,006,600	4,561,800	2,821,100

Source: USDA Forest Service (1966–1984).

Table C-8.—Trends in small game user-days on the national forests by assessment region.

Year	National	North	South	Rocky Mountain	Pacific Coast
1965	3,891,000	1,075,000	1,202,000	546,000	350,000
1966	3,535,000	924,000	1,405,000	706,000	500,000
1967	3,252,000	866,000	1,271,000	620,000	495,000
1968	3,227,000	792,000	1,343,000	590,000	501,800
1969	3,436,000	897,000	1,423,000	594,000	522,000
1970	3,488,000	880,000	1,480,000	617,000	511,000
1971	3,646,000	920,000	1,575,000	635,000	516,000
1972	3,378,000	768,000	1,592,000	593,000	425,000
1973	3,713,000	948,000	1,664,000	638,000	469,000
1974	3,719,000	956,000	1,593,500	678,100	491,400
1975	3,834,100	1,015,200	1,635,800	686,500	496,600
1976	3,899,400	1,090,400	1,612,500	664,300	532,200
1977	3,965,100	1,031,600	1,690,900	746,100	496,500
1978	4,195,400	1,042,300	1,729,100	807,500	616,500
1979	4,340,000	1,007,500	1,792,800	866,000	673,700
1980	4,711,000	1,279,400	1,925,300	914,100	592,200
1981	4,741,100	1,180,700	1,906,300	1,044,600	609,500
1982	4,601,700	1,113,700	1,807,100	1,019,600	661,300
1983	4,367,300	1,101,100	1,757,100	951,000	557,500
1984	4,056,500	984,200	1,690,300	882,500	498,700

Source: USDA Forest Service (1965–1977, 1978–1985).

Table C-9.—Warm- and coldwater fishing user-days on national forests, by region.

Year	National		North		South		Rocky Mountain		Pacific Coast	
	Warm	Cold	Warm	Cold	Warm	Cold	Warm	Cold	Warm	Cold
1967	2,457,000	12,248,000	904,000	686,000	1,154,000	596,000	291,000	4,973,000	108,000	5,993,000
1968	2,385,000	11,530,000	807,000	609,000	1,196,000	541,000	254,000	4,806,000	128,000	5,574,000
1969	2,862,000	11,554,000	1,141,000	662,000	1,275,000	571,000	311,000	4,982,000	135,000	5,339,000
1970	3,019,000	11,751,000	1,294,000	579,000	1,281,000	595,000	306,000	4,979,000	138,000	5,598,000
1971	3,188,000	11,917,000	1,353,000	646,000	1,334,000	582,000	230,000	5,156,000	271,000	5,533,000
1972	3,102,000	11,600,000	1,072,000	623,000	1,391,000	619,000	243,000	5,205,000	396,000	5,153,000
1973	3,314,000	12,000,000	1,125,000	619,000	1,433,000	672,000	360,000	5,444,000	396,000	5,265,000
1974	3,568,700	12,021,300	1,404,000	690,600	1,422,600	776,600	337,900	5,338,900	404,200	5,218,200
1975	4,432,200	11,783,800	1,601,800	661,100	2,095,800	741,800	373,100	5,196,800	361,500	5,184,100
1976	4,152,800	11,772,800	1,352,400	705,400	2,053,600	735,600	389,400	5,186,400	357,400	5,145,400
1977	3,894,200	11,834,700	1,335,300	680,200	2,194,900	690,600	226,000	6,123,100	138,000	4,340,800
1978	4,118,500	12,059,200	1,384,500	698,600	2,181,800	723,200	265,600	5,870,400	286,600	4,767,000
1979	3,937,700	11,649,500	1,231,400	625,300	2,126,200	799,800	293,400	5,959,100	286,700	4,825,300
1980	4,328,800	12,358,600	1,330,500	622,100	2,327,700	823,100	331,500	6,027,500	339,100	4,885,900
1981	4,096,400	12,402,300	1,389,200	640,400	2,047,900	798,300	326,900	6,215,200	332,400	4,748,400
1982	4,089,400	11,989,100	1,387,200	664,100	2,034,800	774,500	324,900	5,898,300	342,500	4,561,200
1983	4,119,400	11,402,600	1,428,100	658,000	2,010,900	764,600	282,800	5,371,700	397,600	4,248,300
1984	4,046,700	11,125,600	1,327,600	639,500	1,966,900	787,400	351,100	5,365,800	401,100	4,332,900

Source: USDA Forest Service (1965–1977, 1978–1985).

Table C-10.—Harvest trends for selected big game species on NFS lands in the North.

Year	Deer	Turkey	Black bear
1965	62,000	450	760
1966	66,000	2,100	900
1967	60,000	1,700	970
1968	68,000	2,100	650
1969	62,000	2,100	890
1970	54,000	2,900	850
1971	41,000	3,100	760
1972	29,000	3,600	770
1973	37,000	3,300	730
1974	39,000	4,200	650
1975	43,000	3,600	670
1976	44,000	4,600	790
1977	45,000	4,100	760
1978	51,597	5,217	1,147
1979	53,900	4,895	1,268
1980	54,329	5,596	1,262
1981	54,484	7,675	1,278
1982	60,607	7,444	1,356
1983	56,564	7,377	1,255
1984	61,348	4,291	1,401

Source: USDA Forest Service (1965–1977, 1978–1985).

Table C-11.—Harvest trends for selected game species on NFS lands in the South.

Year	Deer	Turkey	Black bear
1965	20,000	2,300	230
1966	32,000	4,800	370
1967	32,000	5,500	420
1968	34,000	4,700	500
1969	32,000	5,800	560
1970	33,000	6,800	310
1971	36,000	7,200	370
1972	36,000	6,600	310
1973	34,000	6,000	300
1974	36,000	6,900	300
1975	39,000	5,400	210
1976	41,000	6,400	230
1977	41,000	6,800	330
1978	39,739	7,969	264
1979	39,705	9,552	310
1980	41,908	11,241	359
1981	41,859	11,605	310
1982	45,728	10,816	282
1983	49,120	11,569	364
1984	48,788	10,432	450

Source: USDA Forest Service (1965–1977, 1978–1985).

Table C-12.—Harvest trends in selected big game species on NFS lands in the Rocky Mountains.

Year	Moose	Pronghorn	Elk	Pecarry	Mountain lion	Turkey	Deer	Mountain goat	Bighorn sheep	Black bear
1965	1,450	10,670	50,100	2,300		6,450	295,470	624	380	4,849
1966	1,420	7,900	47,000	2,900		6,805	342,230	604	365	4,734
1967	1,530	7,490	50,400	3,800		6,380	294,520	588	316	5,103
1968	1,610	7,340	50,800	4,600		5,650	309,000	620	362	4,730
1969	1,590	6,930	57,800	3,000		4,910	325,860	615	370	5,301
1970	1,380	5,940	61,500	3,400		3,886	300,570	600	286	4,616
1971	1,570	6,290	58,400	3,000		4,170	298,160	550	380	4,453
1972	1,725	6,260	50,800	2,600		5,500	254,480	517	290	4,451
1973	1,911	6,480	53,500	2,300	522	3,660	243,600	480	298	4,178
1974	2,050	6,840	63,600	2,500	579	4,985	228,990	540	357	4,056
1975	1,950	7,480	12,000	2,300	680	4,415	191,450	460	80	918
1976	2,050	8,270	63,600	2,500	700	6,030	159,245	380	409	4,621
1977	1,740	9,070	55,400	3,000	660	4,670	140,540	420	399	4,362
1978	2,036	9,790	60,753	2,148	691	4,724	170,753	409	402	4,406
1979	1,815	7,852	58,194	2,595	652	5,335	177,301	376	448	4,341
1980	1,840	5,724	60,108	2,608	649	6,126	169,118	394	505	4,300
1981	1,663	5,814	58,204	3,742	619	6,024	177,557	361	505	4,655
1982	1,716	7,252	64,985	3,506	741	6,975	203,055	347	528	4,003
1983	1,609	9,307	65,824	3,865	936	7,406	191,309	263	596	3,995
1984	1,396	10,716	64,172	3,671	862	7,038	212,130	280	682	4,377

Source: USDA Forest Service (1965–1977, 1978–1985).

Table C-13.—Harvest trends in selected big game species on NFS lands in the Pacific Coast.

Year	Moose	Pronghorn	Gray wolf	Elk	Mountain lion	Turkey	Deer	Mountain goat	Bighorn sheep	Caribou	Black bear
1965	760	90	280	18,060		0	133,420	800	10	0	3,560
1966	470	110	230	14,300		36	109,200	660	25		4,030
1967	340	90	240	16,120		30	141,280	880	40	0	3,901
1968	470	110	290	13,120		90	126,680	770	38	0	3,510
1969	730	90	230	13,100		80	143,500	850	56	0	3,430
1970	840	120	240	13,160		40	105,800	900	57	0	3,660
1971	750	130	250	15,090		60	96,820	800	79	0	2,690
1972	720	220	210	11,040		85	77,290	690	24	0	3,040
1973	500	300	92	11,915	143	235	61,560	920	23	6	3,160
1974	410	270	65	14,018	73	80	72,060	770	25	12	3,020
1975	210	220	100	15,031	121	90	65,000	800	25	40	3,280
1976	161	185	120	17,025	102	90	69,700	640	12	85	3,170
1977	161	370	80	15,030	120	100	63,100	610	13	80	3,090
1978	217	329	77	18,923	146	110	97,246	550	18	27	2,971
1979	327	263	110	18,077	169	122	83,085	605	57	30	3,117
1980	115	284	81	16,689	152	127	77,507	639	25	33	3,108
1981	295	274	88	21,288	138	177	81,526	537	28	38	3,086
1982	371	296	98	18,619	167	189	91,887	510	26	42	2,975
1983	375	305	87	18,188	127	189	68,621	638	32	0	2,795
1984	365	315	147	15,772	111	186	68,590	620	38	42	2,740

Source: USDA Forest Service (1965–1977, 1978–1985).

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