Chapter 2

Contemporary Human Use of Southwestern Ponderosa Pine Forests

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Introduction

The ponderosa pine forests of the Southwest provide land, resources, products, and recreational opportunities for both urban and rural communities of the region and the nation. These human uses and activities affect resident and migratory bird populations in both negative and positive ways. This brief review focuses on three major kinds of human use that have the greatest potential to affect bird populations of the area: 1) commercial and personal-use wood harvest; 2) livestock grazing; and 3) recreation (USDI Fish and Wildlife Service 1995). In addition, growing urbanization, which also has the potential to affect bird populations, is briefly reviewed. The geographic focus is the USDA Forest Service land within the Southwestern Region (Region 3), located in Arizona and New Mexico, with a special emphasis on New Mexico and some of the long-standing, traditional use patterns of the state. Since another portion of this overview presents a history of human use of the ponderosa pine forest, this review is concentrated upon present-day uses and issues.

Commercial and Personal-Use Wood Harvest

Southwestern ponderosa pine forests provide wood and wood products for both commercial and personal purposes. Large-scale and small-scale commercial activities include the harvest of sawtimber, poles, posts, and fuelwood. Personal-use fuelwood and Christmas trees constitute the major noncommercial products. Data from Region 3 indicate that there were 58,733 wood and wood product sales of all types during fiscal year 1995. Timber of all types cut on Forest Service lands in Arizona and New Mexico during the same period had a value approaching $9 million.[1]

[1] *All figures on timber and wood product sales and volume throughout this chapter were obtained from the USDA Forest Service Southwestern Region 3, Regional Office, Albuquerque, New Mexico, with the help of Milo Larson, Marlin Johnson, and Paul Fink.*

Ponderosa Pine as a Timber Resource

To understand the effect of the various human uses on the ponderosa pine forest, it is helpful to review background information concerning these lands and their timber resources.

Forest land falls into two major categories—timberland or woodland—based on levels of tree stocking. Timberland is forest land on which tree species, such as industrial roundwood products like ponderosa pine and Douglas-fir, make up at least 10 percent of the stocking level. Woodland areas are other forest lands on which timber species are not present at the minimum stocking level. Woodland tree species, such as pinyon and juniper, are typically not used for roundwood products other than fence posts but are an important source of fuelwood and, in some cases, Christmas trees (Conner et al. 1990).

In 1986, of the 61 million hectares (ha) in Arizona and New Mexico, about 17 million ha or 28 percent were forest lands (Conner et al. 1990; Van Hooser et al. 1993). One-fourth of the forest land is reserved or withdrawn from timber harvest through statutes or administrative designations. More than 3.5 million ha are designated as nonreserved, commercial timberland. The ponderosa pine forest is the most extensive nonreserved timberland, accounting for more than 2.5 million ha, or over 72 percent of the timberland available for harvesting roundwood products in the Southwest. Nearly two-thirds (64 percent) of the ponderosa pine timberland is administered by public agencies (figure 1). The National Forest Service, with over 1.56 million ha, manages the largest area of ponderosa pine forest in the Southwest. Other public agencies such as the Bureau of Land Management and various state, county, and municipal governments administer just over 57,000 ha. Ponderosa pine timberland in private ownership equals over 914,000 ha. Owners vary from individuals to large corporations, including Indian tribes, farmers, and ranchers (Connor et al. 1990; Van Hooser et al. 1993).

Silvicultural Systems

Silviculture has been defined as: 1) the art of producing and tending a forest; 2) the application of the knowledge of silvics in forest culture; and 3) the theory and practices of controlling forest establishment, composition, and growth (Smith 1962). In essence, silvicultural practices can be used to mold the forest in desired directions, forms, or

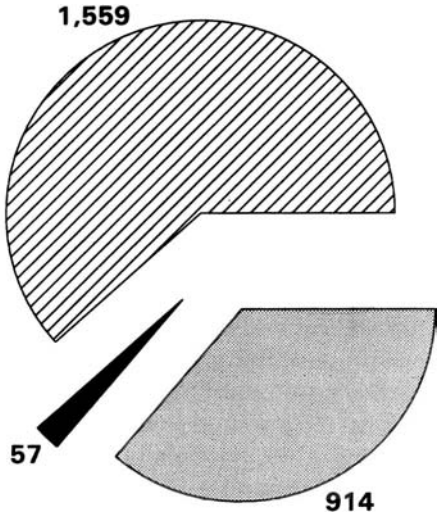

*Figure 1. Ownership and adminstration of ponderosa pine timberland in Arizona and New Mexico (data summarized from Conner et al. **1990;** Van Hooser et al. **1993).***

conditions. Economical wood production is commonly the primary objective.

A silvicultural system that includes harvest cutting, regeneration, and intermediate treatments manages a stand of trees for an entire rotation. Regeneration cuts usually harvest timber and establish tree reproduction simultaneously. Silvicultural techniques used to manage ponderosa pine forests in the Southwest produce stands with two types of age structure: even-aged and uneven-aged (Schubert 1974; Alexander and Edminster 1980). Regeneration techniques that mimic natural disturbance regimes lead to forests that are similar to "natural (unrnanaged) forests," which are generally uneven-aged.

Even-Aged Management

Under even-aged management, harvest and regeneration are planned by area and are a function of rotation age, which is the age at which a stand is considered to be regenerated on the basis of management objectives. Trees of a given stand are of one or two age classes. Sustained yield is maintained at the forest, not the stand, level (Alexander 1987). Historically, techniques leading to even-aged stand management have been favored for timber harvest on public lands in the Southwest for reasons of economy and efficiency (USDI Fish and Wildlife Service 1995). Cutting methods traditionally used to harvest or regenerate stands under even-aged systems include: 1) the shelterwood method, which consists of the gradual removal of most or all trees in a series of partial cuttings extending over a portion of the rotation; 2) the seed tree method, which consists of removing all trees in a stand except a small number (left singly or in groups) to reseed the harvested area; and 3) the clearcutting method, which consists of harvesting the timber crop in one step to establish a new stand (USDA Forest Service 1983).

Uneven-Aged Management

Under uneven-aged management, individual trees or small groups of trees are selectively removed throughout the stand on the basis of age, diameter, vigor, form, and species to maintain a relatively consistent stand structure. The individual tree selection cutting method is used to produce uneven-aged stands, which regenerate continuously. The objective is to produce a stand with trees of different sizes and age classes intermingled on the same site (USDA Forest Service 1983). The group selection cutting method is also used to selectively harvest trees in groups from geographic areas ranging from a fraction of a hectare up to about 5 ha (USDA Forest Service 1983). The area cut is generally smaller than the minimum feasible for a single stand under even-aged management.

Regeneration and Intermediate Treatments

Following or during harvest, a ponderosa pine stand is treated to create conditions favorable for regeneration of desired species. Site preparation may involve removal of slash, preparation of a loose seedbed, and removal of the competing ground vegetation by mechanical, chemical, or burning treatments (Johnsen et al. 1973; Thompson et al. 1995). Slash may be removed to reduce the fuel load for wildfires or because it physically impedes stand regeneration or causes too much shade. Slash is commonly removed in combination with planting by means of broadcast burning, piling and burning, lopping and scattering, windrowing, or chopping on site. Seedbed preparation involves removing organic matter to expose mineral soil. Predominant methods of seedbed preparation include prescribed burning and scarification, which is the mechanical removal or mixing of the organic matter and the mineral soil. Competing vegetation is usually controlled by prescribed burning, mechanical treatment, or herbicides. Prescribed burning can also be used to encourage the growth of desired fire-adapted or dependent species (Thompson et al. 1995).

Natural regeneration of ponderosa pine depends on moisture conditions. Since the seed of ponderosa pine often does not germinate until the coming of the summer rains, its vitality is impaired by the usual period of drought between April and June. The seedlings that do come up are subjected to another drought from the latter part of September to November (Woolsey 1911). Artificial regeneration is accomplished by planting young trees or by

seeding before or after removing the old stand. This technique is often used with conifers because of low natural regeneration, high probability of successful artificial regeneration, and high financial yield (Thompsonet al. 1995).

Intermediate cuts include all the cutting treatments made from establishment of the new stand until replacement. Cuts are made when needed, but normally at specific intervals, to increase the quantity and quality of timber produced and to salvage material that would be lost. Common intermediate cuts in the Southwestern ponderosa pine forests include: 1) thinning, in which the smallest trees and rough dominants are removed; 2) release cutting, to release young trees from the competition of grass, brush, or trees to provide adequate growing space, light, and moisture for early rapid development; 3) improvement cutting, which resembles a sanitation-salvage cutting to improve the quality of the residual stand and reduce mortality; 4) sanitation cutting, which eliminates trees that have been attacked or are likely candidates for attack by insects or disease to prevent spread to other trees; and 5) salvage-cutting dead, dying, damaged, or deteriorating trees to derive economic benefits before decay processes reduce such values. Salvage cutting is a widespread practice often employed after insect outbreaks, fire, windstorms, and other natural disturbances (Schubert 1974; Thompson et al. 1995).

History of Management of Ponderosa Pine Forests

Prior to European settlement and management, the ponderosa pine forests in the Southwest were uneven-aged, with the trees usually arranged by even-aged groups (Myers and Martin 1963). Since forest management began in the area, both even-aged and, to a lesser extent, uneven-aged systems have been used. In the early 1900s unmanaged ponderosa pine forests were converted to managed stands to maintain higher growing stock levels and timber production (Woolsey 1911; Pearson 1950; Myers and Martin 1963).

The primitive application of the shelterwood method was the major harvest and regeneration practice used on ponderosa pine forest on Forest Service land in the Southwest. Two-thirds of an original stand was cut and the remainder was removed when the new crop was established (Woolsey 1911), which usually took 15 to 20 years. On many of the federal forests, selective cuttings were made in a series of light cuts, which generally amounted to the shelterwood method (Clapp 1912; Pearson 1910). These light cuts eventually removed 60 to 70 percent of the volume, and the rest was cut 10 to 20 years later after reproduction was established (Schubert 1974).

"Loggers' selection" (high-grading), sanitation salvage, and improvement selection cutting, which removed trees in a series of cuts on an individual or group basis, were widely adopted in the early and mid-1900s. Cutover areas were allowed to restock naturally regardless of the time required or the stocking achieved. Management intensity was increased by the 1970s. Managers were increasingly concerned with prompt restocking of cutover areas and with increasing the growth rate of the new stand by control of stand density. They sought to improve quantity and quality of yields by periodic thinning (Alexander and Edminster 1980).

Silvicultural practices create edges and alter landscape structure, forest age, and structure that affect bird populations. Concern over these effects is often greater when timber is harvested on public forest lands since they are some of the least fragmented forests remaining in North America (Wilcove 1988; Thompson et al. 1995). The problems of meeting avian habitat needs while managing other forest resources on public lands became an important issue in selecting silvicultural practices in the late 1970s and early 1980s. A series of workshops and symposia were organized to bring together avian ecologists and forest resource managers to discuss common problems (see Smith 1975; DeGraff 1978, 1980; McComb 1984). In the late 1980s and early 1990s concern mounted over the effects of timber harvest on bird and other wildlife habitat, leading to court actions and legislatively mandated studies of habitat and wildlife populations on public land (USDI Fish and Wildlife Service 1995). A review of the status of current knowledge derived from these and other research projects and a discussion of critical future issues are presented in Martin and Finch (1995).

To manage forests for habitat requirements of bird populations (as well as other species and resources), biologists now recommend a shift away from an over-emphasis on even-aged management strategies (Szaro and Balda 1979; Thompson et al. 1995; USDI Fish and Wildlife Service 1995). They recommend a mix of silvicultural practices, including both even-aged and uneven-aged management strategies, that maximize landscape and regional diversity. A review of information gathered from bird community studies in Rocky Mountain habitats suggests that species respond individually to different silvicultural treatments. The authors (Hejl et al. 1995:236) state:

> . . . many forest birds were less abundant in clearcuts than in uncut forests, and species that frequent open forests or open habitats were more abundant in clearcuts than in uncut forests. Most permanent residents were less abundant after either kind of harvesting treatment (clearcut or partial logging), whereas about half the migrants were less abundant and half more abundant in harvested areas.

Thus, emphasizing any one silvicultural technique or management strategy would favor some birds at the expense of others. Broad-scale management strategies and

those that use many different techniques to mimic natural patterns and processes are recommended (Hejl et al. 1995). Researchers urge that stand-level management should occur with knowledge of the regional status of the species and the ecosystem and that local-level management should complement regional goals (Hejl et al. 1995; Thompson et al. 1995). The goal, admittedly difficult and unattainable if too much is asked of the land, should be to manage the forest system for simultaneous production of goods and services in an optimal manner, while maintaining a healthy and balanced environment.

Forest Changes and Silvicultural Practices

Silvicultural practices have changed the availability, structure, and conformation of the ponderosa pine timberland in the Southwest. Silvicultural prescriptions have changed as our knowledge of forest ecologies has increased. Public opinion, political expediency, and individual personalities have also affected how the land has been managed, often irrespective of silvicultural requirements, site conditions, and conflicting objectives (Hejl et al. 1995). In-depth discussions of historical human activities and pre-European settlement conditions in ponderosa pine forests of the Southwest are presented in Scurlock (this volume) and Moir et al. (this volume). Thus, we focus here on presenting some of the more detailed information on changing forest condition and composition.

In the following review, we use information gathered by the Forest Service since most ponderosa pine is under Forest Service management. Growth, mortality, and removals through harvest are the principal elements of change of ponderosa pine timberland in the Southwest today. Based on surveys conducted by the Forest Service in 1962 and 1986, it is estimated that the annual growth of ponderosa pine forests is about 4.62 million m^3 in the Southwest. About 6 percent of the growing stock dies, leaving a net increase of 4.34 million m^3. If one subtracts an annual logging harvest (from those years) of 2.24 million m^3, the net annual addition is about 2.10 million m^3. The causes of mortality in ponderosa pine that could be determined include insect infestation, disease, fire, animal damage, logging, suppression of growth by weather, and suppression by thinning and other silvicultural techniques (figure 2). In 1986, weather killed 72,000 m^3 and disease accounted for another 14,000 m^3.

Ponderosa pine forests have always been the mainstay of the timber industry in the Southwest (Clapp 1912; Pearson 1910; Pearson and Marsh 1935). In New Mexico, about 73 percent of the lumber cut by sawmills has been ponderosa pine (Van Hooser 1993). Although other species have gradually become more important, ponderosa pine still accounted for 54 percent of the total lumber output for New Mexico in 1962. It increased to 69 percent in 1986 (Choate 1966; Van Hooser et al. 1993). In 1986, 91

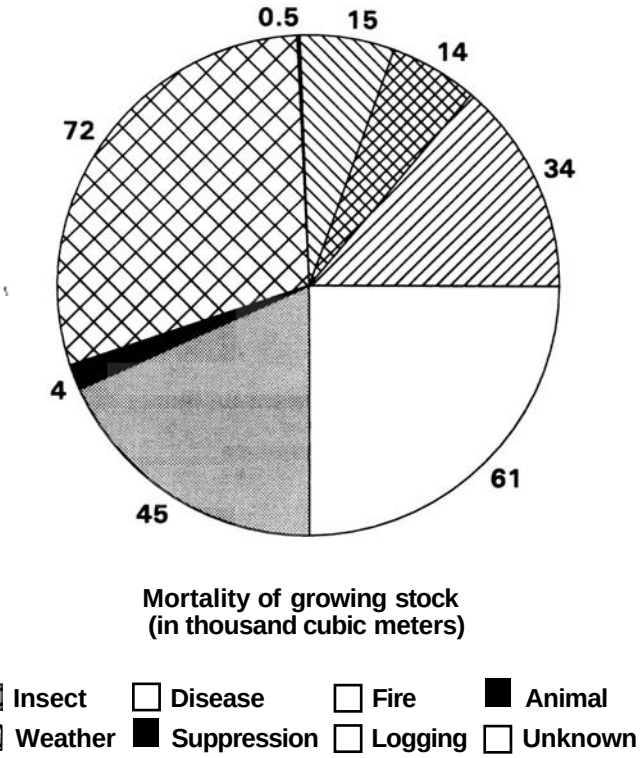

Figure 2. Distribution of annual mortality of growing stock on ponderosa pine timberland by cause of death in Arizona and New Mexico (data summarized from Conner et al. 1990; Van Hooser et al. 1993).

percent of the 1.8 million m^3 harvested in Arizona was ponderosa pine. In the two states combined, a total of 2.24 million m^3 of ponderosa pine was logged in 1986, and sawtimber trees accounted for 90 percent of the total cut.

Based on surveys by Choate (1966), Spencer (1966), Conner et al. (1990), and Van Hooser et al. (1993), we found that in New Mexico and Arizona ponderosa pine accounted for 3.2 million ha of timber lands (78 percent of all the commercial forest types) in 1962 and 2.5 million ha in 1986 for a 22 percent decrease. This trend toward decrease is not consistent among stand classes. While the area of small tree stands (poletimber, sapling, and seedling) increased 238,000 ha or more than 2.5 times between 1962 and 1986, sawtimber stands decreased 892,000 ha. The sawtimber stands accounted for 92 percent of 3.2 million ha of timberland in 1962 with a 10 percent reduction in the intervening 24 years (figure 3). Within the sawtimber stands, the volume of trees of dbh 243.2 cm (17 inches) decreased 992 million board feet, while the volume of trees of dbh below 43.2 cm increased 708 million board feet (figure 4). This resulted in a net decrease of 284 million board feet of sawtimber volume. The volume of growing stock showed similar trends between 1962 and 1986. The average growing stock volume of ponderosa pine timberland was 79 m^3/ha in 1962 and 72 m^3/ha in 1986 (figure 5).

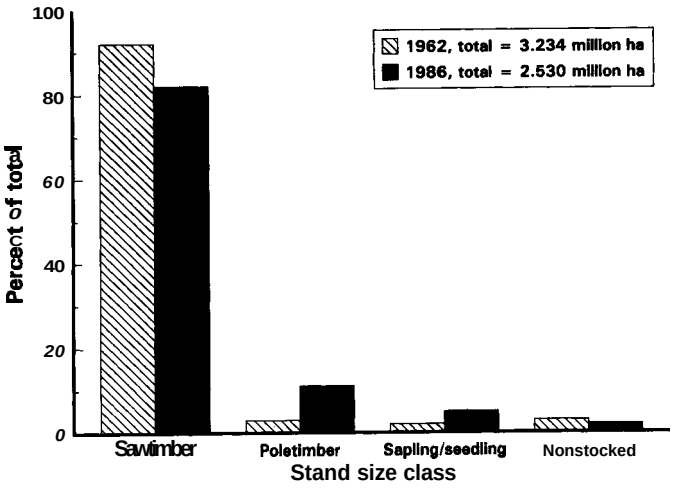

Figure 3. Change of stand size of ponderosa pine timberland in Arizona and New Mexico between 1962 and 1986 (data summarized from Choate 1966; Spencer 1966; Conner et al. 1990; Van Hooser et al. 1993).

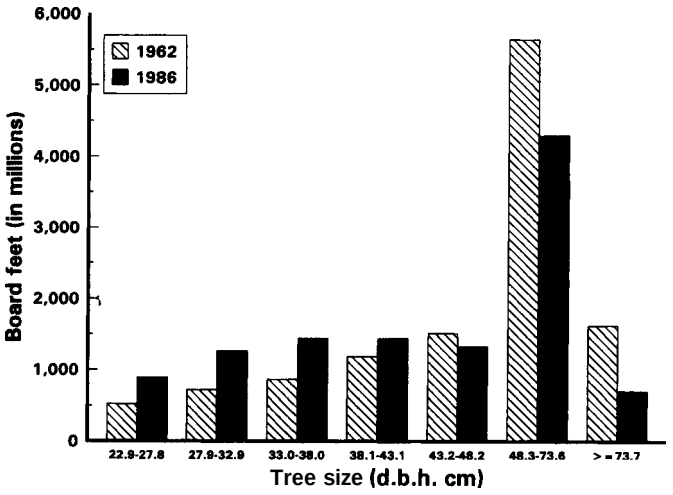

Figure 4. Change of sawtimber volume of ponderosa pine timberland in Arizona and New Mexico between 1962 and 1986 (data summarized from Choate 1966; Spencer 1966; Conner et al. 1990; Van Hooser et al. 1993).

Because the general rule of historic logging was that the most accessible and commercially valuable trees were logged before less accessible and less valuable trees, logging and other silvicultural practices affected availability, structure, and species composition not only at the stand level, but also at the landscape level. For example, even-aged management creates a specific age-class distribution of forest habitats that usually differs from forests with no timber harvest. A common trend among forests managed under even-aged systems is that the oldest age classes are often absent because rotation ages are generally shorter than tree longevity. Depending on rotation age and frequency of natural disturbances, forests managed by even-aged management could have more or less early successional forest than natural landscapes (Thompson et al. 1995). Even-aged management can result in an unnatural uniformity of habitat patch size and distribution, excluding small and very large patches. Our analysis suggests that current ponderosa pine forests in the Southwest contained more early successional forest in 1986 than in 1962.

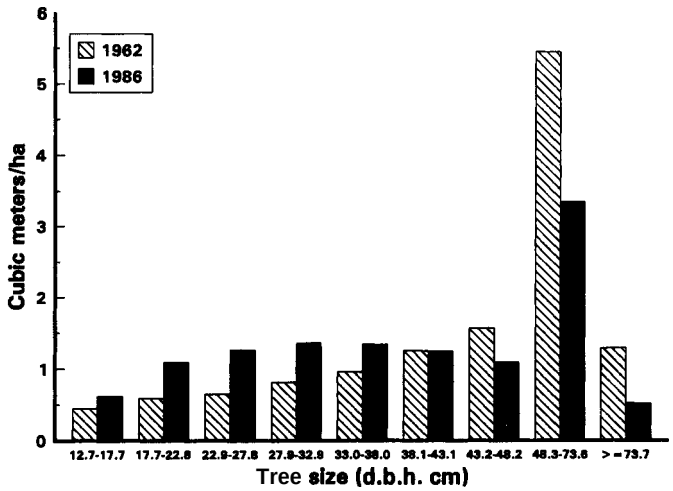

Figure 5. Change of growing stock volume of ponderosa pine timber stands in Arizona and New Mexico between 1962 and 1986 (data summarized from Choate 1966; Spencer 1966; Conner et al. 1990; Van Hooser et al. 1993).

Contemporary Sawtimber Harvest

In 1995, 27 million board feet of ponderosa pine were cut on Forest Service lands in Arizona, while 3.7 million board feet were cut in New Mexico for a Region 3 total of over 30.8 million board feet. Ponderosa pine still is the largest component of the sawtimber cut from Forest Service lands in both states, though there have been changes in the size and number of commercial sawtimber sales. A comparison of the figures from 1979, the first year for maintaining the regional data base in the current format, with 1995 figures is instructive in this regard. In 1979, 227 million board feet of ponderosa pine were cut on the forests of Region 3. In 1995, that figure was about 30.8 million board feet. The number of large sales over 2 million board feet has also dropped substantially over the years from 34 in 1979 to 5 in 1995. These declines have affected the commercial timber-related industries of Arizona and New Mexico.

A Southwestern Region Forest Service white paper presents figures from 1984–1993 describing conditions and trends in the timber industry (USDA Forest Service Region 3 1994). During that period, the volume of all species cut declined from a high of 434 million board feet in 1989 to a low of 159 million board feet in 1993. In 1995, the figure had declined further to 99.6 million board feet. Volume under contract also showed a steady decline throughout the period. In 1989, most of the major mills of the region were operating two shifts but were becoming concerned about the supply problem and were considering reducing to one shift. Toward the end of that year, several mills shut down for a short period and several reduced from two shifts to one owing to low volume under contract and market conditions. During this period, 520 mill workers and 355 forestry workers were affected in New Mexico and Arizona (USDA Forest Service Region 3 1994). In the period from 1991 to 1993, all operating mills in New Mexico and Arizona reduced to one shift and eight shut down leaving about half the mill capacity that existed in 1984 (USDA Forest Service Region 3 1994). In 1984, 24 large and small mills were listed by the Forest Service in the two states, excluding mills on Indian lands. By mid-1996, 10 were operating (Buddy Stewart, USFS Regional Economist, personal communication, 1996).

Timber Industry in Rural Northern New Mexico

Information from New Mexico provides an example of the role of the timber industry in local communities. Though the timber industry in the state is modest when viewed on a national scale, lumbering is a substantial business in New Mexico (Baker et al. 1988 cited in Van Hooser et al. 1993). In 1963, 2,200 people—one of every seven manufacturing workers—were employed in logging, milling, or some other wood products-related industry (Choate 1966). The number of jobs in the lumber and wood products sector peaked between 1972 and 1977 at 3,200 per year, or approximately 10 percent of the manufacturing jobs. By 1989, the number had declined to 2,500, or 6 percent of the manufacturing workforce (Van Hooser et al. 1993).

Historically, almost two-thirds of the wood processing plants were located in the northern and central portions of the state (Van Hooser et al. 1993). Especially in the small, rural communities of the north, industries based on forest products have been major sources of employment. Six small mills that processed products from the Carson and Santa Fe National Forests have closed in the 1980s and 1990s in places such as Chama, Alamosa (Colorado), Taos, Costilla, Española, and Las Vegas (New Mexico). A larger mill operated by Duke City Lumber Company at Cuba was also shut down in 1992. Lack of supply was given as the reason for the closures (USDA Forest Service Region 3 1994). In a pattern seen commonly across the state, timber industry officials often blame closings on the lack of Forest Service timber sales resulting from environmental legislation and litigation. Local environmental groups, on the other hand, stress the role of competition with timber coming in from Canada and the southeastern U.S. and alleged Forest Service mismanagement in the closings (Eichstaedt 1995; McClellan 1995; Toppo 1995; Korte 1996; Ragan 1996).

Small-Scale Commercial and Personal-Use Wood Harvest

The smaller scale harvest of both commercial and personal-use wood products is also important, even though these types of industries do not have the overall economic impact of large-scale, sawtimber harvests. Across the region in 1995, fuelwood formed the largest component of the non-sawtimber harvest from Forest Service lands followed by poles and posts. Christmas trees also comprise a substantial component. They are not discussed further here since ponderosa pine does not make up a large portion of this cut, ranking fourth well after pinyon, other softwoods, and true fir.

The fuelwood cut for 1995 in Region 3 was 42.5 million board feet for both personal and commercial use. Poles accounted for 7.8 million board feet, while posts comprised 455,000 board feet. Of these cuts, ponderosa pine forms the largest component of the pole harvest at over 4.5 million board feet with aspen forming the second largest component. With respect to both fuelwood and posts, ponderosa ranks second to pinyon and juniper. Of the large fuelwood harvest, ponderosa comprises only 3.3 million board feet, while it makes up 61,500 board feet of the posts. As discussed by Van Hooser et al. (1993) for New Mexico, the pinyon-juniper woodlands provide the majority of the fuelwood and fenceposts for the state. Pinyon is the favored fuelwood for both heating and cooking because it burns hot and is long-lasting. Green pinyon is especially favored for these reasons. "Dead and down" ponderosa is also used, however, because of its availability as a byproduct of timber sales (Van Hooser et al. 1993).

Fuelwood and small products harvests have the greatest potential to disturb bird habitat when they occur as unregulated activities. Habitat destruction and damage can occur through removal of snags, large downed logs (230 cm midpoint diameter), and particularly critical species (Brawn and Balda 1988; USDI Fish and Wildlife Service 1995). Poaching live trees, as well as snags and large downed logs, from undesignated areas are common occurrences in some locales that can threaten the integrity of bird habitat. In order to minimize negative impacts to habitat, fuelwood harvest should be regulated to control access and the kinds of materials that are taken. Designated harvest areas can be useful but may be difficult to enforce, especially in areas with a long tradition of ready access to forest resources and scant personnel for patrol (USDI Fish and Wildlife Service 1995).

In many rural portions of the Southwest, fuelwood gathering is a necessity, not a luxury. Homes are often heated solely with wood and cooking is done on wood stoves. This is especially true of many rural areas of northern and central New Mexico. To complicate matters, much of the Forest Service land where the wood is gathered is former Spanish land grant land lost by the original owners in the aftermath of the Mexican War of 1846–1848 (Harper et al. 1943; Eastman et al. 1971). Harvesting wood is considered to be a traditional "right" in these areas that ties the people of the villages back to their ancestral lands. Thus, many villagers often resent federal restrictions on land they consider to be rightfully theirs.

A case in point is the local response to the federal injunction issued in August 1995 placing restrictions on logging and fuelwood harvesting on Forest Service land in Arizona and New Mexico to protect Mexican Spotted Owl habitat. The court ruling stemmed from a lawsuit filed by several environmental groups against the Forest Service, charging that the agency failed to consider adequately the cumulative impacts on the owl in planning its timber program. The resulting injunction restricting wood cutting and gathering hit the rural, primarily Hispanic, communities of northern New Mexico especially hard. Most of their heating and cooking wood comes from the Carson and Santa Fe National Forests. For example, since the early 1700s people from the villages of Truchas, Las Trampas, and Peñasco have cut and gathered their fuelwood from the surrounding area—first from the Truchas Land Grant, and after portions of the grant became National Forest, from the Carson Forest (Eichstaedt 1995). Under Carson Forest policy, residents could obtain a permit to gather "dead and down" wood anywhere on the Forest and could even cut some snags. Part of the reason for allowing Forest-wide fuelwood harvesting, rare among Forests of Region 3, was that many of the wood gathering areas were part of the old land grant lost under U.S. takeover (Eichstaedt 1995).

After the injunction, gathering "dead and down" wood was limited to specific marked areas, and the species of standing dead trees that could be cut were also limited (Eichstaedt 1995). No live or green trees could be cut, and sales of these types of trees were barred. Residents feared inadequate fuelwood supplies from the designated harvest areas, many of which were also farther away than local people normally travel to obtain wood (Ragan 1996). They were also concerned about job losses from the previously discussed mill closures (Ragan 1996).

The villagers, as well as the loggers, lumber company officials, and sawmill owners and operators, blamed the environmentalists and the Forest Service for their plight. The environmentalists responded by blaming the Forest Service for inefficiency and mismanagement, and the big timber companies for greed. There were angry words and confrontations with charges of racism and "newcomerism" reported in both the local and national press (Eichstaedt 1995; McClellan 1995; Toppo 1995; Korte 1996). A new activist group, La Herencia de Norteños Unidos, was formed to represent ranching, land, and logging interests in northern New Mexico. In late November 1995, the Herencia group staged a protest rally and hanged two Santa Fe environmental group leaders in effigy. Some lumber company officials and others with extractive interests on forest lands were also on hand to lend their support (McClellan 1995).

After the rally the situation calmed somewhat. Discussions began between the opposing groups, and community drives and donations of wood (some from the "hanged" environmentalists) allayed most residents' fears about having sufficient wood to make it through the winter. Community leaders have urged compromise and understanding that would allow both protection of wildlife species and maintenance of traditional lifeways (de Buys 1995). Whether or not compromises will be made remains to be seen, as does local community response to what are perceived as growing restrictions on forest use. These types of challenges are not unique to northern New Mexico but seem to occur with regularity throughout the West, as the economic orientation and values of local and newly arrived populations come into conflict.

Livestock Grazing

Livestock grazing in the ponderosa pine forest has a long history in Arizona and New Mexico and has been examined by various researchers. Range management in the ponderosa pine type of Arizona and prior range studies were discussed in detail by Clary (1975) and formed a portion of the symposium on Multiresource Management of Ponderosa Pine Forests, held in Flagstaff in 1989 (Tecle et al. 1989). Recently, several studies have reviewed the status of range research in varying geographic areas and vegetation types in terms of needed future direction (Evans 1990; Everett 1992; Kennedy et al. 1995; Vavra 1995). Understanding both the needs of wildlife and the needs of society concerning rangelands is mentioned as a key issue requiring study in the coming years (Kennedy et al. 1995; Vavra 1995).

Effect of Grazing on Bird Populations and Habitat

Saab et al. (1995) reviewed research on the effect of cattle grazing on bird populations and habitat in western North America. Finch et al. (this volume) present a more specific review pertaining to the effects of livestock grazing on bird species in ponderosa pine. They state that the de-

gree to which grazing affects habitat, and the birds using that habitat, relates to the number of animals grazing in an area (intensity), the timing of grazing, and the grazing system used. Not surprisingly, greater habitat changes occur as grazing intensity increases (Johnson 1956; Skovlin et al. 1976 cited in Finch et al. this volume). Grazing during the spring and early summer can directly affect reproductive success of breeding birds through destruction or disturbance of nests of ground or shrub nesting species (Finch et al. this volume). Heavy grazing during the growing season can also negatively affect regeneration of favored plant species. Vegetation in riparian areas may be especially susceptible since these zones are often overused by cattle in forested habitats (Samson 1980; Roath and Krueger 1982 a, b; Willard 1990 cited in Finch et al. this volume).

Cattle compact soil by hoof action, remove plant materials, and indirectly reduce water infiltration, all of which can result in decreased vegetation density (Holecheck et al 1989; Saab et al. 1995). Intense grazing pressure in coniferous forests, in conjunction with fire suppression, sometimes leads to enhanced establishment of conifer seedlings and consequent conversion of montane shrub, meadow, and grassland areas to forested habitat (Saab et al. 1995). As with varying responses to silvicultural treatments, some bird species respond positively to the effects of cattle grazing while others respond negatively (Saab et al. 1995).

From their literature reviews, both Saab et al. (1995) and Finch et al. (this volume) conclude that little is known about the effects of different grazing systems on bird habitat in western coniferous forests. Saab et al. (1995) speculate that birds most likely to be negatively affected by grazing are those that are dependent upon herbaceous and shrubby ground cover for nesting and/or foraging and those requiring open savannahs as opposed to closed-canopy forests. They also suggest that as a result of foraging, the diminished fine fuels reduce fire frequency which results in a decrease in fire-caused snags. This decrease would negatively affect primary and secondary cavity nesters (Saab et al. 1995). Research is needed, however, to confirm these suggestions. Species that have increased or decreased with grazing are reviewed in Finch et al. (this volume).

Saab et al. (1995) recommend a concerted study effort to provide information where little currently exists concerning the impacts of grazing on neotropical migrants in western coniferous forests. They suggest monitoring, with attention to matched forest habitats differing in grazing regimes or grazing histories, as a means of supplying this much-needed data. In addition, studies which examine the status of bird habitat and populations in areas that have been both grazed and logged are much needed. We were unable to find reported studies from these types of areas.

Grazing on National Forest Lands in Region 3

Livestock grazing is a major, long-standing use of National Forest lands throughout the Southwest.[2] Table 1 gives figures on the numbers of permittees, animals, and animal unit months (AUMs) in Region 3 in 1995. An AUM is the amount of forage required to support a mature 1000 lb cow or its equivalent for one month (USDA Forest Service 1996).

Nationally, Region 2 (Colorado, Nebraska, South Dakota, and eastern Wyoming) and Region 3 rank second only to Region 4 (southern Idaho, Nevada, Utah, and western Wyoming) in amount of grazing use based on permitted head months (the time in months livestock spend on Forest Service land). Table 2 presents figures on the Region 3 allotments with a vegetation type composed of 50 percent or greater ponderosa pine and mixed conifer in 1995.

Of the 253 ponderosa pine-mixed conifer allotments in Region 3, we have information on the grazing system in use on 232 of them. Seven allotments have combination systems which are not discussed here, and the remainder do not have information on the grazing system. The systems in use are seasonal, rest rotation, deferred, and yearlong. Under a seasonal system, the allotment is grazed

[2] *All range figures were obtained from the USDA Forest Service Southwestern Region 3, Regional Office, Albuquerque, New Mexico, with the help of Dave Stewart and George Martinez. George Martinez also obtained information from Region 3 Forests on the number of allotments in ponderosa pine and mixed conifer and the types of grazing systems used on those allotments.*

Table 1. Livestock grazing by permittees on National Forests in Region 3, 1995[a].

State	No. of permittees	No. of animals	AUMs
Arizona	469	137,830	1,113,230
New Mexico	1066	90,585	791,953
Total	1535	228,415	1,905,183

[a] Figures obtained from the USDA Forest Service Southwestern Region 3, Regional Office.

Table 2. Grazing allotments on National Forests in Region 3 with a vegetation type consisting of ≥50% ponderosa pine and mixed conifer, 1995[a].

State	No. of allotments	Ha of allotments	AUMs
Arizona	100	1,139,813	249,472
New Mexico	153	1,248,185	195,041
Total	253	2,387,998	444,513

[a] Figures obtained from the USDA Forest Service Southwestern Region 3, Regional Office.

continuously throughout the growing season on an annual basis, while under a year-long system the allotment is grazed continuously throughout the year (Saab et al. 1995). Under rest rotation, the allotment is divided into pastures or segments with one being rested (usually for 12 months) while the others are grazed. The period of nonuse is rotated among the pastures. Under deferred rotation, at least one pasture is rested during part of the grazing season and the deferment is rotated among pastures in succeeding years. This system is often used to graze one pasture during the early part of the growing season and the remaining pastures later in the season (discussed in Saab et al. 1995).

Region 3 has the following breakdown of systems in use on the ponderosa pine-mixed conifer allotments: year-long—2 allotments, seasonal—54, rest rotation—69, and deferred—107. The year-long systems are in the southern part of New Mexico on the Lincoln and Gila National Forests, while the seasonal systems are concentrated in the northern part of New Mexico on the Carson and Santa Fe National Forests (43 of the seasonal systems). The remainder are scattered throughout the Region. In future studies, this type of information will be valuable for the kinds of research that are needed to assess the effect of different types of grazing systems on bird populations and habitat as discussed by Finch et al. (this volume). In addition to different grazing systems, the types of Southwestern ranching operations themselves also have a significant impact on wildlife habitat and management, as discussed in the following section.

Commercial and Traditional Ranching Operations

Throughout the West, the rural ranching lifestyle is a deeply rooted tradition. Ranching on public lands is a strong, though not universally appreciated, aspect of this tradition, as demonstrated by the recent congressional debates and public controversy over range and grazing fee reform (Richardson 1995; Varela 1996). Scurlock (this volume) describes the history and development of range resource use in Arizona and New Mexico, from its beginnings in 1598 with Spanish colonization and the introduction of domesticated herbivores. Range statistics from Region 3 show a fluctuating but generally downward trend in numbers of permittees, animals authorized to graze, and AUMs from 1982–1995. Numbers of permittees in both states have dropped by about 25 percent, while animals authorized to graze have dropped by roughly 25 percent in Arizona and 20 percent in New Mexico. These declines relate to climatic and market fluctuations, consolidation of permits, and growing urbanization in the region. The larger commercial operations generally fare better than smaller ones in terms of profit and maximizing the opportunities of technological advances and additional land acquisitions (Clary 1975; Harris et al. 1995). Smaller commercial operations tend to be hit more heavily by environmental and market fluctuations.

There are many small operations in the region, and many that can be considered non-commercial (or traditional) on the basis of herd size (Eastman and Gray 1987). According to a recent statement by Congressman Bill Richardson in the discussions over grazing fee and range reform, 70 percent of federal permittees (on lands from all agehcies) in New Mexico have fewer than 100 head (Richardson 1995), which is about the minimum size of a small commercially viable operation as discussed by Eastman and Gray (1987). The willingness of these ranchers to implement grazing system practices and range improvements that benefit wildlife habitat will definitely be a factor in the success of habitat management strategies.

Small, traditional operations occur throughout the region but tend to be concentrated in the more mountainous, ponderosa pine zones, with a special clustering in the small Hispanic villages of northern and central New Mexico. Owning animals is a very important aspect of these operations. The animals provide the villagers with a means of reaffirming ties to their ancestral lands and heritage. In many cases, the extra buffer that the animals provide allows the family to remain in the ancestral, rural community and continue at least a part of the traditional lifestyle (Eastman et al. 1971; Eastman and Gray 1987; William de Buys [personal communication] 1995; Raish 1996; Varela 1996).

Herd sizes, goals, and methods of operation differ significantly between the small-scale, traditional ventures and even small, commercial cattle ranches. Average herd sizes for the traditional enterprises are around 19, while small commercial ranches have about 100 head. Making a profit is the number one goal of commercial ranchers (even small-scale ones), followed by maintaining a good quality of life. These producers tailor their methods to maximize profit by increasing production. They tend to seek out and adopt new practices and range improvements that increase production and the quality of the herds. They are willing to invest cash, borrow, and take risks in the hope of eventual profit (Eastman and Gray 1987).

The small-scale, traditional operators, on the other hand, rank quality of life first, followed by avoidance of being forced out of ranching, with making a profit last on the list. These goals condition their behavior and methods of operation. They are less willing to invest cash in what they perceive to be risky improvements or new techniques that may not work out. New technology often requires considerable time and effort to learn, while the benefits to the very small operation may be limited. Any increases in operational costs hit this group harder than the commercial stock raisers who sell many more animals and realize greater profits with which to fund rising costs (Eastman and Gray 1987; Richardson 1995). Thus, the small-scale operators may oppose actions that increase the cost of their

operations, such as increases in grazing fees or range improvements mandated to improve environmental conditions. Since small operators are prevalent in the region, their education and cooperation on issues of wildlife improvements may be critical to the success of habitat management programs.

Urbanization and Recreation

The ponderosa pine forests of the Southwestern United States, although currently sparsely inhabited, are disproportionately affected by increasing human population. Many small towns have grown exponentially in the last three decades as tourism and retirement industries boomed. Moreover, cool temperatures and scenic beauty attract many recreationists to the forests, especially during the summer months when desert dwellers try to escape extreme temperatures. The importance of ponderosa pine forests as recreation sites indicates that the potential impacts of humans on the forest are likely to be far greater than resident population censuses alone might suggest. Human pressures on the ponderosa pine forest will certainly continue to increase. Urban populations are projected to increase (e.g., Anderson 1995), and recreation demands throughout the United States are projected to accelerate (Boyle and Samson 1985; Flather and Cordel 1995).

Urban Growth in Ponderosa Pine Forests

The ponderosa pine forests of Arizona and New Mexico are sparsely populated by full-time residents. Flagstaff, Arizona, is the largest city situated wholly in ponderosa pine. It occupied 164 km^2 and held 50,000 residents in 1990 (U.S. Census Bureau). However, from 1960 to the present, Flagstaff has grown tremendously and is currently increasing at a rate of 15 percent per year (figure 6). The Arizona Department of Economic Security projects its population will exceed 100,000 in the year 2040.[3]

Flagstaff's growth is not unique among cities in ponderosa pine forests or adjacent pinyon-juniper woodlands. Other important urban centers in or adjacent to ponderosa pine are Santa Fe, New Mexico (primarily in pinyon-juniper), and Prescott, Arizona, both of which are increasing rapidly (Fig. 6). Five smaller cities (Payson, Pinetop, and Showlow in Arizona; and Ruidoso and Taos in New Mexico) are showing the first stages of rapid growth (figure 6). Payson and Ruidoso will likely follow Flagstaff's steep trajectory in the next few decades. The economic fuel for much of this rapid growth in ponderosa pine forest cities is provided by retirees, tourists, and recreationists.

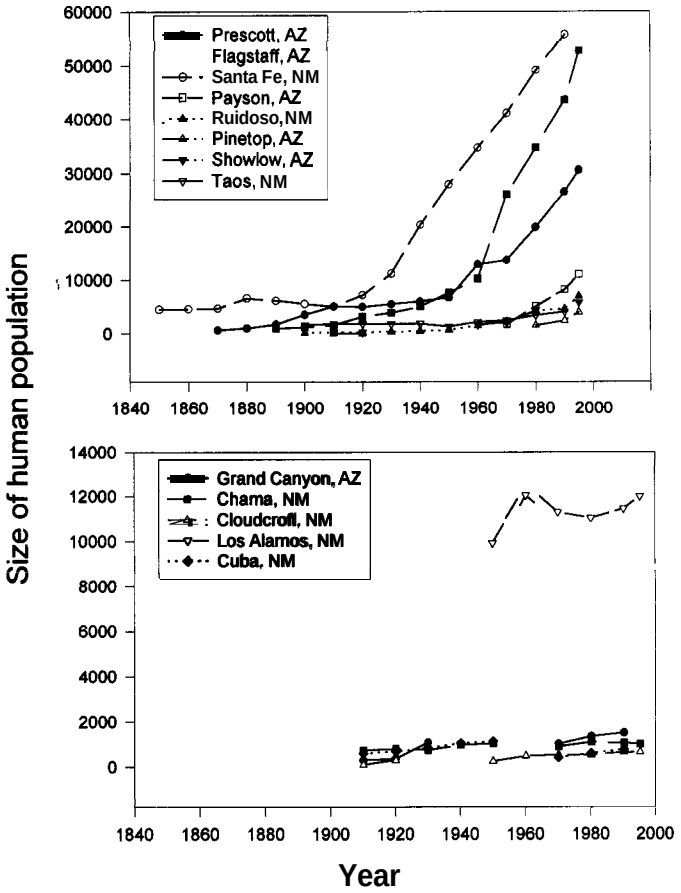

Figure 6. Human population changes in towns in and adjacent to ponderosa pine forests in Arizona and New Mexico. Towns experiencing growth are plotted in the top panel. Towns of relatively stable size are plotted in the lower panel. Data from the time records were kept until 1990 and were provided by the U.S. Census Bureau Library. Data for 1995 were obtained from local chambers of commerce or city clerks.

Not all towns in ponderosa pine forest are increasing in size. In contrast to those in the top panel of figure 6, five towns appear relatively stable in size (lower panel of figure 6). They apparently have not grown because of their isolation and proximity to federal or private land that is unavailable for subdivision. In the interesting case of Los Alamos, New Mexico, which was built in 1942 to house those developing the atom bomb, the lack of growth has resulted because the U.S. Department of Energy has not expanded operations.

[3] *Judy Burding (Flagstaff Chamber of Commerce), Joyce Wachter (U.S. Census Bureau), Colleen Marzluff (S.E.I.), and Al Sanford (NM Institute of Mining and Technology) provided information on economic growth and population size in Southwestern cities. Britta Morner, Tah Yang, Bill Larsen, Lorie Long, and Buddy Stewart of the USDA Forest Service Southwestern Region 3 provided recreation use and occupancy data.*

Recreation in Ponderosa Pine Forests

The national trend toward increased recreation (Boyle and Samson 1985; Flather and Cordel 1995) is evident within the ponderosa pine forests of Arizona and New Mexico. Most significant in this respect is Grand Canyon National Park, which includes campgrounds, lodges, roads, and scenic viewpoints in the ponderosa pine forest of northern Arizona. Visitation to the Park has grown tremendously since its opening in 1915 (figure 7). Nearly 5 million people visited the Park in 1995. Even if each person only stayed one day, and visitation was evenly spread throughout the year, over 13,500 visitors would have been present each day of 1995. In reality, most visitation is during the summer when numbers of visitors per day can reach a total half as large as Flagstaff's population.

Recreational use of National Forests in Arizona and New Mexico is also on the rise. Specific figures have been recorded only recently and are unavailable by forest type. However, recreation in the region is primarily in ponderosa pine and is useful for defining trends and activities. Recreation use increased from 1992 to 1995 in Region 3; over 40 million visitor-days of recreation were recorded in 1995 (figure 8). Most visitors were viewing scenery or camping, picnicking, and swimming (figure 8). Non-motorized travel (hiking, horseback riding, and river rafting) has increased most rapidly, as also noted for the nation as a whole (Flather and Cordel 1995). Hunting, fishing, winter sports, and resort camping have remained fairly stable and include many fewer people than travel and camping (figure 8). Nonconsumptive wildlife recreation (bird watching, nature study/viewing/photography) has increased each year, but involves relatively few people.[3] However, nonconsumptive activities can have significant impacts on species of great interest if individuals of these species are disturbed repeatedly.

Marzluff presents a detailed discussion of the effects of the various different types of recreational activities on bird populations and habitat in another section of this volume. He reviews motorized travel and viewing scenery; camping and picnicking; hiking, nature study, and wildlife photography; resorts and recreation residences; and winter sports and mechanized off-road travel in his discussion. This section also describes the types of research required to address the effects of both urbanization and recreation on songbirds in Southwestern ponderosa pine forests (Marzluff this volume).

Increased recreational use of the National Forests has led to an expansion of public facilities. Current (1995) facilities have the capacity to hold over 130,000 visitors per day, up from 98,000 in 1990 (U.S. Forest Service Annual

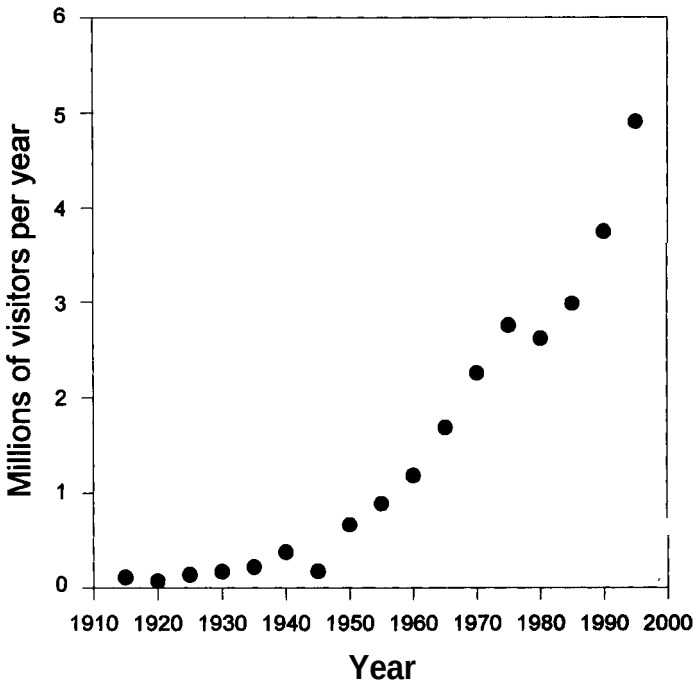

Figure 7. Visitation to Grand Canyon National Park from 1915 to 1995. Data were collected by the U.S. National Park Service. The visitor-per-day vehicle multipliers were updated during 1992. Visitation in 1995 was estimated to be reduced by 50,000 people due to a government shutdown.

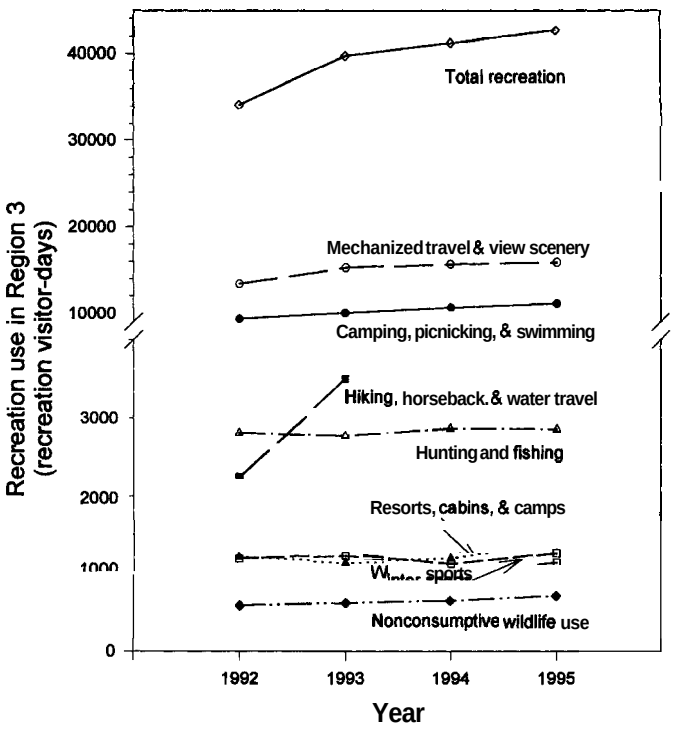

Figure 8. Recreation use in Region 3 of the USDA Forest Service (Arizona, New Mexico, and a small portion of Texas and Oklahoma). Data were collected by surveying visitors to local facilities. Data before 1992 were obtained with varying methods and are not directly comparable to those presented.

Recreation Site and Area Information). The number of campgrounds and picnic areas increased slightly from 1990 to 1995 (figure 9). The number of recreational residences in and adjacent to a National Forest has declined recently. Since Forest Service Region 3 recreation information is not maintained by vegetation type, it is difficult to determine the nature and extent of activities focusing in the ponderosa pine type. More research is needed on this topic, just as more research is needed concerning the effects of the various different types of recreational activities on bird species and habitat.

Conclusion

The issue of land use and its effects is a complex one. The environmental effects of a particular land use can be singular, synergistic, or cumulative with long- and short-term consequences. Both synergistic and cumulative land use effects require considerably more research. An especially important area that should be targeted for future studies concerns the combined effects of logging and grazing on birds and bird habitat.

Although we have focused primarily on human land uses and their negative effects to wildlife species, results of land use activities can also be positive or neutral for these species. Both Thompson et al. (1995) and Hejl et al. (1995) review positive, negative, and neutral effects of varying silvicultural treatments on selected species. Saab et al. (1995) provide a similar discussion with respect to grazing in western habitats.

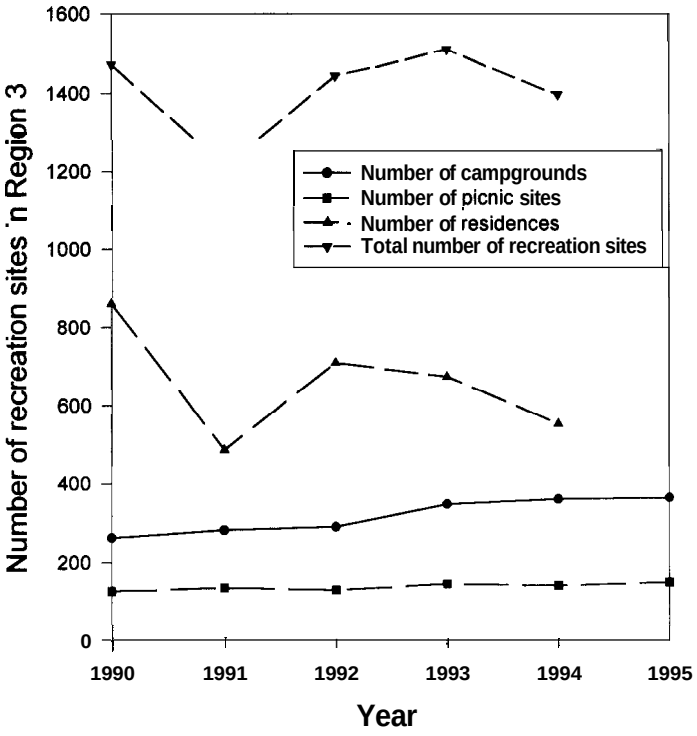

Figure 9. Number of developed recreation sites in Region 3 of the USDA Forest Service.

Since the 1960s and 1970s, the precedence of human resource consumption and use over other considerations has been under increasing scrutiny as demonstrated by environmental protection legislation and court actions. The National Environmental Policy Act, the Endangered Species Act, the National Forest Management Act, and the Migratory Bird Treaty Act are examples of legislation designed to help protect the environment, as well as wildlife species and habitat. This legislation indicates the strength of the environmental movement and the general importance of wildlife protection to at least a certain segment of the American public.

Despite the increase in environmental protection legislation, ponderosa pine habitat declined in geographic extent and tree volume in the period from 1962 through 1986 in Arizona and New Mexico. Though the geographic extent and volume of small trees (poletimber, saplings, seedlings, and trees with a dbh below 43.2 cm) increased, these measures decreased for large trees, yielding an overall decrease. As discussed previously, logging is generally the prime cause of changes in stand geographic extent and volume (Choate 1966; Spencer 1966; Conner et al. 1990; Van Hooser et al. 1993). Historically, ponderosa pine has been a main, heavily cut component of the Southwestern timber harvest (Schubert 1974), and this pattern continued into the 1980s. Since the beginning of the 1990s, both timber sales and cut volume of all species have declined on Forest Service land. Many factors contributed to these declines, including implementation of the Mexican Spotted Owl and Goshawk Habitat Protection Guidelines (USDA Forest Service Region 3 1994). The effect of these declines on the health and extent of ponderosa pine habitat remains to be seen.

In addition to wood harvest, cattle grazing (as well as the grazing of wild herbivores such as elk) can alter ponderosa pine habitat. There is less information on the effects of grazing (Finch et al. this volume) than on the effects of timber cutting and even less on the combined effects of timber harvest and grazing. Grazing on public lands is now coming under increasing scrutiny and discussion. Recent congressional debates and public controversy over range and grazing fee reform show a changing, more negative public perception of ranching on federal lands (Kennedy et al. 1995; Richardson 1995; Mitchell and Fletcher 1996; Varela 1996). Judging the extent to which perceptions and attitudes of the general public differ from those of non-governmental organizations and advocacy groups is difficult and is becoming an area of concern to federal land managers (Mitchell and Fletcher 1996). In any event, there is growing awareness of the potentially harmful effects of grazing on birds and

other wildlife species and recognition that future range studies must consider both the needs of wildlife and the needs of society if they are to be effective (Kennedy et al. 1995; Vavra 1995).

Since the 1920s and 1930s, there has been a downward trend in the number of animals grazing on public lands in the Southwest (discussed in Raish 1996). As discussed previously, in the years from 1982 through 1995 the numbers of Forest Service permittees dropped by about 25 percent in Arizona and New Mexico, while the number of animals authorized to graze dropped by 25 percent in Arizona and 20 percent in New Mexico. However, the ways in which these figures relate to the various different grazing systems in use and the effects of these systems on wildlife and wildlife habitat are not well known. The effect of wild herbivore grazing in conjunction with cattle grazing is also a topic that requires additional research. Answering these questions requires a concerted program of study focusing on the effects of different grazing systems on wildlife in matched habitat types (Saab et al. 1995).

In addition to studies focusing on the effects of cattle grazing, more information is needed on the effects of urbanization and recreation on wildlife species and habitat. With urban populations projected to increase and recreation demands projected to accelerate throughout the United States (Boyle and Samson 1985; Anderson 1995; Flather and Cordel 1995), the potential for considerable negative effects from these activities is high. Studies designed to assess the impacts of these types of activities can assist planners to prepare growth models and recreation development strategies that are the least harmful to species and habitat.

Though there are indeed many human activities occurring in the ponderosa pine forests of the Southwest, this review has examined those that have the greatest potential to affect bird species and their habitat. Thus, commercial and personal-use wood harvest, livestock grazing, recreation, and urbanization have been considered. Of these, we have the greatest amount of research information on the effects of large-scale timber harvesting on habitat. Considerably more research is needed concerning the effects of different types of grazing systems and the effects of combined grazing and logging. Different types of recreational activities and growing urbanization in the region also require additional research. Studies of the effects of these activities are crucial for planning future developments that consider both human and wildlife needs.

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