SECTION I

Past Sierra Nevada Landscapes

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Reconstructing the Landscape: An Environmental History, 1820–1960

ABSTRACT

Sierra Nevada environmental history between 1820 and 1960 can be divided into three clear phases. The first period, 1820–1900, included entrance by European-Americans, displacement of Native Americans, the discovery of gold, and the development of other resources such as timber, water, rangeland, and scenic sites. Concern for the effects of this development led to the creation of Yosemite Valley as a state park and the designation of Sequoia and Yosemite (not including the valley) as national parks. Additional Sierra Nevada forestland was included in several federal forest reserves. No effective system of regulation accompanied the creation of these areas, however. The second period of the Sierra Nevada's history, 1900–1940, saw the creation of the U.S. Forest Service and the National Park Service and the beginning of effective management of Sierra Nevada resources by these agencies. Even as federal action was being taken, private development of natural resources continued, especially logging. Automobile access stimulated recreation demand. Decisions to provide Sierra Nevada water for San Francisco, Los Angeles, and numerous hydroelectric projects affected the range as well through this period. The third period of the range's environmental history, 1940–60, was marked by accelerated use of all of its resources, especially timber and water. Improvements in automobile transportation led to increased winter uses associated with skiing. Federal and state agencies responded by trying to meet these growing demands. By 1960, many environmental groups and some elements within the federal services began to express concern over the effects of such accelerated growth. A period of environmental activism in the Sierra Nevada was about to begin.

INTRODUCTION

In December 1994 a colloquium sponsored by the Sierra Nevada Ecosystem Project (SNEP) discussed the need to describe an 1800s Sierra Nevada landscape and considered how best to summarize the region's environmental history since then. All participants agreed that no published comprehensive environmental history of the Sierra Nevada existed.

This chapter of the final report addresses one of SNEP's five fundamental questions, that is, "What were historic ecological, social and economic conditions, trends and variabilities?" (SNEP 1994).

The historians participating in the December 1994 colloquium identified three key periods in the range's history to be addressed:

1. 1820–1900: opening, unrestricted development, and early resource regulation
2. 1900–1940: establishment of agency management, continued private uses, and major environmental effects
3. 1940–60: expanding demand, agency response, and growing environmental concern

A comprehensive and detailed environmental history of the Sierra could not be expected in the short time available, nor could detailed primary source research be undertaken, because of limits set by SNEP guidelines. A more limited objective was suggested: delineate the key issues associated with ecological conditions as shaped by human actions for these three periods, and then summarize published and unpub-

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lished secondary sources and available primary sources that bear on them. In addition, summaries of key issues and events were prepared by selected U.S. Forest Service and National Park Service personnel and other experts to supplement these sources.

Although there is no comprehensive environmental history of the Sierra Nevada, Farquhar's classic History of the Sierra Nevada (1965) gives a general history of the region. Many of its sections are out of date, however, and it fails to document many of the historical changes in the Sierra Nevada environment. Three environmental studies focusing on portions of the Sierra Nevada's environmental history do exist: Challenge of the Big Trees (Dilsaver and Tweed 1990), Yosemite: The Embattled Wilderness (Runte 1990), and Tahoe: An Environmental History (Strong 1984). Two U.S. Forest Service studies of the Sierra Nevada also exist. The Spotted Owl: A Technical Assessment of Its Current Status includes a historical review of Sierra Nevada forests (McKelvey and Johnston 1992), but it is limited primarily to the period from 1850 to the turn of the century. "A History of the Human Element in the Sierran Province" (Lux 1995), published as an appendix to the Draft Environmental Impact Statement: Managing California Spotted Owl Habitat in the Sierra Nevada National Forests of California, provides a useful extension of the time periods considered but is limited by its length as a summary to a larger report. Numerous other works, published and unpublished, deal with aspects of Sierra history. Unfortunately, no synthesis of this body of secondary sources has emerged. Many research repositories such as the Bancroft Library, the Huntington Library, the California State Library, the Yosemite Library, and the National Archives contain material relating to the range. These also have yet to be effectively synthesized.

Historians at the 1994 symposium, and others not attending, were contacted and asked to contribute. Those who responded included Richard Markley and Carmel Meisenbach, contributing information on the Tahoe National Forest; Susan Lindstrom, contributing information on the Tahoe Basin; Dana Supernowicz, contributing information on the Eldorado National Forest and other aspects of the Sierra Nevada; Pamela Conners, contributing information on the Stanislaus National Forest and Sierran water developments; Stephanie Tungate, contributing information on the Sequoia National Forest; William Tweed, contributing information on Sequoia and Kings Canyon National Parks; James Johnson, contributing information on Sierra conifer forests; William Laudenslayer, contributing information on Sierra vegetation; Linda Lux, contributing information on Sierra Nevada environmental history; Norman Wilson, contributing information on Sierran Native American patterns; Lary Dilsaver, contributing on gold rush agriculture; and Kevin McKelvey, contributing information on Sierra Nevada environmental history.

1820–1900: OPENING, UNRESTRICTED DEVELOPMENT, EARLY RESOURCE REGULATION

Opening the Sierra Nevada, 1820–55: The Impact on Natives

Prior to 1820, the Sierra Nevada was occupied by Native Americans. Anthropologists have considered the native use pattern, including the use of fire as a management tool, as resulting in a "dynamic equilibrium" (Baumhoff 1978) or even as creating a "domesticated environment" (Blackburn and Anderson 1993). Native use of the Sierra before historic contact is described in Anderson and Moratto 1996.

Between 1820 and the 1850s, native land use of the Sierra Nevada was displaced by the arrival of the Spanish and other European-Americans. Contact with the Spanish and Mexican occupants of the coastal plain and the Central Valley after 1820 changed native life patterns and the areas in the Sierra Nevada foothills occupied by natives. Spanish-Mexican pressures included conflict during exploration (Larson 1985) and raids to capture natives for mission or ranch uses. The natives responded by using armed resistance, taking livestock, and withdrawing farther into the foothills to minimize contact. Native raids in turn bred punitive actions by the Spanish and Californios, creating a cycle of disruption for the native population. All of the Sierra foothills, from the north to the south, were affected to some degree (Castillo 1978; Wilson 1995). Described by one expert as a "ripple effect," this contact would mark the beginning of the end for native dominance of the Sierra Nevada and a change to a more aggressive utilization of the range's resources (Wilson 1995).

Diseases introduced by Europeans reduced native populations. Fur trappers from the Hudson Bay Company introduced smallpox to valley natives. Contact spread the disease to Sierra Nevada foothill populations. Disease introduced to Sierra Nevada natives as a result of contact with the Spanish also had both direct and indirect effects, ranging from north to south on the western side of the range (Cook 1978; Wilson 1995; Tweed 1995).

The earliest recorded isolated crossings of the Sierra Nevada occurred in 1827 and 1833 (Smith [1827] 1977; Leonard [1833] 1978). Between 1840 and the gold rush, increasing numbers of European-Americans migrated to California. To assist this movement, federal agents such as John C. Fremont explored the northern Sierra (Goetzmann 1959). Because most of these travelers did not remain in the Sierra for any length of time, their impact on natives and the Sierra landscape was limited (Markley and Meisenbach 1995). Most of this activity was concentrated in the northern Sierra, in the modern counties of Plumas, Nevada, and El Dorado, because of their lower-elevation passes and because they were associated with more direct routes from the east. The configuration of the range, which rises in elevation as it progresses to the south, also in-

fluenced route choices. Exceptions, such as the infrequent use of Ebbetts and Sonora Passes in the central Sierra, should be noted (Stewart 1962). The hunting of wildlife, the gathering of firewood, and the grazing of travelers' animals during this crossing undoubtedly had an effect on those areas most directly contacted.

The gold rush did bring some cooperation between miners and natives (most notably in the use of natives as laborers), but contact mainly produced conflict. The most direct effect of contact during the gold rush period was upon native people living in the areas of intense mining activity or in areas adjacent to them. On the western side of the range, the contact especially affected the foothill groups, including the Konkow and Maidu in the Feather River area; the Nisenan and the Miwok in the American and Merced River drainages; and, to a lesser extent, the Yokut and Tubatulabl in the more southerly parts of the range (Castillo 1978; Larson 1985; Hurtado 1988; Markley and Meisenbach 1995; Deferrari 1995). Food resources were reduced, and game became skittish and hard to find. In one case, pressures even on such food sources as grasshoppers forced some intergroup cooperation between the Miwok and Paiutes in order to conserve a dwindling resource (Conners 1995; Deferrari 1995). Most of the impact was associated with placer mining in the northern and central foothills, although quartz developments created some negative effects as well. On the eastern side of the Sierra, the Washoe were directly affected by mining in the Comstock Lode area (present-day Virginia City, Nevada). They were forcibly excluded by loggers, commercial fishermen, and resort developers from using the Tahoe Basin, thus losing access to fish and other food resources (Lindstrom 1995). Various eastern Paiute groups were directly affected by eastern Sierra mining developments, which included the Comstock and Bodie areas, similarly losing access to subsistence resources (Malouf and Findlay 1986).

Most deaths of Sierra Nevada natives were from disease, with most mortality concentrated in the areas of most direct contact (Cook 1978). However, the effects of disease spread beyond areas of direct contact, bringing catastrophic population reductions even in the more isolated southern Sierran regions. It is estimated that nearly 100,000 Native Californians died as a result of disease (this accounted for more than 80,000 deaths, more than 80% of the total), starvation, or the effects of violence between 1848 and 1855. A great many of the dead were Sierran natives (Cook 1978; Tweed 1995; Deferrari 1995). When we consider that the number of deaths represents about one-third of the total estimated population of California natives before contact (310,000, plus or minus 10,000) (Cook 1978), it is clear that the gold rush period had catastrophic effects. Violent confrontations between natives and European-Americans were significant, producing about 12% of the native deaths of this period. While whites were killed as well, the native population bore the brunt of the casualties, at a rate of more than 50 to 1 (Cook 1978). The effects of organized and unorganized violence resulted in the displacement of native populations from village sites and subsistence areas and a reduction in animal and plant resources. Placer mining operations reduced or eliminated fish populations (Castillo 1978; Hurtado 1988; Deferrari 1995).

The gold rush period marked the "true" opening of the Sierra Nevada to European-American occupation. A way of life marked by relatively small populations, limited technology, and seasonal limits on the use of the Sierra Nevada ecosystem was destroyed. Native fire-management practices that had shaped prehistoric forests were altered (Baumhoff 1978; Blackburn and Anderson 1993). Forest management policies developed between 1900 and 1960 specifically rejected native fire practices in their adoption of fire suppression (Show and Kotok 1923, 1924; Supernowicz 1983; Runte 1990; Tweed 1995).

Unrestricted Development, 1848–90

The discovery of gold in 1848 led to profound changes in the Sierra Nevada ecosystem. Mining promoted development in lumbering and grazing. Transportation, market hunting, tourism, and urban development followed in support of major extractive industries.

Mining

Mining history in the Sierra Nevada before 1900 can be divided into three chronological periods, recognizing that some overlap occurred. During the first of these, 1848–51, deposits of placer gold were exploited primarily by amateurs who had few skills and employed only simple technology such as pans, "rockers," and simple sluices. In the second period, between 1851 and 1859, miners exhausted most of the surface deposits and turned to the exploitation of riverbeds, veins of gold embedded in quartz, and deposits of alluvial gravel. This change required more capital, new techniques (such as the use of wing dams and ground sluicing), and larger supplies of water. In the third phase, 1860–90, Sierran mining become a capital-intensive industry employing wage-earning miners and better trained or more experienced engineers. These were employed chiefly in deep mines and gigantic hydraulic operations (Paul 1947).

Mining in the Sierra Nevada was intimately connected to the development of lumber and water resources and promoted the development of camps and towns to supply the needs of miners and loggers. Water was necessary in all gold production, and in later times it provided power for mining activities. Lumber was required to carry water in flumes, to support excavations, to provide fuel for steam engines and pumps, and to support tunnels. It was also needed for housing and business structures. Camps and towns were often consumed by fires, requiring further timber harvest. Contemporary sketches and photographs of northern and central Sierran communities show barren environments around mining settlements (Jackson 1970; Beesley 1979, 1994; Mann 1982).

Placer mining caused environmental damage. Most obvious was the mud, sand, and other debris deposited in streams.

Hillsides became pockmarked from mining operations. Channels and tunnels were cut to divert water so that streambeds could be mined. Flumes were constructed of wood to divert water from streambeds, requiring the cutting of adjoining forests. This water was used and reused farther downstream. Rivers became filled with sand. Boulders were moved out of streambeds to expose placer gold and were placed elsewhere, creating new riverine environments. Flumes leaked or collapsed, creating erosion gullies. Water storage dams burst, generating great surges of water that pushed mud, stones, and trees before the flood (Ziebarth 1984; Beesley 1994). Mercury was used to assist in the recovery of fine gold particles in placer, hydraulic, and hardrock mining during this period. Its release into stream systems stretching all the way to San Francisco Bay has to be measured in tons before 1940 (Meals 1995). The impact of this release has not been measured, and much of this metal is still in Sierran streams and soils.

The development of large-scale hydraulic mining profoundly affected the Sierra. The largest operations were located in the northern part of the range, in the Feather, American, Bear, and Yuba River drainage systems. The center of the industry was the Yuba drainage. The soil, sand, gravel, and rock displaced by hydraulic mining was immense. A report submitted by the state engineer to the California legislature in 1880 estimated that more than 680,000,000 cubic yards of debris had been washed into northern stream systems by hydraulic operations (Kelly 1959). William Brewer, a member of the state Geological Survey, made note of the immense hydraulic operations he observed in the 1860s (Brewer [1930] 1966). The impact of winter and spring floods, which carried this debris to foothill and valley communities, was disastrous. In the Sierra, hydraulic mining created areas that some contemporaries claimed could never fully recover from the damage caused (Brewer [1930] 1966; Leiberg 1902; Kelly 1959).

The direct effects of mining were not evenly distributed in the Sierra. The western foothills, ranging from Plumas County in the north to Mariposa County in the south, were most severely affected. The eastern Sierra did not produce as much gold as the western side (Clark 1980; Supernowicz 1992; Markley and Meisenbach 1995; Deferrari 1995). The Tahoe Basin was not directly affected by mining, but it was changed by the demand for lumber in the Comstock mining area (Lindstrom 1995). Mining was of very little significance in the southern third of the range, although some development occurred at Mineral King (Tweed 1995).

Logging

Logging before 1900 affected many parts of the Sierra Nevada. This industry developed primarily in support of mining activities near newly created camps and towns located on the western and eastern slopes of the northern and central parts of the range. It also provided material for the building of Central Valley towns where rail connections existed. The Sierran logging industry provided the ties, timbers, fuel, and planking necessary to build the Central Pacific and other Sierran railroads. The Central Pacific also provided timber for communities and railroads in the barren Great Basin. The Central Pacific received not only a right of way upon which to lay its track but also twenty alternate sections of land on either side. Much of the lumber to build the railroad came from these granted lands. Other private companies supplemented the railroad's cutting in nearby areas. The building of the snow sheds for the railroad near the western summit required 300 million board feet, and another 20 million board feet were required annually to keep them repaired. During the peak years of the Comstock's operation in Nevada, it consumed 70 million board feet of timbers and cordwood annually (Knowles 1942). Demand for lumber for fence posts and other uses led to the cutting of some giant sequoia near Grant Grove. At least one giant in the Kings River Basin was cut down so that it could be displayed in the East (Knowles 1942; Ayres 1958; Clar 1959; Farquhar 1965; Dilsaver and Tweed 1990).

Contemporary accounts of the Sierra timber industry written during this period reflect a dualistic perspective; most are praiseworthy, but some show concern for what are described as negative effects. On the positive side, estimates of the large volume of board feet of timber cut in Sierran forests are recorded in all contemporary accounts of the industry, reflecting pride in economic growth. Descriptions of the numerous mills are also reported in early county histories for the Sierra Nevada, for the same reason. No accurate overall total for the lumber cut for the counties included in the Sierra Nevada exists, but claims from contemporary histories range in the millions of board feet (Beesley 1984). The number of mills that operated before the turn of the century is likewise imprecise. One study written in 1924 cited 80 for the whole state in 1855 and noted that this number had increased to 320 by 1860 (Stanford 1924). Most of these mills were concentrated in the western counties of the northern and central Sierra because of the demands of gold mining (Clar 1959).

On the negative side, a California State Forestry Board report published in 1886 estimated that twenty years of cutting and fire had "consumed and destroyed" one-third of the Sierra's timber. It further estimated that if the same rate of consumption was continued, all of the range's forests would soon be cut (Clar 1959). Two turn-of-the-century U.S. Geological Survey reports detailed the impact of unregulated cutting in the northern and central Sierra, on both of its flanks. The reproduction of certain species such as sugar pine was reported to be imperiled by the wasteful high-grading practices of shake makers who took only the best parts of the large trees, leaving the rest as waste. Yellow pines were reported to have been taken in great numbers, especially in areas adjacent to mining operations, and brush and other noncommercial plant species were reported to be replacing them (Sudworth 1900; Leiberg 1902).

When confronted with conflicting reports, how can modern observers make judgments about historical logging con-

ditions? Perhaps narrowing the view from the whole of the range to one area affected by several of the forces that dominated this period of unrestricted development can provide some perspective. The Tahoe-Truckee area was among the earliest portions of the Sierra Nevada to be contacted by European-Americans. It supported a nearby mining area and was therefore developed by loggers and railroad companies. It also was close to the route chosen for the nation's first transcontinental railroad. A study of the Tahoe-Truckee basin illustrates the intensity of logging that occurred in sections of the Sierra.

Nearly all virgin timber in the basin was cut between the 1850s and 1936, most of it between 1856 and 1880. This cutting began on the eastern side of the Sierra, near present-day Carson City, Nevada, and then moved into the Lake Tahoe Basin. From there it continued down the Truckee River corridor. Markets for this lumber included the Comstock Lode, the Central Pacific and Virginia and Truckee railroads, and cities in the Great Basin. Lumber was used to build V flumes in the steep Truckee River corridor to transport timber to Truckee and markets served by the Central Pacific (Knowles 1942). John Muir traveled up the Truckee River to Lake Tahoe in 1888 and expressed hope that eventual renewal of the forest would occur, noting that the ground was littered with "fallen burnt logs or tops of trees felled for lumber." The "best timber," he said, had been cut (Muir 1938). The forest that did return was changed, however. White fir began to dominate an area that formerly had included not only this fir but significant proportions of yellow (primarily Jeffrey) and sugar pines (Strong 1984).

Tahoe-Truckee forests at this time were also reduced by human-caused fires resulting from careless actions by logging personnel and by wasteful logging practices then common to the industry. Examples of such practices included leaving stumps as high as 3 feet because of terrain and tree girth. Felled logs were frequently cut at the point where limbs began, leaving the rest behind to serve as fuel when fires started, often damaging nearby merchantable timber. Potentially salable trees were cut to build V flumes to transport cut lumber. These V flumes consumed 135,000 board feet per mile. Steam engines called steam donkeys damaged young trees and disturbed forest soils as they dragged logs to chutes or loading pads, where they were loaded on wagons or railcars for transport to the mills. Saws at the mills generated large quantities of sawdust, which was often dumped into nearby rivers, killing fish and creating health hazards and reduced water quality for those living in cities such as Reno (Pisani 1977b). On the Truckee River, specially constructed "splash dams" were developed at one time to float logs to the mills at Truckee. The repeated scouring of the streambed that resulted when the logs and water that collected behind these dams were released altered the riparian habitat and contributed to declining fish populations (Leiberg 1902; Knowles 1942; Pisani 1977b; Beesley 1984).

This case study of one area in the Sierra Nevada contains elements that are site-specific, such as the heavy use of V flumes and the uncommon use of the Truckee River to transport logs and dispose of sawdust. It also contains elements common to other areas in the northern and central Sierra Nevada. Disturbance of soils, injury to young trees, careless fire management, wasteful cutting practices, and careless slash handling are examples that can be cited. The most significant logging areas were in the foothills of Nevada and Sierra Counties and portions of Placer County, and in association with the major mining districts stretching from Placerville to Mariposa County. Less timber harvesting occurred in the southern Sierra Nevada because of transportation difficulties associated with the terrain and because of the lack of substantial mining deposits (Supernowicz 1983; Markley and Meisenbach 1995; Lindstrom 1995; Deferrari 1995; Tweed 1995).

Grazing

Sierran meadows were heavily grazed before 1900. Most grazing involved seasonal transhumance, meaning that animals were grazed on low-elevation winter ranges and then driven to alpine areas for summer range use. This practice included cattle, sheep, horses, goats, and, in some areas, pigs. Cattle, raised for meat as well as for dairy purposes, were driven from valley or foothill areas into the Sierra for relatively lightly used summer pasture. Extreme drought in the Central Valley and in southern California in the 1860s led to increased livestock use of Sierran ranges. Meat, butter, and cheese were supplied to railroad workers, lumberjacks, miners, and town or camp dwellers in the Sierra Nevada (Edwards 1883; Sudworth 1900; Leiberg 1902; Claytor and Beesley 1979; McGlashan 1982).

The sheep industry in California developed in two distinct periods before 1900. The first, 1848–60, involved driving animals from New Mexico and southern California to mining camps and towns in the western foothills for consumption. This phase did not result in much actual grazing in the Sierra Nevada. The second phase, after 1860, depended on grazing Sierran pastures. Itinerant or "gypsy" sheep bands were driven into both sides of the Sierra Nevada from southern and central California because drought and competition for land in those areas made free range in the mountains desirable. The number of sheep that foraged on Sierran meadows before Forest Service regulation began can only be guessed at. There was no limit to the size or the number of bands that entered the Sierra before 1900, nor was there a limit on the length of time they could utilize a specific area. Undoubtedly, the number of sheep using all available meadow systems in the Sierra Nevada during this time would be in the millions (Douglass and Bilbao 1975). Some observers attribute the reduction of some native perennials and their replacement by more aggressive annual species in upper-elevation grassy hillsides and higher-elevation meadow systems to this unregulated sheep grazing (Muir 1894; Douglass and Bilbao 1975; Rowley 1985; Beesley 1985).

Sheep grazing in the Sierra Nevada before 1900 was condemned by contemporary observers. It was judged by these critics to be more destructive than cattle grazing. John Muir memorably named sheep "hoofed locusts," their being in his view more effective than fires or glaciers in destroying vegetation. Two complaints from nineteenth-century critics predominated: first, that too many animals were grazing for too long on Sierran pastures (LeConte [1875] 1930; Edwards 1883); and second, that sheepherders were starting fires to improve future range or remove barriers to sheep movement. The First Biennial Report of the California State Board of Forestry for the Years 1885–1886, reflecting this antisheep view, recommended that all sheep be excluded from the Sierra because of the damage they caused to soils and vegetation (Wagoner 1886; Muir 1894; Sudworth 1900; Leiberg 1902; Johnston n.d.).

Regardless of whether the contemporary observers were accurate or not in their assessment of damage caused by sheepmen, their views would shape future forest management policies. No understanding of previous native or natural fire patterns existed. In the view of contemporaries opposed to fires, the sheepmen added to naturally caused fires in a significant way. The California State Board of Forestry wanted to exclude all fires so as to improve timber production and watershed potential of Sierra Nevada forests for agricultural uses (Wagoner 1886).

Most of the Sierra Nevada was affected by grazing. Foothill, middle-elevation forests, and subalpine areas such as the upper Kern Basin were heavily impacted. Only alpine fell fields escaped impact because they had little vegetation and were in difficult terrain. Most cattle, especially those associated with dairying, were kept on lower-elevation, higher-quality, and often fenced ranges. Sheep grazed on all other rangeland (Sudworth 1900; Leiberg 1902).

Transportation

Western immigration across the Sierra Nevada into California, during its beginnings in 1840, was limited to passages across the mountain barrier. The discovery of gold in 1848 and the development of timber and rangeland resources led to a change in transportation patterns. Passes that earlier had been used for east to west movement were often abandoned for a diffuse system of routes leading into mining areas, lumber sources, or mountain pastures, as development progressed. Food and other necessities flowed from valley and foothill agricultural areas and supply towns into the Sierra. Surveys were made by private commercial interests and county governments to mark out feasible wagon routes across the mountains, and California passed legislation to create an improved wagon route through the old Carson Pass in 1858 (White 1928; Beesley 1994).

Regional differences affected transportation development. Areas with more valuable resources, such as gold or timber, were more rapidly accessed by transportation networks. The most accessible northern Sierra Nevada roads originated from valley, river, or foothill towns such as Sacramento, Yuba City, Stockton, Merced, Grass Valley, and Nevada City and extended to western Sierra Nevada mining districts and to the Comstock Lode in Virginia City, Nevada. The most used roads included the Beckwourth or Feather River route in the northern Sierra Nevada to the Comstock Lode and Virginia City; the system called Henness, which led from Marysville and Nevada City to the Comstock Lode in Nevada; and the Carson Pass route connecting the Comstock Lode to Placerville and Sacramento. Many of these were variations of earlier emigrant routes that were supplanted when the Sacramento Valley Railroad connected Sacramento to Placerville, where it joined the road that led through Carson Pass to Nevada mining areas. The Dutch Flat Toll Road from Sacramento into the northern Sierra Nevada and the Comstock later was used by the Central Pacific Railroad (Supernowicz 1983; Rice et al. 1988; Beesley 1994; Markley and Meisenbach 1995).

Economic development in the central and southern Sierra produced foothill road systems in the most accessible areas. Roads from Stockton, Modesto, Merced, and other Central Valley towns reached mining and timber areas near Jackson, San Andreas, and Sonora. Access to Yosemite was well established by the 1870s through Great Oak Flat near present-day Groveland, California. Much of the southwestern portion of the range remained isolated. Only two major roads existed, one to the Kaweah Colony timber claims and another to Mineral King. Some well-developed packing trail systems were created, however (Russell 1947; Larson 1985; Deferrari 1995; Tweed 1995).

Like road and trail development, railroad construction was confined to the more accessible areas in the northern Sierra, often along existing roads or trails. The construction of the Central Pacific, completed in 1869, used vast quantities of Sierran resources such as lumber. It also opened the way to construction of two other railroads, the Virginia and Truckee and the Nevada County Narrow Gauge, which connected mining communities to the transcontinental rails (Myrick 1962; Best 1965). Some logging operations in the Tahoe Basin used rail to transport logs (James 1915; Strong 1984). Increased access to the Sierra Nevada via the Central Pacific led to increased tourism in the Sierra, with Lake Tahoe, Weber Lake, and Independence Lake becoming tourist destinations (Beesley 1994).

Market Hunting and Fishing

A predictable food supply was needed by Sierran miners, loggers, camp residents, and city dwellers. Meat, grains, and vegetables supplied much of this need. In the earliest stages of contact, wildlife was hunted for market. Mule deer were heavily hunted for market in portions of the range (Brewer [1930] 1966). The species persisted, but their growing scarcity was noted (Deferrari 1995). Pronghorn of the eastern Sierra, bighorn sheep, and grizzly bears were also the focus of market hunting, and their numbers declined (Storer and Tevis 1978; Farquhar 1965; Beesley 1994). Market fishing, added to the effects of mining and logging, brought a reduction in fish

populations, especially in the Lake Tahoe and Truckee River drainage. Commercial fishing of Lahontan trout was initiated to feed tourists and residents and later was expanded to serve consumers in San Francisco. Non-native trout species were introduced after the Lahontan variety declined in numbers (Pisani 1977b; Strong 1984).

Tourism

The Sierra Nevada provided scenery of exceptional grandeur and a variety of recreational activities. Even while rushing to get over the barrier formed by the Sierra Nevada, many immigrants noted its spectacular beauties. Some members of the Mariposa Battalion, fearfully searching for Miwok Indians, also expressed awe when they encountered Yosemite Valley. Tourism remained a secondary industry during the years of heavy resource development. But after the decline in the mining, logging, and grazing industries, recreation increased greatly in importance. Most of the focus was on the lakes of the northern Sierra Nevada, on Yosemite, and on the Big Trees in the Calaveras area. Development of the Mineral King Road opened that area to tourism in the 1880s. The Central Pacific and Southern Pacific Railroads provided access to many of these features, including the connection from the Central Valley to El Portal, near Yosemite. The publication of tourist guides to the Sierra became a regular industry by the end of the nineteenth century (Farquhar 1965; Strong 1984; Runte 1990; Beesley 1994).

Urban Development

Mining was the basis of most early European-American settlement in the Sierra. These settlements tended to be ephemeral because of the vagaries of a mining economy. Mining communities generally can be divided into short-lived camps that disappeared when the gold supply or hope of finding gold faded and more permanent towns that developed where supplies of gold persisted (Dilsaver 1985). More than three hundred mining communities existed from Plumas County in the north to Fresno County in the south during the most active period of the gold rush, from 1848 to the 1880s. Most of these camps and towns were in the northern and central portions of the western Sierra Nevada (Gudde 1975). Besides towns and cities based on gold mining, other communities, such as Truckee in the northern Sierra, developed around industries such as lumbering, railroading, or service functions for Tahoe's tourists. Lumber and tourism produced long-lived communities at Tahoe, including Glenbrook and Tahoe City. Foothill towns up and down the western side of the range supplied food and other needs for camps and towns further into the Sierra. Other towns provided government services (Hinkle and Hinkle 1949; Gudde 1975; Meschery 1978; Mann 1982; Strong 1984; Beesley 1994).

Those communities that survived the initial gold rush phase developed multiple economic activities, some of which included agricultural production. Fresh vegetables and fruit were produced in foothill communities, especially in such counties as Placer, El Dorado, Nevada, and Mariposa. In mining and timber production areas, beer and wine were produced from locally grown as well as imported ingredients (Taylor 1975; Dilsaver 1985; Beesley 1988).

The Beginning of Resource Regulation, 1864–1900

Concerns about the effects of unregulated development of the Sierra were raised by citizens, county and state officials, national politicians, and organized conservation interests before the mid-1860s. This protest led to the creation of institutionalized management of the Sierra. Five well-defined, though not coordinated, sets of actions mark the beginnings of the conservation movement in the range: (1) protection of Yosemite Valley and the Calaveras Big Trees; (2) control of hydraulic mining; (3) attempts to protect Lake Tahoe and the Truckee River; (4) attempts by the State of California to control forests; and (5) creation of national parks and forest reserves.

Protection of Yosemite Valley and the Big Trees

The discovery of the Calaveras Big Trees and Yosemite Valley quickly attracted national attention and led to actions to promote them for private gain. Prominent among these early promoters was James Hutchings, who quickly developed tourist facilities and services in Yosemite Valley (Farquhar 1965; Runte 1987). Many eastern visitors and some California citizens feared that such activities, resembling those that had commercialized Niagara Falls, could lead to similar effects in these two Sierra Nevada areas. California politicians and business interests in the Central Valley joined to demand federal protection. In 1864, Yosemite Valley and the Calaveras Big Trees area were granted to the State of California, marking the first time that federal action was taken to preserve land from development (Runte 1987).

Although California established a commission to administer Yosemite Valley and the Calaveras Big Trees, very little funding was provided. Regardless of the intent of the commission, these areas were developed. In Yosemite Valley lodging was built for tourists, commercial signs were created promoting the valley's features, trees were cut to improve views, meadows were fenced to provide pasture for livestock, orchards were planted to provide fruit for tourists, ladders were built to help people reach Vernal Falls, ferries and bridges were built to facilitate stream crossing, and Nevada Falls was altered to force more water into a central channel so that tourists would be more likely to see the waterfall in the summer (Runte 1987, 1990; Beesley 1994).

Control of Hydraulic Mining

Hydraulic mining in its most highly developed form in the late nineteenth century used the force of water collected in dams in higher Sierra Nevada elevations. It was then transported in flumes and penstocks under ever-increasing pres-

sure to water cannons or "monitors" where it was released against gold-bearing gravel deposits. This mining technique created immense amounts of debris, which clogged stream systems and contributed to disastrous floods in the foothills and Sacramento Valley when spring flooding occurred. Irreversible damage, whole hillsides being washed away, for example, occurred in many sites. Related riparian systems were also affected by the millions of cubic yards of sand, gravel, rocks, and other debris produced by this activity. The California legislature responded to complaints from foothill and valley interests by promoting measures to control flooding. Representatives from California areas not directly affected by this problem eventually refused to appropriate state funds for flood control. Eventually farmers and cities deluged by the miners' debris turned to the courts. In 1884 an injunction against the depositing of hydraulic mining debris was granted by a federal court. In the 1890s, federal legislation responded to this injunction with legislation that allowed hydraulic mining as long as debris was contained on-site. Some small-scale operations were able to comply, and other operations continued to operate illegally for a short while. In time, however, these operations ceased, and large-scale hydraulic mining came to an end during the 1890s (Kelly 1959; Beesley 1994).

Lake Tahoe and Truckee River Protection Attempts

Concern by the public to limit resource use at Lake Tahoe (originally named Lake Bigler) and the Truckee River resulted in attempts to protect parkland around the lake and to stop the dumping of sawdust into the river drainage. In the 1860s legislation by the California legislature was considered to promote fire reduction and theft of forest resources. While most of this proposed legislation did not become law, concern was clearly demonstrated. In 1883, the California legislature created a study group, named the Lake Bigler Forestry Commission, to specifically address the problems of overcutting in the Tahoe Basin. National concern over wasteful forest practices and overcutting influenced the thought of some Californians at this time. Between 1865 and 1868 Frederick Starr's American Forests and George Perkins Marsh's Man and Nature were published. In 1873 Franklin B. Hough presented a report to the American Association for the Advancement of Sciences, which led to the creation of the American Forestry Association in 1875. The members of the Lake Bigler Forestry Commission were all familiar with the ideas generated by these books and reports (Clar 1959).

The ensuing Lake Bigler (Lake Tahoe) Forestry Commission report called for the protection of Lake Tahoe and the land around it for the use of tourists. It also called for control of the lumber operations that were rapidly harvesting the forests on its shores. A park was proposed, to be created by the transfer of state, federal, and private land to the State of California, obviously operating on the model of the earlier Yosemite Valley grant. Objections to land transfers that would bring profit to the Central Pacific Railroad prevented action to protect this area (Pisani 1977a).

The dumping of huge quantities of sawdust into the Truckee River by lumber mills was another problem noted at this time. It was the cheapest way to dispose of this bothersome by-product. But its effects, which included pollution and fish reduction, created conflict between loggers and Reno city residents, grazers, and Paiute fishermen, all of whom used the river. Finally, the California and Nevada legislatures agreed in 1889 to jointly prohibit the dumping of sawdust. Most dumping stopped. In 1894, the California Fish Commission put pressure on lumber operations persisting in dumping and secured the end of the practice (Pisani 1977b).

State Attempts at Forest Protection

Conservationists and valley irrigation interests desiring protection of watersheds combined forces to create a state Board of Forestry in 1885. Identified in 1868–69, and proposed in the Lake Bigler Forestry Commission report, this new board was intended to help manage state school lands and to promote state control over unregulated federal lands. Because most of the forestlands in California remained under private or national control, the board was capable only of studying the problem and suggesting remedies (Clar 1959). In 1886 the California Board of Forestry called for control of California forestlands by the state to reduce fire damage, prevent trespass and theft, and protect watersheds in the interest of irrigationists. Luther Wagoner, as a representative of the state Board of Forestry in 1886, called for the complete exclusion of sheep from Sierra Nevada forests for both erosion control and watershed protection reasons (Wagoner 1886; Beesley 1994).

The board published four biennial reports, collectively mentioning brush taking control of cut-over forestland, fire and erosion resulting from sheep grazing, the wasting of timber by shake makers, the composition of timber species in Sierran forests, and the need either for more effective federal management of forests or for such authority to be transferred to the State of California (Beesley 1994). Limited by funding and the fact that most California timberlands did not belong to the state, the California Board of Forestry remained weak. It was abolished following the enactment of the Federal Forest Reserve Act under President Benjamin Harrison in 1891 (Clar 1959; Beesley 1994).

The Beginning of Federal Park and Reserve Action

State measures to protect Sierran forests or monumental features such as Yosemite and the Calaveras Big Trees before 1890 dissatisfied some conservationists, who called for more protective federal action. By 1890, some forest and scenic resource issues were addressed by the creation of two national parks (Sequoia and Grant Grove, and Yosemite) and several Sierra Nevada forest reserves (Sierra, Stanislaus, and Tahoe). While federal legislation was passed, no overall policy was developed to administer these two new federal responsibilities (Runte 1987). A nongovernment group called the Sierra Club was founded at the same time to help shape policies for these areas (Jones 1965).

The park boundaries were molded through the actions of local civic interests, state politicians, railroad officials, conservationists, and national politicians who joined to protect these two specific sites (Runte 1990; Beesley 1994; Tweed 1995). They were limited in size and location by political and economic concerns. Few known commercially valuable resources were included in most Sierra Nevada park grants. Later, when mining, hydroelectric, or water resources were identified, both Yosemite and Sequoia were reduced in size or invaded. Sheep grazing in Yosemite and Sequoia was ended by the use of federal troops, who were able to exclude sheep bands. Conflict over boundaries in the Sequoia National Park led to the continued cutting of trees for several years after park designation (Runte 1987, 1990; Beesley 1994; Tweed 1995).

Forest reserves were primarily the product of national actions that came to include the Sierra Nevada (Steen 1976). Between 1893 and 1900, three forest reserves were created in the Sierra Nevada, one each in the southern, central, and northern parts of the range. The southern reserve was called Sierra, and it made up most of the current Inyo and Sequoia National Forests (Larson 1985). The drainages of the central Sierra rivers, which included the Mokelumne, Merced, Stanislaus, and Tuolumne, became the central division and were eventually included in the Stanislaus National Forest (Conners 1992). Reserved lands in the northern part of the range included elements of the Tahoe and Eldorado National Forests (Markley and Meisenbach 1995). No effective management plan or organization was proposed or developed for these reserves at this time. Trespass, unauthorized grazing, and timber theft continued. Forest reserve legislation may actually have stimulated attempts by timber speculators to file with the Government Land Office for claims before land could be placed in reserves. Railroads also relied on another federal law, called the Lieu Land Act of 1897, to trade some of their original right-of-way lands (often cut over) for forested land not in the reserves. Despite these last vestiges of uncontrolled activities, a milestone had been passed. Park and reserve lands had been withdrawn from sale. In the future, unauthorized use of forests under federal control would be reduced (Ayres 1958; Tweed 1995).

Summary

Between 1820 and 1900, the Sierra Nevada was opened to historic forces that transformed its human use patterns and changed the physical nature of the range. Native populations were decimated, and their long-established land-use practices were displaced by different technologies. European-American population densities during this development phase were greatly expanded. Large-scale extractive industries became a dominant feature of many parts of the Sierra Nevada. Mining, logging, grazing, and other activities affected many aspects of the range's ecosystem. Concern about the negative effects of the chief extractive industries and the danger to scenic resources led to the first local, state, and national actions to provide some protection. This included ending hydraulic mining and creating state and national parks and forest reserves. These actions marked a transition to a new period of Sierra Nevada environmental history.

1900–1940: ESTABLISHMENT OF AGENCY MANAGEMENT, CONTINUED PRIVATE USES, MAJOR ENVIRONMENTAL EFFECTS

The next phase of the Sierra Nevada's environmental history, taking place in the period from 1900 to 1940, featured growth of federal, state, and municipal agencies whose jurisdictions included much of the public lands and resources in the Sierra. Private ownership of Sierran resources continued to affect the most productive Sierra Nevada forestlands. Effective agency regulation in public land marked a distinct change from past national land-use practices.

Establishment of Agency Management

National Forests

The establishment of federal control over forested lands became effective with the creation of the U.S. Forest Service. Congressional action in 1905 transferred forest reserves to the Department of Agriculture under the direction of Gifford Pinchot. In 1907 these reserves were redesignated as national forests. Pinchot immediately began to professionalize the new service in line with modern forestry practices. In the Sierra Nevada, the early reserves were reorganized into eight more manageable national forests: Plumas, Tahoe, part of Toiyabe, Eldorado, Stanislaus, Sierra, part of Inyo, and Sequoia (Farquhar 1965; Steen 1976).

Most activities of Forest Service personnel before 1940 could be described as custodial. Their principal duties were establishing accurate boundaries, preventing timber theft and trespass, suppressing fires, managing special use activities such as mining and grazing, building ranger facilities, preparing and supervising timber sales, and building campgrounds (Bigelow n.d.).

Although the policy of "multiple use" of national forests was not explicitly stated until 1960, it was practiced during this early period. Under Pinchot and other Forest Service chiefs until 1945, balanced stewardship of all resources was emphasized. In practice this meant that logging would always be considered important to sound forest management where it was appropriate. Watershed protection and hydroelectric development were promoted. Grazing, mining, recreation, wildlife habitat, and hunting were seen as desirable uses, but

logging was stressed as the most significant contribution to society from the national forests. Limited demand for timber on Forest Service land in the Sierra Nevada from 1907 to 1920 (the best forestland in the range in private hands was being developed heavily at this time) and reduced demand during the Great Depression, 1929 to 1939, meant that balanced use was relatively easy to maintain (Ayres 1958; Sedjo 1991; Conners 1990; Hirt 1994).

National Parks

While Yosemite Valley and the Calaveras Big Trees represented the first areas in the Sierra set aside as parks, they were under state jurisdiction. The first national parks in the Sierra Nevada (Sequoia/Grant Grove and the Yosemite high country) were established in 1890 (Runte 1987; Tweed 1995). These two parks were not integrated into any general management scheme. Protection was assigned to the U.S. Army, which used mounted patrols that were generally successful in keeping sheepherders and other trespassers at bay.

In 1905, Congress passed what is commonly called the "Right-of-Way Act," which allowed utility corridors to be created on federal lands in the West. At times portions of the designated park areas were removed because economic interests such as mining demanded them, as in 1907 when the Devil's Post Pile and Banner Mountain areas were taken away from Yosemite National Park (Russell 1947; Runte 1990). In 1913 the Minarets, a series of sharp peaks near Banner and Ritter Mountains, were also removed from Yosemite National Park for similar reasons (Albright and Cahn 1985). Hydroelectric developers secured entry into Sequoia National Park between 1905 and 1915 and cut timber, developed roads, and began construction work on a dam. The dam was not finished because of geological problems (Dilsaver and Tweed 1990).

National park policy from 1890 to 1916 was developed without any central plan to guide it. It was not clearly established just what a national park was and what could be done in one. The failure to address these two issues would lead to the flooding of Hetch-Hetchy Valley behind a dam to supply San Francisco with water. The outrage caused by this invasion of a national park was a key factor in the creation of the National Park Service in 1916 (Runte 1990; Tweed 1995).

Stephen Mather, the first head of the National Park Service, shaped national park policy in the years from 1916 to 1928. Horace Albright, a trusted associate, was chosen to replace him, thus guaranteeing a continuous policy over several decades (Albright and Cahn 1985). Some changes in park configuration in this period occurred. In 1926 Sequoia National Park was expanded to include the headwaters of the Kern River and Mount Whitney, removing them from Forest Service control. In 1940 Congress created Kings Canyon National Park, incorporating parts of the Sierra and Sequoia National Forests and all of General Grant Park into the new entity. Sequoia and Yosemite expanded tourist facilities, created roads and trails, established or expanded fire-suppression actions, and began predator control and wildlife management (including the feeding of bears so as to reduce problems for tourists). Grazing continued in the valley until 1933, although most had been excluded by the mid-1920s. Various types of vegetation manipulation, such as mowing and some burning, were used into the 1920s in the valley (Russell 1947; Gibbens and Heady 1964; Runte 1990; Tweed 1995).

California State Actions

The history of state land management following the demise of the first Board of Forestry, as it affects the Sierra Nevada, divides into three clear periods. The first, lasting from 1890 to 1905, saw little interest by the California government in its grain, forest, or grazing lands. While private interests were concerned about watershed protection and fire dangers, no major state legislation was written. The period between 1905 and 1919 brought the establishment of a second state Board of Forestry, which tried to address the issues of fire control, reforestation of cut-over lands, and protection of state forestlands. Without much funding, the board had little impact. In 1911, under the influence of Republican Progressive reformers, a state Conservation Commission was created, largely to deal with water conservation and hydroelectric power development, reflecting the growing influence of California's urban centers. In 1927, the third period of California resource history began when Governor C. C. Young and the legislature cooperated to pass a law that created a Department of Natural Resources. Although placed under a single state agency, jurisdiction over California's forestlands was separated from that over the newly defined state parks, all of the latter of which were outside of the Sierra Nevada (Clar 1959).

Between 1922 and 1945, four major issues dominated the state's resource thinking: (1) providing sufficient funding to suppress forest fires, (2) gaining control of logged-over lands to form the basis for future state forestlands, (3) reforesting these cut-over lands, and (4) surveying and developing watersheds for irrigation and domestic water uses (Clar 1959). The water issue led the state in the 1930s to plan a major water project to utilize water from the Sacramento and American Rivers to irrigate the Central Valley. The Great Depression forced the state to abandon the idea because of funding problems, opening the way for the federal government to step in and appropriate the project (Hundley 1992).

Water Agencies

The creation of forest reserves in 1891 was based on the major premise that forests were needed for lumber, as watersheds for irrigation and domestic purposes, and for development of hydroelectricity (Conners 1992). Political pressure for water resource protection and development in the West before 1900 was based on the need of irrigation interests to preserve forests as watersheds. Unregulated logging and grazing were condemned because they threatened the forests that made possible the development of irrigated agriculture. Farming was judged more likely to produce stable societies and econo-

mies than the extractive and wasteful logging and grazing practices that existed before 1900 (Worster 1985). While small-scale irrigationists would continue to exert an influence on water policy and the protection of watersheds, the impounding of water in dams for larger-scale irrigation, hydroelectric power generation, and urban uses emerged as more important factors in molding western and Sierran water policy in the twentieth century. Water development in the Sierra Nevada from 1890 to the early 1940s would be carried out primarily by federal agencies, urban governments, public utilities such as Pacific Gas and Electric, and local irrigation agencies (Worster 1985; Frederick 1991; Hundley 1992).

The largest of all government agencies to begin development of Sierran water was the federal Bureau of Reclamation. The major actions of this bureau that affected the Sierra Nevada occurred during the Great Depression, 1929 to 1939. During that time, the federal government took over control of the state-proposed Central Valley Project (Frederick 1991). Construction of a portion of the federal project began in the 1930s, but the dams and aqueducts that constitute most of the project were not completed until the 1950s (Hundley 1992).

The quest for water by the cities of San Francisco and Los Angeles had an immediate impact on the Sierra Nevada's streams at this time. Many histories exist of these two cities' attempts to gain control of Hetch-Hetchy Valley and the Tuolumne and Owens River water (Jones 1965; Worster 1985; Reisner 1986; Hundley 1992). While water for growing populations was an important reason for seeking to use Hetch-Hetchy and the Owens River, both cities clearly wanted hydroelectric generation to be an important part of these developments (Hundley 1992). It is often stated in historical accounts that San Francisco had other options. John Muir even suggested that Lake Tahoe, its shores denuded of timber and facing degradation of its water purity anyway, be given to San Francisco (Jones 1965). Regarding this view, however, it is also possible that, given the growing population in East Bay cities, even if San Francisco had not claimed Hetch-Hetchy, other urban centers would have pressed claims for it. In the climate of Progressive politics under Presidents Roosevelt and Wilson, a conservation ethic that stressed utilization of resources in service to the public interest was likely to prevail in any struggle for power (Fox 1981; Nash 1982).

Actions taken to assure a water supply for the city of San Francisco had direct effects on the environment of the Hetch-Hetchy/Tuolumne River system, including the construction of the O'Shaughnessy Dam, the cutting of Hetch-Hetchy's forests, and the flooding of its meadows. The effects of the construction of the Los Angeles Aqueduct involved the diversion of water away from Owens Lake, converting it into a salt flat. Declining water supplies also meant that Owens Valley farmers and the remnant elements of the local Paiutes faced economic ruin as the agricultural economy died. The city of Los Angeles purchased a great deal of land in Inyo County, but the majority of the land remained as federal lands in the Inyo National Forest. Tourists from Los Angeles soon began to utilize this area as automobile travel developed (Hundley 1992).

Although large state and federal water projects had substantial environmental effects on the Sierra Nevada, the numerous medium to small-sized dams and water delivery systems built after 1900 may have had an even greater influence on the Sierra Nevada ecosystem, because of their sheer numbers. No overall study of this impact has been published. Three studies of specific portions of the range, however, serve as examples of the potential impact of these projects on its northern, central, and southern parts. The earliest significant use of water before 1900 was related to mining or agriculture. While agriculture would continue to claim Sierran water resources after 1900, generation of hydroelectric power became much more important. The Pacific Gas and Electric Company (PG&E) consolidated control over electrical generation for Placer, Nevada, and Sierra Counties between 1905 and 1913. It constructed several dams and generating facilities, the largest at Spaulding. By 1940, PG&E had become the primary producer of electricity for much of the Pacific Coast, and much of its generating capacity came from facilities within the Tahoe National Forest (Jackson et al. 1982).

In the central Sierra at various times between 1905 and 1920, several smaller companies, such as the Tuolumne Electric Company, the Main River Water Company, the Stanislaus Electric Power Company, and the Sierra and San Francisco Power Companies, constructed facilities in the Stanislaus National Forest (Conners 1992). In the southern Sierra Nevada, potential hydroelectric generation sites within Sequoia National Park and on the Kings River were identified between 1913 and 1920. Unlike the situation in the northern and central Sierra, however, in this area demands to dam or utilize streams did not produce significant effects other than exploratory construction activities (Dilsaver and Tweed 1990).

Grazing Management

Most grazing land in the Sierra Nevada came under control of the Forest Service in the period 1900–1940. A major exception was Sierra Valley, in the northern part of the range, where significant private ownership existed (Sinnott 1979). All Sierra Nevada national forests established special use permits that favored grazing by local ranchers over "gypsy" sheep bands and unauthorized cattle interests (Douglass and Bilbao 1975; Steen 1976). Local grazers in some cases resisted this new control, but many soon came to realize the advantages that came with guaranteed access by "local" interests (Bigelow n.d.; Rowley 1985). Regulation did not necessarily reduce the number of animals utilizing U.S. forests in the period after 1907. By 1917 there had been a 50% increase in the number of animals grazing in national forests, and demands during the First World War pushed usage beyond that. Better management practices and increased grazing land placed under Forest Service control have been cited as reasons for this increase (Rowley 1985). It is likely that numbers of grazing animals in the Sierra Nevada increased similarly.

Gradually during this period, cattle began to replace sheep on many Sierran ranges, resulting in more soil compaction and increased effects on vegetation in riparian zones (Lux 1995). Between 1905 and 1930 the Forest Service developed policies intended to balance grazing intensity and range conditions. These included instituting term-grazing privileges, limiting the number of animals allowed under existing climate and range conditions, and closing some areas to grazing in order to protect watersheds or to limit impacts on wild game. The Forest Service established predator control and poisonous plant reduction to serve those holding livestock permits on forest ranges (Markley and Meisenbach 1995).

In the 1930s Forest Service control of its rangeland was challenged by the creation of a rival Grazing Service in the Department of Interior following the passage of the Taylor Grazing Act of 1934. The Taylor Act did not apply to most Sierran rangeland, but it did create competition between the Interior and Agriculture departments that forced the Forest Service to modify its policies. These policy changes included offering ten-year leases, relaxing policy that previously had reduced animal usage during drought, and permitting more animals on western ranges. While these changes did not lead to grazing that was as severe in its impact on Sierra Nevada rangelands as that of the unregulated years, Sierra ranges were opened to greater usage than had occurred in the two decades between 1910 and 1930 (Rowley 1985).

Continuing Private Uses

Much of the most accessible Sierran timberland by 1900 was in private hands. Application of railroad logging techniques permitted greater amounts of lumber to be brought to market and allowed more distant areas to be logged economically. Hydraulic mining continued on a limited basis. Mining at hardrock sites continued. The 1870s mining law allowed mineral resources to be easily appropriated by private interests but did not regulate their operations adequately (Lux 1995; Markley and Meisenbach 1995).

Railroad and Other Logging in the Sierra

The use of railroads to transport lumber to distant markets began first in the northern Sierra with the construction of the Central Pacific Railroad (Edwards 1883; Knowles 1942). This railroad permitted the shipment of timber from the Sierra Nevada to Great Basin cities such as Salt Lake City. California areas along the railroad route, and national and international markets, were served before the turn of the century, when the Central and Southern Pacific railroads were integrated. Access to other markets stimulated the development of other rail logging systems to harvest Sierra Nevada timber. The railroad lumber industry of the Sierra Nevada grew most between 1890 and the 1920s, and more than eighty rail logging companies were created (Ayres 1958; Lux 1995). Logging rail systems opened formerly inaccessible privately held timberlands to intense development until the 1930s. Privately owned rail logging systems encouraged Forest Service personnel in the Sierra to open timber sales in lands close to rail systems, thereby aiding industries and the Forest Service in reaching their separately defined goals (Conners 1990).

Railroad logging occurred in most of the Sierra, with much less taking place in the southern one-third of the range. Areas especially affected included the Tahoe-Truckee Basin, the portion of the South Yuba River drainage close to or in the Tahoe National Forest, areas located within or near the Eldorado and Stanislaus National Forests, and locations near the Sequoia National Forest. Railroad logging primarily harvested pine and redwood. Fir was generally used for fuel and pulp. Cedar was used for fuel as well. The cutting left many acres denuded. No overall figures are available, but examples can be cited to illustrate this point. Records from the Hobart Mills operation in Sierra County, only one of the three counties in the northern Sierra in which this company owned land, lists more than 105 million board feet cut between 1916 and 1919 (Knowles 1942). In the central Sierra, the West Side Lumber Company cut more than 90 million board feet in 1915 and 1916 (Conners 1990).

A report issued by S. B. Show for the Forest Service in 1926 warned that if the pine forestland in California, 80% of which was in private hands, continued to be cut at currently existing cutting rates, most of the companies involved would soon be in the "cut-over land business" (Conners 1990). Their methods of moving cut timber to the rail landings, judged to be wasteful by Forest Service standards, included flumes, steam donkeys, and chutes that caused damage or used considerable amounts of timber for construction or fuel (Brown and Elling 1981; Supernowicz 1983; Conners 1990; Markley and Meisenbach 1995). Other wasteful practices included careless slash handling and fire control practices. At times, however, cooperation between the Forest Service and private companies occurred in the area of fire control. Forest Service standards were imposed on the rail loggers when they bid for federal timber sales (Conners 1990; Markley and Meisenbach 1995).

Prices for timber from the Sierra Nevada fluctuated between 1900 and the 1930s. At times prices were low because of low demand and overproduction, and at other times they were high, especially because of wartime demand during 1914 to 1918. Rail connections reduced transportation costs and, until the late 1920s, aided rail logging operations, even though they continued to utilize older and more wasteful methods (Brown and Elling 1981; Supernowicz 1983; Lux 1995; Markley and Meisenbach 1995). During the Depression many companies operating on private land went bankrupt or adopted more aggressive cutting policies to maximize profits (Conners 1990). Economic conditions in the 1930s sometimes created advantages for the Forest Service, leading to land exchanges and extensions of cutting rights that provided short-term cash advantages to private companies and long-term gains for Sierran national forests (Conners 1990).

Sierra Nevada forests before 1940 were commonly more

open than those of today, with large, even-aged trees under which grew perennial grasses and few shrubs. The most significant effect of logging before 1940 was the removal of the largest yellow and sugar pines. Replacing these were smaller but more densely packed pines in some areas, more fir and cedar in other areas formerly dominated by pine species, and more shrubs than had existed in the earlier forests (Laudenslayer et al. 1989; Laudenslayer and Darr 1990). By 1934 more than half of the mixed conifer forestland in the north-central Sierra Nevada had been entered for harvesting, although logging was restricted primarily to ponderosa, Jeffrey, and sugar pines. Fir was less affected. The southern part of the range, where rail logging did not develop, still served primarily local markets. On Forest Service land only 7% of mixed conifer forests had regenerated second-growth stands, because of the recentness of cutting. More than 90% of the remaining unharvested conifer stands in the Sierra were located on Forest Service land (Johnston n.d.).

Mining Developments

Quartz gold mining grew in importance after 1900. Permanent communities such as Sierra City, Alleghany, Nevada City, Grass Valley, and Sonora reflected the relatively stable nature of this industry (Clark 1963, 1980; Sinnott 1976). The impact of this industry on water and other Sierran elements has not been determined. During the Second World War, most of these hardrock gold mining operations were closed so that the iron, fuel, and wood they consumed could be redirected into the war effort. Few reopened after 1945.

While gold mining declined during the period from 1900 to 1940, other types of mining developed in many areas in the Sierra. More than twenty different minerals were mined between 1900 and 1960, many having been developed before the Second World War. These minerals included copper, chromite, barite, molybdenite, and tungsten. Their development contributed to the economic viability of local communities (Jackson et al. 1982; Supernowicz 1992). Their impact on ecosystem conditions in the Sierra Nevada has not been assessed.

Other Major Environmental Effects

Agency management significantly changed Sierran use patterns after 1900, especially related to fire suppression and recreation development.

Fire Suppression

Among the Forest Service personnel in the Sierra Nevada, fire was one of the most frequently mentioned subjects: extinguishing fires, training people to fight them, establishing lookouts to spot them, establishing phone lines to report them, and requiring timber sales to limit the possibility that one would start. July and August forestry concerns were dominated by fire (Bigelow n.d.).

During the early part of the twentieth century the Forest Service identified and studied sources of fire. Fire was generally seen as a degrading force to be excluded, if possible. These attitudes were also shared by Park Service personnel. By the mid-1920s all national forests and national parks in the Sierra Nevada had fully developed policies, procedures, and organization to suppress fire in their jurisdictions; these took into consideration season, topography, and past fire histories for their special area. Regulations for timber sales required that fire control equipment be readily available, enforced brush and vegetation piling procedures, and even set limits on where loggers could smoke (Ayres 1958; Supernowicz 1983; Cermak 1988; Markley and Meisenbach 1995; Tweed 1995). All national forests in the Sierra Nevada had developed infrastructures such as lookouts and phone systems. Some observers noted that such policies did reduce fire frequency by the late 1920s, although others said that low fuel levels dating from earlier forest conditions were actually the reason for fewer fires (Ayres 1958; Cermak 1988; Lux 1995).

The decision to exclude fire from public lands came about as the result of a debate over whether to permit "light burning" or, as some called it, "Indian burning" or to use complete suppression. Studies that included field experimentation, most notably those of Forest Service personnel S. B. Show and E. I. Kotok, were established over time in several different locations, with national and state foresters coming down hard on fire-caused damage. Logging and grazing interests and even some nature writers held that light fires reduced fuel, thereby creating more open forests and lessening the danger that excessive fuels would feed destructive crown fires (Ayres 1958; Cermak 1988). Concern by the Society of American Foresters about this growing disagreement led them to offer to arbitrate the differences. A California Forestry Commission was created, with representatives from both sides of the issue appointed. Eventually, this commission supported a policy of complete suppression (Pyne 1982).

In 1923, Show and Kotok published a study that essentially settled the debate for the Forest Service. They concluded that all fires, especially repeated light fires in the same area, caused progressive damage and hence were not benign. Repeated burnings, in their view, killed young and less-fire-adapted species, creating unnatural forests that favored mature pines. While mature trees and open canopies were good for logging and grazing interests, fire discouraged effective regeneration of mixed forests. If forests were to be sources of a sustainable timber supply, fire had to be suppressed (Show and Kotok 1923). The next year they published another report that established policies to implement their conclusions (Show and Kotok 1924). In the same year, the Clarke-McNary Act was passed by Congress, and it clearly established fire exclusion as national policy. Federal money was offered to state agencies that would comply with suppression doctrine (Pyne 1982). Absolute fire suppression would form the basis of Forest Service and Park Service policy until the 1960s, when it was reconsidered (Pyne 1982; Supernowicz 1983).

In the Depression of the 1930s, declining timber sale rev-

enues reduced fire-fighting funds. To compensate for reductions in fire-fighting personnel at this time, the Forest Service utilized the Civilian Conservation Corps (CCC), a federal employment program created for young men, to assist in fighting fires. The CCC also provided valuable help in building and improving Forest Service and national park trails and facilities (Supernowicz 1983; Markley and Meisenbach 1995; Tweed 1995).

Expansion of Recreation

After 1900, tourist revenue created by automobile access grew in economic importance in areas where roads and natural beauties existed together. Expanded demand created by recreation and tourism added another significant force to bring about further changes in environmental conditions in the Sierra Nevada (Strong 1984; Runte 1990).

Monumental Features. Before 1900 the focus of Sierran tourism was on its monumental features (Yosemite Valley State Park, the Calaveras Big Trees, Yosemite National Park, and Sequoia National Park) and its lakes (Tahoe, Independence, and Weber). Limits set by horse transportation eventually were pushed back when railroads made travel more comfortable for a growing middle class (James 1915; Hinkle and Hinkle 1949; Beesley 1979; Strong 1984; Runte 1990; Tweed 1995). Cars increased the numbers of visitors in all of these areas. Automobiles, natural beauty, and Kodak cameras acted together to stimulate increased camper and tourist use. Railroad connections to Tahoe and Yosemite rapidly declined as most tourists used the more convenient automobile. In Yosemite alone, the number of visitors using automobiles doubled every several years until the Great Depression (Schmidt 1990; Demars 1991).

Yosemite National Park, officially admitting automobiles in 1913, was affected more by automobile tourism before 1940 than Sequoia or Lake Tahoe. In 1926, a shorter all-season road was opened up on the Merced River–El Portal route, making Yosemite even more accessible. Park promotion by the service after its founding in 1916 was intense. Park Director Stephen Mather stressed that national parks were the "playgrounds of the nation." He cooperated with the National Park to Park Highway Association in its promotion of vacationing by cars. The Park Service encouraged more visitors per year and longer stays by them. In practice, this led commercial concessions to construct non-nature-oriented facilities such as bowling alleys and swimming pools. The "Fire Fall," which involved pushing burning debris over Glacier Point as an evening attraction for Yosemite Valley tourists, was reintroduced by David Curry, a park concessionaire. Thousands of car campers who visited the valley also used the Merced River for cooking and bathing. Sanitary facilities were inadequate, resulting in increased pollution. Winter use was promoted where possible. The Park Service worked closely with commercial concessionaires such as the Curry and Yosemite Park Companies. In Yosemite this meant promoting winter carnivals, sporting contests, snowshoeing, ice skating, and snow play. Badger Pass Ski Lodge was opened in 1935 for touring and downhill skiing (Schmidt 1990; Demars 1991).

Sequoia and General Grant National Parks had very little environmentally significant tourist impact before 1900. Appropriations by Congress allowed some low-level road and trail development in 1900, making sequoia groves in both areas more accessible. Between 1920 and 1934 the "Generals" highway was constructed, connecting Sequoia and General Grant. In the 1930s the U.S. Forest Service and the State of California cooperated to build a road from General Grant Grove to Kings Canyon, opening these spectacular areas to automobiles. By the end of the decade, Sequoia and Kings Canyon National Parks had well-developed tourist infrastructures that included roads, trails, lodges, and campgrounds (Tweed 1995).

Lake Tahoe was transformed in much the same way as Yosemite and Sequoia by automobile access and recreation. Because much of Tahoe's land was in private hands, more private recreation development occurred there than in the federal park areas. Transportation costs to Tahoe dropped considerably as adequate roads and reliable automobiles became common. Little tourism occurred in the winter, when the Tahoe Basin was isolated because of heavy snowfall (Strong 1984; Lindstrom 1995).

Highway transportation to the Tahoe Basin was built on the older network of freight and wagon roads that had developed to serve Lake Tahoe and the Comstock Lode/Virginia City, Nevada, area before 1900. Many of the engineered roads were the product of the forest highway program of the 1930s. Paved highways such as Highway 50 connected California to the lake's south shore, and state routes 89 and 28 opened the western, northern, and eastern shores as well. In 1931 Nevada relegalized gambling, and by the mid-1930s facilities on the Nevada side of the lake and in Reno began to generate more tourist and automobile travel. As a result, tourist activities changed. The railroad, lake steamer, and luxury hotel pattern of the pre-1900 days rapidly declined, with car camping, use of cabins and auto courts, cafes, and service stations replacing it. In essence, a new class of tourists came to dominate the lake (Strong 1984; Supernowicz 1983; Lindstrom 1995).

The addition of winter sports activities in conjunction with better roads and autos caused increased winter use of Lake Tahoe. In the 1920s some winter sports activities were promoted at Tahoe Tavern, including ski races, bobsled races, and sleigh rides. In 1930 a national ski jumping competition was staged. Shortly after that, a small T-bar lift was built at Spooner Summit. Large-scale winter sport development would not occur, however, until after 1945 (Strong 1984).

Other Recreation Development. Automobiles also opened areas of the Sierra that had not drawn tourist attention at earlier times. Development of county, state, and federal roads, including Highways 4, 20, 28, 40, 49, 50, 89, 108, 120, 180, and

395, opened many parts of the Sierra to Californians and other tourists. Improvement of roads within and connecting to national park areas also facilitated this process (Supernowicz 1983; Lux 1995; Lindstrom 1995; Markley and Meisenbach 1995; Tweed 1995). More camping brought new concerns to federal agencies, especially the fires caused by campers (Bigelow n.d.; Show and Kotok 1924).

Automobile access to the Sierra between 1900 and 1940 changed the range, just as other human activities had in past periods. The Tahoe, Eldorado, Stanislaus, and Sequoia National Forests offer representative examples. All saw increased use with the advent of automobile access. The forests increased the availability of improved campgrounds along major routes. Because of these campgrounds, programs to increase awareness of fire danger were instituted. Sportfishing and hunting activities were encouraged. Visitor use significantly increased in all of the national forests. During the Great Depression some consideration of camping time limits was considered because of what was deemed "squatting." In the northern Sierra Nevada, national forest land was developed for skiing and other winter sports activities, especially in the areas served by Highways 40 and 50. All of the forests encouraged the development of "summer home" sites based on terminable leases. These homesites were usually located near established highways (Markley and Meisenbach 1995), with streams or lakes acting as drawing factors (Conners 1993). Local materials were usually granted to the builders of these homes (Supernowicz 1983; Conners 1993). Homesites at Wilsonia and at Mineral King represented similar development in the southern part of the range (Dilsaver and Tweed 1990; Tweed 1995). No summary of the environmental impact of such housing exists.

Summary: Establishment of Agency Regulation

Between 1900 and 1940, the unregulated use of the Sierra Nevada came to an end. Development of the range continued, but under some form of regulation. Federal and state agencies such as the U.S. Forest Service, the National Park Service, the U.S. Reclamation Service, the California Division of Forestry, the state Natural Resources Agency, and several municipal water agencies imposed limits on the use of much of the Sierra Nevada's resources. While private land and resource development continued, notably in areas served by railroad logging operations, regulated use exerted a significant influence. Recreation emerged as a dominant force, largely because of automobiles and better roads. Water for urban, hydroelectric, and irrigation purposes was developed. The Sierra ecosystem continued to change in response to human actions, but the patterns were different from those of its opening phase.

1940–60: EXPANDING DEMAND AND AGENCY RESPONSE

The Second World War was a watershed event in California and the Sierra Nevada. After a decade of economic collapse, the 1939–45 years of war-driven economic growth put the nation's natural resources and labor power back to work. Demand for lumber alone from national forest lands rose by more than 200% compared to prewar levels, and the percentage of the nation's supply of lumber that came from Forest Service lands increased from 5% of the total to 10% (Hirt 1994). Continuing economic expansion from the end of the war to 1960 had effects on the Sierra Nevada that probably exceeded those of extraction during earlier periods (Strong 1984; Rice et al. 1988; Hundley 1992; Hirt 1994). The response of national, state, regional, and local agencies promoted growth and constitutes the third phase of this period of the range's history. Overall, there was an increase in resource demand, especially in the areas of timber and recreation. Agency actions supported attempts to offer more services and resources to meet these demands, in the belief that the Sierra Nevada was an inexhaustible resource as long as it was effectively managed. This optimistic viewpoint would be called into question in the 1960s (Hirt 1994).

Population Growth and Resource Demand, 1940–60

War-related economic expansion in the United States began in 1939. California benefited greatly from increases in defense production spending. Although California's population had grown steadily and at a faster rate than that of the nation as a whole until the 1920s, during the Depression growth declined. Following 1940, however, people relocated to the San Francisco Bay and Los Angeles areas, where war production boomed. Although some still predicted that a postwar slump would occur, the beginning of the cold war between the United States and the USSR led to continued war-related production and employment. Instead of a decline, growth in population again outpaced that of the nation as a whole (Thompson 1955; California 1970, 1979; Hart 1978; Rawls and Bean 1993).

This population growth had an immediate effect on the Sierra Nevada because of demands for timber and mineral resources. Ironically, the gold mining industry, considered by many to have been the foundation upon which the state was built, was dealt a death blow by a war-closure ruling. In order to control the use of resources such as steel and lumber, all hardrock mines were shut down. Just as federal action in the 1880s had effectively ended hydraulic mining, the mine closure order killed off most quartz mining. Although some of the largest hardrock gold mines would revive after the war, most closed by the 1950s, thus ending a significant pattern of Sierran land use. Mining of many resources, including gold,

would still be a part of the range's economy and would continue to create environmental problems, but not at the levels of the past (Clark 1980; Palmer 1992).

The urbanization of California and economic growth produced increased demands for recreation facilities and use of natural places by a mobile and more affluent public. The national forests and national parks in California drew most of their visitors from urban areas within the state itself. The infrastructure that served tourism in the forests and parks did suffice in the immediate years after the war, but strains and increasing demands would exert pressure for expansion (Strong 1984; Runte 1990; Demars 1991; Tweed 1995; Lindstrom 1995).

Government agencies and private sector elements met demands for Sierra Nevada resources after the war by producing, in one word, more. Some uses, such as mining and grazing, were reduced, but other resources were exploited beyond previous levels.

U.S. Forest Service Response

In 1945, the Forest Service acknowledged that timber from the lands it managed was going to play a more important role in meeting the nation's needs than in the past. The service moved from a custodial role into a production mode (Hirt 1995). As an example, between 1902 and 1940, the total timber harvested on the Eldorado National Forest was 148.9 million board feet. From 1941 to 1945 it totaled 175.4 million board feet, reflecting wartime demand. Between 1946 and 1959, the harvest total stood at 728.9 million board feet (Supernowicz 1983), meaning that in thirteen years more than twice as much timber was harvested on the Eldorado Forest than in the preceding forty-three years.

The Forest Service was hard-pressed during World War II to meet the demand for timber while still practicing sustained-use forestry and trying to meet multiple-use ideals. After the war the service attempted to develop national regulatory standards. Private interests initially resisted, but eventually a rough sort of cooperation developed between the Forest Service and the larger private developers, who received access to increasingly valuable Forest Service sales. The Forest Service could not cut and process its own trees, but it could force private cutters to respect regulations established on public lands, because private companies needed the wood. As part of this accommodation, both public and private forestry in the postwar period moved toward "intensive timber management" practices to try to keep up with increasing public demands (Sedjo 1991; Hirt 1994).

During the 1950s, pressure from private and Congressional development interests, assisted by the Eisenhower administration, caused the Forest Service to increase its output of timber. The Republicans used the threat of reducing the amount of land administered by the service as leverage. Under Forest Director Richard McCardle, national forests allowed larger timber sales and constructed more roads. Many of the areas opened had previously been considered too remote or steep to log. Watershed damage, erosion, and wildlife impacts resulted from this increased activity from public and private sources. Timber supplied by the national forests rose to almost one-third of the nation's supply by 1970 (White 1991). While the largest increase in logging on Forest Service lands occurred in the Pacific Northwest and portions of the Rockies, the Sierra Nevada was affected because of the market created by population growth in California. By this time demand for Sierra Nevada timber may already have exceeded timber growth (Johnston n.d.). Between 1940 and 1960, timber harvests in the state grew from 2 billion board feet to 6 billion board feet per year, with most of the rise coming after 1946 (Rice et al. 1988; Hirt 1994; Markley and Meisenbach 1995).

During the 1950s, concern about the rate at which forests were being cut and the negative effects on soil, watersheds, and wildlife resulted in resistance to the policies of the Forest Service. While the service had always stated a multiple-use approach to the lands in its control, timber had always dominated its activities. As an example of the mounting criticism, Willis Evans of the California Department of Fish and Game expressed concern to the Society of American Foresters in 1959 that the effects of high-yield production were destroying the West's forests for the sole purpose of timber production. He said that the public interest in its forests as a whole was not being served (Hirt 1994). Because of such growing public concern, Congress passed the Multiple Use–Sustained Yield Act in 1960. As a result of this policy, environmental activists began to demand changes from the Forest Service. Emphasis was placed on preservation of wilderness areas, protection of streams and watersheds, and preservation of wildlife habitat. These actions constituted the beginning of a new phase in the range's history (Strong 1988; White 1991; Hirt 1994).

Lake Tahoe and National Park Response

Lake Tahoe, Yosemite, and Sequoia/Kings Canyon, the three most important early monumental features of the Sierra, were all affected by postwar expansion. Tahoe had already been heavily logged, so its lands were not subjected to the same levels of cutting as other areas of the range following the war. Yosemite and Sequoia/Kings Canyon, long under federal resource controls, were similarly spared from such actions. They did, however, face increased recreation demands. Expansion in all tourist activities in these parks and in adjacent privately held facilities occurred following 1945 (Strong 1984; Runte 1990; Clawson and Harrington 1991; Tweed 1995).

The Lake Tahoe Area. After 1945, urbanization at Lake Tahoe occurred at a rate far exceeding that of past periods. Development would overwhelm all attempts to deal with the impact on Lake Tahoe as a whole and the adjoining areas. It would not be until the late 1950s that anyone would ask questions about problems being generated by mushrooming growth (Strong 1984).

In 1945 business and political leaders in the Tahoe area, concerned by its near desertion during the war, developed

programs to draw tourists. Local booster agencies and governments staged events to draw more people. They also worked to improve transportation connections. The Placerville to Lake Tahoe Resort Owners Association exerted political pressure that led to the extension of an all-weather road to the south shore of Tahoe in 1947. With gambling in nearby Nevada, travel to the lake rose dramatically. Air travel to Tahoe between 1945 and 1949 also increased (Strong 1984; Lindstrom 1995).

Following 1955, growth accelerated along the Highway 50 corridor. Skiing resort developments such as Heavenly Valley and the opening of new gambling facilities at the lake and in Reno provided the draw. To supply services for tourists, permanent residency grew, leading to increasing pollution problems. Despite such problems, local governments promoted this transient and year-round population growth (Strong 1984). In 1960 the Olympic Winter Games were staged at Squaw Valley, dramatically increasing year-round use of the Sierra Nevada (Strong 1984). Facilitating the Olympic developments was the building of Interstate 80, which connected the area to Sacramento.

Yosemite. By 1945, park accommodations had seriously affected the Yosemite region. Wildlife had been controlled to meet visitor needs; for example, mountain lions were killed, as were aggressive bears in higher camps. Scenic and biological resources were strained, in the view of some contemporary observers, as the postwar period opened (Runte 1990).

In 1954, more than 1 million visitors came to Yosemite. By 1967 the 2 million visitor level was reached. Under pressure from concessionaires, the Park Service generally increased the number and variety of housing units, camping facilities, and different recreation activities. Some within the Park Service and the Sierra Club pushed to have all unnatural features removed from the valley floor, but to no avail (Runte 1990). One historian, speaking of the valley campgrounds in these years, described them as a rural slum (Demars 1991).

While most of the increasing use of Yosemite was concentrated in the valley, pressures also mounted to open the adjoining high country. Between 1954 and 1961, a struggle (between developers and Park Service personnel on one side and environmental interests such as the Sierra Club on the other) ensued over the construction of the Tioga Road. In the end, the road interests won, opening another area to easy tourist access (O'Neill 1984; Runte 1990; Demars 1991).

Sequoia and Kings Canyon National Parks. In comparison to the more northerly areas, Sequoia and Kings Canyon were less affected. Demand for timber had no direct effect, because logging had long been excluded. However, on adjacent land, heavy logging of all conifer species occurred, leaving the nationally protected parks as "biological islands," cut off from developed lands near them (Tweed 1995). Tourist interest led to increased use, as it did elsewhere in the range. Because the tourist and road facilities were generally overbuilt for the needs of the 1930s, they absorbed growth in use to the 1950s. With increased use, however, a need developed during the following decade to replace and upgrade these facilities. A general National Park Service policy called "Mission 66" led to the upgrading of most facilities at Sequoia/Kings Canyon but did not increase development into new areas (Tweed 1995).

In general, park policies in the time between 1940 and 1960 continued to stress total fire suppression. Management goals stressed natural appearance and visitor safety. Transportation and urbanization remained generally at 1940 levels. Wildlife management policies were consistent with pre-1940 practices. It would be after 1960 that most of these policies would be challenged, leading to different management practices and perspectives (Tweed 1995).

Water Agency Responses

Population growth in California after the war was primarily an urban phenomenon. The Sierra Nevada supplied most of the water for the state's largest cities. San Francisco relied on Hetch-Hetchy, and Los Angeles obtained nearly 80% of its water from the Mono and Owens River drainages (Kahrl 1979). Expansion of populations in other urban areas, in the San Francisco Bay Area, in Sacramento, and in the Tahoe Basin (including Reno) would lead to further Sierran water development. In addition to being used to supply cities of California and Nevada, Sierra Nevada water was demanded by California corporate farmers for irrigation (Kahrl 1979; Strong 1984; Hundley 1992).

The Central Valley Project. In the 1930s the Bureau of Reclamation and the U.S. Army Corps of Engineers began construction of the Central Valley Project to regulate the Sacramento, American, Stanislaus, and San Joaquin Rivers and to provide water for contracted users. Most of this huge project would be completed after the war. By the 1950s, the Shasta, Keswick, Folsom, New Melones, and Friant Dams had been built, and a complex system of canals distributed more than 3 million acre-feet of water to state interests. These dams generated electricity and provided recreation for thousands of users (Hundley 1992).

The California Water Project. California lost control over development of several Sierran rivers when the federal government established the Central Valley Project. But many California agribusiness interests, angered by a federal 160-acre limit on subsidized water use, still longed for a less restrictive state water project. The recovery of the state's prosperity after the war led to political action to create a state-controlled system. The focus of water planners was on the Feather River. Flooding caused by the Feather River in the 1950s added to the justification for a dam in the eyes of many voters. Because of the high cost of the project, it was planned that not only would Central Valley farmers use the water, but much of it could be shipped south over the Tehachapis into

the Los Angeles Basin. Governor Edmund Brown secured passage of legislation in 1959 to authorize funding. By 1962 Sierra Nevada water began flowing south, making it over the mountains in 1971 (Worster 1985; Hundley 1992).

Tahoe Basin Water. The need for water from the Sierra Nevada to meet urban growth demands in the Tahoe Basin and nearby Reno exceeded supply during the postwar boom. As early as the 1930s Lake Tahoe property owners and businesses at the lake were contesting with irrigators and power suppliers over Tahoe and Truckee water. The dispute was complicated because two states, several county governments on both sides of the state boundaries, and several federal agencies had conflicting jurisdictions. In 1934 a temporary solution, called the Truckee River Agreement, was cobbled together. It prohibited tunneling into Lake Tahoe or cutting its rim, as some Nevada interests had desired. Minimum and maximum lake levels were established. A reservoir was to be built by federal water agencies at Boca on the Little Truckee to store water for Nevada. After the war a second dam on Prosser Creek in the same drainage was constructed. Sierra Pacific Power and Light was allowed to build a small reservoir for power generation (Taylor 1975; Strong 1984).

Accelerated postwar growth soon made these earlier compromises unworkable. Local, county, state, and national interests began to work at cross-purposes. California and Nevada came to realize that they could not achieve any of their goals exclusively without costly court battles, something that neither really wanted. In 1955 they cooperated to create a California-Nevada Interstate Compact Commission. It took until 1963 for that group to create a report that apportioned water in the basin between the two states. It would not be until 1971 that both state legislatures ratified the agreement (Strong 1984).

The fundamental problem of growth in the basin was not addressed in any of these attempts to work toward a compromise solution. It was not just the amount of water that caused difficulty. Pollution in the Tahoe Basin, and thus eventually in the lake itself, was also an issue. Raw sewage was detected in the lake. Debris and nutrients created by runoff and development seriously affected water purity and clarity. Between 1945 and 1960, numerous studies by the city, county, and state governments were conducted. No action to address the problems would be taken until the 1970s, however (Strong 1984).

Recreation Demands

Transportation Development. The key to recreation development in the Sierra Nevada was always access. Trails, roads, rail connections, and eventually automobile connections had opened much of the Sierra to tourists by the end of the 1930s. After World War II, improved automobile transportation routes expanded tourist and recreation use. Interstate 80, in particular, changed Sierran use patterns. Instead of seasonal limits imposed by weather, the new freeway encouraged heavier year-round use and permanent population growth. The construction of the Tioga Road increased access to Tuolumne Meadows and the Yosemite high country between 1950 and 1961. Connections from Los Angeles to ski areas such as Mammoth and June Lakes were supplied by an improved Highway 395. Two major exceptions to the response of agencies for expanded highway connections involved the projected Emerald Lake Highway at Tahoe and a trans-Sierra highway in the Banner-Ritter area. Protests from a growing number of environmentalists stopped all serious consideration of these roads (O' Neill 1984; Strong 1984; Rice et al. 1988; Runte 1990).

The Development of Skiing. The most significant expansion of recreation in the Sierra Nevada following the Second World War came from skiing. While air transport facilitated some of this expansion, notably at Tahoe-Donner, it was automobile travel that turned it from a marginal recreational use to a major industry. The earliest skiing before 1940 had been in Yosemite near Badger Pass, at the Twin Bridges area along Highway 50, or along Highway 40, especially at Cisco Grove, Norden, and Sugar Bowl. These areas would continue to develop after the war. They were joined by new areas because the Forest Service cooperated with private developers (Farquhar 1965; Fairclough 1971; Strong 1984).

Ski developments new to the Sierra or expanded after 1945 included the Mammoth and June Lakes region, Donner Summit resorts such as Sugar Bowl and Squaw Valley (stimulated by the 1960 Olympics), and Tahoe resorts such as Alpine Meadows and Heavenly Valley (Farquhar 1965; Fairclough 1971; Strong 1984).

Challenges to Growth-Oriented Policies, 1950–60

Population and economic growth after the Second World War in the nation, California, and the Sierra Nevada was supported by most of the public and all agencies of government. A nation and people scarred by a ten-year-long depression but put back to work in the war and the decade of economic growth that followed showed little concern for the effects of this growth. Access to national parks was convenient, and tourists were welcomed. Forest resources, including lumber, pasture, camping, hunting, and fishing, were all expanded to meet public demand (Strong 1984; Runte 1990; Demars 1991; Hirt 1994).

Not all who utilized the Sierra were happy with the effects of postwar growth. Groups with conflicting goals such as grazers and timber users continued to have conflicts. Conservation groups, which included the Sierra Club, the Wilderness Society, the National Wildlife Federation, and the Audubon Society, were troubled by the effects of increased postwar development. While divided on the particulars, conservation advocates were troubled by the emphasis that forest officials placed on timber production. Sierra Nevada environmental activists developed new ideas concerning wilderness and in-

tegrated wildland approaches. These were expressed most effectively by David Brower of the Sierra Club, who called for reduced demand and less impactive use on Sierra Nevada resources. Taken together, these perspectives meant a different type of environmental movement had begun (Strong 1988; Runte 1990; Hirt 1994).

Agency response to these different demands was mixed. Concern about wildlife was generally not expressed by forest and park officials. Damage to riparian areas did draw complaints from within fish and wildlife services, but their budgets did not allow them to compete strongly with silviculture. Recreation did receive more attention, but disproportionate funding for timber production continued. Some portions of national forest land, mainly "rock and ice" or higher-elevation areas, were set aside before 1940 with a primitive area designation. In the Sierra, the only example was the Desolation Valley area, which lay alongside Highway 50. No further designation of what some in the Forest Service called "wilderness reserves" occurred beyond 1940 until the passage of the Wilderness Act of 1964 (Steen 1976; O'Neill 1984; Palmer 1988; Runte 1990; Hirt 1994; Tweed 1995).

The decade of the 1950s represented a watershed in Sierra Nevada environmental history. Between 1890 and 1950, cooperation between federal agencies and environmental interests had sometimes been strained. But conservation groups compromised or made peace with these federal agencies because more access, fish and game improvements, and scenic preservation were shared values. Many conservation groups believed that not cooperating would bring more harm to the range from extractive industries such as logging and grazing. In the 1950s a new conservation movement began to address broader Sierran and national issues such as wilderness designation and wildlife protection. Their actions led to challenges to federal land-use policies, even if that meant breaking with their allies in park and forest agencies (Strong 1984; Runte 1990; Hirt 1994).

Several key issues illustrate this growing conflict. First was the Forest Service's use in the 1950s of what were defined as "salvage sales," which critics charged was a designation improperly used to justify increased timber cutting in some areas formerly designated as "primitive." Although these redesignated timber harvests were not located in the Sierra Nevada, the Sierra Club began to organize resistance to such actions because of their potential effects. Another area of concern involved the inability of federal agencies to control growth in the Tahoe Basin. Multiple jurisdictions and interests meant that growth and pollution of the lake continued without effective countermeasures. A third issue that drew widespread concern was the Tioga Road expansion within Yosemite National Park. Regardless of environmentalist complaints about the effects of the reconfiguration and the widening of this road, the National Park Service continued construction (Strong 1984; O'Neill 1984; Runte 1990; Hirt 1994).

By the late 1950s numerous conservation groups had mounted a challenge that questioned the ability of the national forests and national parks to meet more than narrowly prescribed growth-oriented uses. The dominant agency concerns of timber production and tourist access were challenged. Wildlife policies were criticized as being oriented only toward predator control and managing animals such as deer and bears. Vegetation control was seen as focusing only on the reduction of vegetation considered harmful to grazing animals. Various political campaigns and internal protests during this period demanded that public agencies consider broader environmental health concerns (Runte 1990; Hirt 1994).

Because of this rising protest, in 1960 the Multiple Use–Sustained Yield Act was passed. For the Forest Service the law confirmed long-standing commitments dating back to the days of Gifford Pinchot to have the forests meet a broad range of uses. No interest was to have special priority (Markley and Meisenbach 1995). In reality, MUSY, as some called the act, left intensive timber harvest policies basically unchallenged. However, the law marked the opening of a new era of resistance from environmental interests. Notably absent from the groups that endorsed the law was the Sierra Club. Its rejection was based on what it described as ambiguities in the act, the prevailing timber and water priorities of the Forest Service, and an unwillingness of the service to protect and develop wilderness areas. Unquestioned cooperation between organized environmental groups such as the Sierra Club and the Forest Service had come to an end (Hirt 1994).

Summary: Agency Response to Growth, 1940–60

The unprecedented growth of the California and U.S. economies after 1940 had a tremendous impact on the Sierra. Demand for lumber, water, rangeland, and recreation access exceeded that of any other period in the range's past environmental history. All of the major resource agencies made efforts to satisfy the needs of the public. Undoubtedly, the greatest area of increased use was in timber production. Across the West, including in the forests of the Sierra, the U.S. Forest Service kept increasing production of timber. Clear-cutting became the dominant form of logging. Criticism from conservation and wildlife groups mounted. By the end of the decade a newly energized environmental movement challenged the growth-oriented policies of public agencies. In response, the agencies began to question their former policies. A new era in Sierra Nevada environmental history had begun.

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