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# *Special Forest Product Harvesting in the Sierra Nevada*

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## ABSTRACT

Special forest products have historically been gathered in the Sierra Nevada for food, medicine, and other household and occupational purposes. Collection of special forest products continues in the Sierra Nevada today for many of these same uses. However, new uses for and values toward special forest products have developed. The most frequently collected and most economically valuable products are in decline while many "minor" products are either emerging or increasing. Some of these products may be intensely valued by particular sociocultural user groups even disproportionately in relation to both the amounts harvested, economic value received, and ecological impacts on the landscape. Conversely, the collection of other special forest products may have unanticipated ecological or socioeconomic consequences depending on past, present, and future conditions of removal, including harvesting pressure. Management options for special forest products include adequate support for special forest product management programs; consistent regionwide reporting of administrative data from these programs; collection of ecological plant association data on key products; and the collection, linkage, and monitoring of administrative, ecological, and sociocultural and economic data as part of forest management systems.



KEYWORDS: Forests and forest lands, ethnobiology, biodiversity, resource administration, special forest products.

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# INTRODUCTION

## The Issue

Special forest products are also referred to as "miscellaneous", "minor", "nonconvertible", or "nontimber" products. In categorizing the products gathered or collected from U.S. national forests, the USDA Forest Service (Forest Service) has defined special forest products as those resources "sold, gathered, or collected from the National Forest System. There are four lists: Plants, Animals, Minerals, and Aquatic Resources" (USDA Forest Service 1994). More narrowly, the Forest Service has defined special forest products as those products constituting or deriving from "trees, shrubs, forbs, non-vascular plants, fungi and micro-organisms that live in forest or grassland ecosystems" (USDA Forest Service 1995). In this assessment, the broad definition was considered for data parameters while the more narrow vegetative definition was used as the assessment focus.

Use of special forest products is diverse, including "aromatics; berries and wild fruits; chips, shavings, excelsior, sawdust, bark, and pine straw; cones and seeds; cooking wood, smoke wood, and flavorwood; decorative wood; forest botanicals as flavorings, medicinals, and pharmaceuticals; greenery and other floral products; honey; mushrooms; nuts; recreation and wildlife; specialty wood products; syrup; and weaving and dyeing materials" (USDA Forest Service 1993, 7). Broadly speaking, however, special forest product use generally falls under five general areas: food, herbs, medicinals, decoratives and specialty items" (USDA Forest Service 1995). All past and potential uses of special forest products were considered in this assessment.

Importance of Special Forest Products

In the northern coastal forests, central Cascades, and western Rockies, the special forest product industry is well-developed. It has been estimated that the floral green and Christmas ornamental trade alone generated almost $130 million in product sales in 1989 while the 3.94 million pounds in wild edible mushrooms gathered in 1992 provided an estimated 10,400 harvesters with just over $20 million in income (Schlosser and Blatner 1994). The economic value of the special forest product industry in the Sierra Nevada is unknown but its potential worth might be compared to not only the economic value of the Pacific Northwest special forest product industry but relative to that of the Sierra Nevada wood product industry as well, e.g., Forest Service revenue sharing to schools and counties in 1991-92 in Sierra Nevada counties totaled just under $31.7 million and about 15,400 workers were employed full-time in logging, sawmilling, and wood remanufacturing (Wildland Resources Center 1994). [1]

Consumer demand for special forest products is characterized by seasonal market dynamics. The Bureau of Land Management (BLM), which administers extensive public forest land in western Oregon and Washington, notes that consumer demand for many special forest products such as cedar boughs seasonally fluctuates, while other products such as chip and cull logs are cyclic according to the market price (USDI Bureau of Land Management 1993). Consumer demand for minor products is also differentiated by regional variation. In western Oregon, consumer demand for minor products increases the

[1] Sierra Nevada counties included Shasta, Tehama, Lassen, Plumas, Sierra, Butte, Yuba, Nevada, Placer, ElDorado, Amador, Calaveras, Alpine, Tuolumme, Mariposa, Madera, Fresno, Tulare, and Kern.

further south one goes in the state with most BLM forest product consumers seeking firewood (USDI Bureau of Land Management 1993). Finally, harvester demand for special forest products varies by ethnicity. In northern California and southwestern Oregon, Southeast Asians represent at least half the number of wild mushroom harvesters (Richards and Creasy in press) while on the eastside, Hispanics appear to dominate the cutting of juniper floral green in eastern Oregon and Caucasians control lichen rock removal (Richards in press).

However, much is unknown about the special forest product industry, even in the Pacific Northwest where the floral green segment alone is a million dollar enterprise (Schlosser, Blatner, and Zamora 1992). Although expansion of the special forest product industry may provide critical jobs in many rural Northwest communities, these jobs are typically accompanied by low wages and "few if any" benefits so that the rural development benefits of the industry may offer only mixed blessings (Schlosser and Blatner 1994). Little socioeconomic information has been collected about the value of special forest products to the landowner, the income which people earn in the special forest product industry, and the distribution channels for plants collected in the "other edible and medicinal" segment of the industry (Schlosser and Blatner 1994). In addition, gathering conflicts between traditional, recreational, and commercial harvesters have resulted since ethnic diversity within the special forest product industries has increased and different social values attributed to various products have diverged (Richards and Creasy in press).

Finally, very little systematic ecological data collection has been applied to special forest product assessment and management. The most complete assessment to date has focused on the floral green segment of the industry and has concluded that product availability and quality are greatly influenced by forest management practices. Floral green and "more traditional" forest product production is reported to be greatest with intermediate stand practices, uneven-aged management, and other partial cutting approaches while other "specific" floral green plants may actually increase under clearcut, seed tree, and shelterwood regeneration techniques (Schlosser and Blatner 1994). This assessment has been possible because the types and amounts of specific floral green plants have been documented (Schlosser, Blatner, and Zamora 1992). Such information on special forest products is currently lacking for the Sierra Nevada forests.

Public Perceptions, and Special Forest Products

For centuries, Native American tribes gathered various plants on the slopes and in the foothills of the Sierra Nevada for medicinal, ornamental, religious, and culinary uses. Their past and present collection of many native plants and their environmental management to enhance production have been well recorded (Blackburn and Anderson 1993). Nevertheless, as a Miwok ethnobotanical guide to Indian Grinding Rock State Park notes, while many native Californians still use plants in the traditional ways:

> it has become very difficult to do so. The botany of California has changed drastically since the arrival of the Spanish in the 1700s. The meadow area before you, surrounding the huge, centuries old valley oaks is a good example. Introduced European plants, such as annual grasses and yellow star thistle, have

successfully invaded, and for the most part replaced, perennial grasses and other native vegetation. This type of invasion is quite common throughout California. Additionally, pollution of soil, water, and air, loss of plant habitat to development, gathering restrictions on public and prviate lands, and the loss of knowledge as the culture was suppressed by Euroamerican settlers, all make living in the traditional ways today extremely difficult (Harrison 1991, 21).

In contrast, plant collection by non-Native Americans from the Sierra Nevada has received surprisingly little documentation. Spanish residents of the coast considered the range formidable and avoided it. Until the discovery of gold in 1849, only a few hardy travellers made any Sierra Nevada crossings. After the gold rush, the non-Native American inhabitants of the Sierra Nevada depended on mining, logging, and ranching, all of which relied on well-organized camps and well-supplied mule-trains, railroads, and subsequently, trucks, for sustenance. Public perceptions about the daily necessity of miner's grub, the chuck wagon, and the logging camp messhall are probably more accurate historic facts about survival in the Sierra Nevada than are any romanticized assumptions about the wilderness foraging skills of most early settlers, who were often unfamiliar with the terrain and plants (Marks 1994). Nevertheless, miners and settlers alike relied on many native California plants for medicinal aid and a seasonal respite from daily diet (Westrich 1989).

With the railroads and improved roads, the recreational industry of the Sierra Nevada slowly grew around the establishment of early resorts and summer homes (Storer and Usinger 1963). Since the late 1940s, urban development has expanded throughout

the foothills and the recreational industry is well established in the high country. All of these developments have depended on supplies imported from outside the Sierra Nevada in exchange for timber, gold, and other traditional resource exports, and more recently, in situ amenity values. Hence, throughout the post-1849 period, special forest product harvesting has not played a significant economic role for non-Native American residents of the Sierra Nevada. This is in marked contrast to the coastal mountain communities of southwestern Oregon and northwestern California where special forest product gathering has not only been a subsistence but an important economic activity since at least the middle part of this century (Robbins 1988; Kunkler 1975; Richards in press).

Despite the fact that special forest product harvesting has not played a major economic role in the non-Native American settlement of the Sierra Nevada, it has nonetheless been an important cultural activity in for Sierra Nevada community life since ethnicity and different community traditions have played an important role in what products have been gathered. Despite its relative unimportance as a historic economic activity, special forest product harvesting may present future development opportunities for not only Sierra Nevada rural residents (Mater Engineering 1993), but for commercial harvesters outside the Sierra Nevada who might shift some of their current harvesting from the Pacific Northwest and northwestern California (Richards and Creasy, in press) to the Sierra Nevada.

Sierra Nevada Ecosystems and Special Forest Products

The physical features, climatic factors, and forest community types of the Sierra Nevada play the major role in determining what products are gathered and in what

amounts. Special forest products are gathered in the Sierra because of natural supply first and foremost. Because ecological conditions in Sierra Nevada forests differ greatly from those in the Pacific Northwest, a particular product like bolete (*Boletus* spp.) mushrooms may be gathered from a Sierra Nevada forest in August even if market demand is greater for another species of mushrooms such as chantrelle (*Cantharellus* spp.) or matsutake (*Tricholoma magnivelare*) mushrooms, which do not generally grow in the Sierra Nevada. Other special forest products like morel (*Morchella* spp.) mushrooms do occur in both Pacific Northwest and Sierra Nevada forests but may not grow in abundance. Anecdotal reports indicate that the drier climate and lower latitudes of the Sierra Nevada generally constrain the supply and season for morels relative to the Northwest forests. Mushroom pickers claim that for the Sierra Nevada, morel production is greatest, and most commercially viable, only following fire. These ecological and economic interactions play important roles, when seasonal and regional fluctuations in market demands (especially in expanding markets) coincide with natural production. Hence, future harvesting pressure for particular special forest products may increase in the Sierra Nevada, as illustrated by the case of morel collection following the Cleveland Fire of 1992 on the Eldorado National Forest. When such events do occur, both public and private forest mangers have to increasingly consider special forest product production in administering different ecosystem management practices and implementing or controlling different disturbance regimes like fire or timber harvest. Despite the fact that special forest product harvesting is illegal in national parks, national park managers also need to understand what products occur within park boundaries and which may be subject to

periodic harvesting pressure, especially where supply may not warrant gathering. Documenting which products are most frequently collected and in what amounts is therefore the most critical initial step toward assessing the ecosystem management implications of special forest product harvesting in the Sierra Nevada.

## KEY QUESTIONS

In the spring of 1994, I proposed to document which special forest products are harvested from the Sierra Nevada and in what amounts study by surveying national forests in the Sierra Nevada on special forest product use. In June 1994, the Sierra Nevada Ecosystem Project (SNEP) Coordinating Committee requested that a special forest product database also be developed for the Camp Creek watershed on the Eldorado National Forest as a special watershed-based case. Following funding in August 1994, my initial fieldwork indicated that little if no special forest product collection occurred in the Camp Creek watershed except for firewood. In October 1994, the SNEP Coordinating Committee redirected the final assessment to focus on the Eldorado National Forest as a case study of special forest product use and to generally survey the other Sierra Nevada national forests. Assessment goals were to ascertain regional current and historic trends and to identify concerns and issues in special forest product use. Because other SNEP projects were focused on Native American issues, the assessment was limited to nonNative American special forest product uses. Within the limited scope of the case study and the general survey of the national forests, the key questions which were addressed in the final assessment were:

1. What has been the historic pattern of nonNative American special forest product collection?
2. What special forest products are currently collected from the Sierra Nevada national forests?
3. What are the trends in current special forest product policy and management and do they affect special forest product collection?
4. How can information from this assessment inform policy choices for ecological sustainability of special forest products and the implications of those choices for ecological, social, and economic conditions?

## BACKGROUND

One of the most important gaps in our existing records about special forest product harvesting in the Sierra Nevada is the extent to which plants and other products have been collected by non-Native Americans since 1849. Few historical records note nontimber forest product collection, and the few which do primarily concern food and medicines. Similarly, little if any information exists about the state of current special forest product harvesting in the Sierra Nevada. This assessment is to the best of my knowledge the first attempt to systematically describe historic and current patterns of special forest product harvesting in the Sierra Nevada forests.

### What is Known About Special Forest Products in the Sierra Nevada

Plants were gathered by early California settlers for enjoyment, medicine, food, and household use. Wild flowers were picked for bouquets just as they are today. However, settlers also gathered various plants that grow wild in the Sierra Nevada high

country and foothills. These plants were eaten as food, employed in work and household chores, and used as medicines for internal ailments, snakebites, lice treatments, poison oak or rheumatism balms, wound poultices, and many other ailments.

Although they were new to California, settlers often recognized native California species from eastern North American or European related species which provided old remedies. Some settlers subscribed to the tradition of herbal medicine known as the Doctrine of Signatures, which holds that

> every single medicinal plant on the face of Mother Earth comes bearing a sort of 'signed statement' as it were, which plainly reveals its potential uses to whoever takes the time to read it. So it goes with Barberry. Its golden wood (from which the pious Spaniards used to fashion crucifixes) is quite plainly its signature. It's the yellowest of golden yellows; yellow is the tint of jaundiced flesh; hence, here's an herb meant to treat an ailing liver (Westrich 1989).

Others read or heard of the teachings of the well known apothecary, Nicholas Culpepper, whose herbal teachings were widely known (Westrich 1989). Some settlers also learned new uses for the new, unfamiliar species from their Native American or Spanish neighbors. A representative list of these native California plants is shown in table 1 (from Westrich 1989; Storer and Usinger 1963 and referenced from Hickman 1993).

Table 1
**Some Native California Plants Gathered from the Sierra Nevada by Settlers**

| Common Name | Scientific Name | Major Product Use |
|---|---|---|
| Alder | *Alnus* spp | Medicine |
| Angelica | *Angelica* spp. | Medicine |
| Arrowhead or wapato | *Sagittaria latifolia* | Food |
| Barberry or Oregon grape | *Berberis repens* | Medicine |
| Bearberry | *Arctostayphylos uva-ursi* | Medicine |
| Blackberries | *Rubus* spp. | Food |
| Bluecurls | *Trichostema* spp. | Tea |
| Bracken fern | *Pteridium aquilinum* | Medicine |
| California laurel | *Umbellularia californica* | Insecticide, tea |
| Canchalagua | *Centaurium venustum* | Medicine |
| Cascara or buckthorn | *Rhamnus purshiana* | Medicine |
| Cattail | *Typha latifolia* | Bandages, diapers |
| Clover | *Trifolium* spp. | Medicine |
| Cow parsnip | *Heracleum lanatum* | Medicine |
| Gray or foothill pine | *Pinus sabiniana* | Tea |
| Elderberry | *Sambucus* spp. | Food |
| Figwort | *Scrophularia* spp. | Balm |
| Gooseberry | *Ribes* spp. | Food |
| Gumplant or tarweed | *Grindelia* spp. | Medicine |
| Horsetail rush | *Equisetum* spp. | Medicine |
| Hound's tongue | *Cynoglossum* spp. | Medicine |
| Juniper | *Juniperus* spp. | Medicine |
| Larkspur | *Delphinium* spp. | Lice treatment |
| Milkweed | *Asclepius* spp. | Medicine |
| Miner's lettuce | *Montia perfoliata* | Greens |
| Mint | *Mentha arvensis* | Tea |
| Mountain bee plant | *Cleome serrulata* | Bee attractant |
| Mountain pennyroyal | *Monardella odoratissima* | Tea |
| Mugwort or wormwood | *Artemisia* spp. | Medicine |
| Oregon ash | *Fraxinus latifolia* | Medicine |
| Pigweed | *Chenopodium* spp. | Greens |
| Plantain | *Plantago* spp. | Poultice |
| Sage | *Salvia* spp. | Medicine |
| Serviceberry | *Amelanchier alnifolia* | Food |
| Sierra plum | *Prunus subcordata* | Food |
| Soap plant or amole | *Chlorogalum omeridianum* | Soap |
| Toyon | *Heteromeles arbutifolia* | Christmas green |
| Tule or bullrush | *Scirpus acutus* | Thatch |
| Western raspberry | *Rubus leucodermis* | Food |
| Wild grape | *Vitis californica* | Food |
| Wild onions | *Allium* spp. | Food |
| Wild rose | *Rosa* spp. | Medicine |
| Wild strawberry | *Fragaria californica* | Food |
| Willow | *Salix* spp. | Medicine |
| Yarrow | *Achillea* spp. | Poultice |
| Yerba santa | *Eriodictyon californicum* | Tobacco, medicine |

In addition to the native plants, settlers also gathered nonnative, introduced plants. Some of these are shown in table 2 (from Westrich 1989; Storer and Usinger 1963 as referenced from Hickman 1993).

Table 2
Some Nonnative California Plants Gathered from the Sierra Nevada by Settlers

| Common Name | Scientific Name | Major Product Use |
|---|---|---|
| Chicory | *Cichorium intybus* | Medicine |
| Curly dock | *Rumex crispus* | Medicine |
| Fennel | *Foeniculum vulgare* | Medicine |
| Groundsel | *Senecio vulgaris* | Medicine |
| Mallow | *Malva* spp. | Medicine |
| Milk thistle | *Silybum marianum* | Medicine |
| Mustard | *Brassica nigra* | Medicine |
| Nettle | *Urtica dioica* | Medicine |
| Queen Anne's lace | *Daucus carota* | Medicine |
| Shepherd's purse | *Capsella bursa-pastoris* | Medicine |
| Storkbill | *Erodium cicutarium* | Medicine |
| Sweet clover | *Melilotus* spp. | Medicine |
| Teasel | *Dipsacus* spp. | Medicine |

Even before the gold rush of 1849, native California plants were collected not only for household use but for commercial sale. The Sierra Nevada foothill plant chia (*Salvia columbariae*), which is also widespread throughout coastal California chaparral, was valued for its seeds as both food and medicine. By 1849, chia seeds were selling by Los Angeles traders for as much as eight dollars a pound (Westrich 1989), a fortune by today's standards and certainly comparable to the twenty-six dollars a pound for which fresh morel mushrooms were being sold in Berkeley in May, 1995!

Other native California plants were valued by American settlers as much as the Spaniards and Native Americans. Such was the case of the common Sierra Nevada

foothill soap plant (*Chlorogalum pomeridianum)* which Kentucky journalist Edwin Bryant, who came to California before the gold rush, enthusiastically mentioned:

> "The botany and flora of California are rich, and will hereafter form a fruitful field of discovery to the naturalists", wrote Bryant. "There are numerous plants reported to possess extraordinary medical virtues. The 'soap plant' (Amole) is one which appears to be among the most serviceable. The root, which is the saponaceous portion of the plant, resembles the onion, but possess the quality of cleansing linen equal to any 'oleic soap' manufactured by my friends Cornwall & Brother of Louisville, Ky" (Westrich 1989, 8).

In some cases, native plants actually did prove commercially valuable. Barter and trade in medicinal herbs was a common practice among Spanish Californians (Westrich 1989) and some plants in particular were important commercial products. A good example is canchalagua (*Centaurium venustum*). Growing from Plumas County southward and common in and near Yosemite Valley, canchalagua is

> unmentioned in modern herbals but was once the talk of California, an old stand-by cure-all to the Indians, the prized panacea of every Spaniard's household, often found hanging in bunches from the hacienda rafters. Here was a commodity in great demand, often coveted, always sought, sometimes traded--even begged for and sent all the way to the Polynesian Islands, where it was eagerly awaited by Spaniards and Americans living in that distant land. Edwin Bryant noted that Californians viewed Calchalagua as "an antidote for all the diseases to which they are subject , but in particular for cases of fever and ague" (Westrich 1989, 23).

During the gold rush, wild plants, some of which are also native to the Sierra Nevada, were collected on the trail to California, often by women whose responsibility it was to keep the family healthy.

> Many herbs and roots were gathered as the overlanders came upon them during their journey. If the time of year was right, herbs such as the mullein plant were collected and made into candy and tea to ward off the bitter winter cold. Horsemint and catnip were gathered by rivers and used for stomach complaints. In late fall, dried sunflower stalks were gathered and used to supplement the fuel supply. In early spring and summer there might be yellow tansy mustard (*Thelesperma trifidum*), pigweed (*Amaranthus*), and peppergrass (*Lepidium montanum*) to gather and cook for greens (Wittmann 1994, 55).

Men, too, collected plants both on the trail and after arrival in California, particularly for medicinal purposes and most commonly, from all accounts, when women were not available to gather.

> In the case of injury or illness, prospectors searched out and collected medicinal plants. Soft turpentine from pine trees was used to coat cuts and wounds. Spruce bark tea became a popular anti-dyspeptic and scurvy treatment...(Marks 1994, 237).

Such an early California male collector was Sutter's Fort resident, Heinrich Lienhard. Lienhard was a Swiss immigrant who traveled to California in 1846 and wrote lengthy descriptions of his experiences. His notes illustrate the dependency of early miners on their Sierra Nevada foothill flora for medical relief:

> Once when Thomen stopped on his way back from the mines, ... he was so sick that I made him a tea brewed from the roots of the California Ash. He believe it would cure him, and it did make him well (Westrich 1989, 95).

Native Sierra Nevada plants were particularly valued as dietary supplements by early Sierra Nevada settlers, who even used the needles of the gray, foothill or digger pine (*Pinus sabiniana*) to combat scurvy.

> The settlers also visited the Digger Pine now and again for a store of its stiff gray-green needles from which to make a medicinal tea, an infusion reputed to prevent scurvy and/or serve as a mild diuretic. Insofar as it furnished leaves for this potion, the Digger Pine was no different than any other California pines or spruces or firs; they all had needles that served this purpose well. This was a fact which many miners, living in mortal fear of scurvy, were quick to take to heart. One such adventurer made a point of mentioning his first needle tea in a journal he penned about life in the California mines. "Had this evening spruce or fir tea for the first time," he wrote. "Some use it daily as a preventative of scurvy. It had to me not a very pleasant taste but think it is healthy. It makes a colorless tea, looks like water" (Westrich 1989, 38-39).

While some native plants were gathered for necessary medical uses, other plants were often collected as a welcome, even joyous escape from the hardships of daily pioneer life. In his 1846 diary, Lienhard wrote that on his long anticipated trip to Sutter's Fort he became distracted by gathering wild blackberries.

> It was not long before the road swung toward the left and curved past a clump of willow on the bank of the American Fork where I saw some blackberry vines. Hungry for fresh fruit, I stopped long enough to pick a handful of these luscious berries. Unfortunately, they stained my best suit, which I was wearing in honor of the occasion; it took me a long time and a considerable amount of scrubbing with cold water dipped out of the river to get it clean again. But the fruit was unbelievably delicious (Westrich 1989, 14-15).

While blackberries are widely reported to have been gathered, other wild foods were also collected from the Sierra Nevada by early settlers. For example, "black" raspberries and wild strawberries were gathered from the forests above Placerville, as witnessed by the name of the general area known as Strawberry where early Placerville residents went every spring to pick wild strawberries (Denis O'Rourke Witcher, Museum Director, Eldorado County, personal communication, 16 June 1995).

Angloamerican settlers were not the only newcomers to California to collect native plants from the Sierra Nevada. Newspaper articles from the 1800s mention that the Chinese and Italians gathered wild mushrooms from the Sierra Nevada (Denis O'Rourke Witcher, personal communication, June 16, 1995). The Chinese also cultivated native California arrowhead (*Sagittaria latifolia*) on the islands of the Sacramento and San Joaquin delta and "ate the tubers under the name of tule potato" (Storer and Usinger 1963, 66).

Although early settlers did not gather many of the staple plant foods which Native Americans used (such as acorns), they did harvest some native plants which Native

Americans also valued. The result was sometimes conflict as Mary Stuart Bailey, a pioneer woman in Amador County noted in her 1852 diary:

> Weather charming. Went out today to gather grapes to eat. Very fine. The stream on which we are is dry, rightly named Dry Creek. Went to gather grapes before the Indians got them all. Gathered about a bushel and intend drying some (Myers 1980, 90-91).

The native resources of the Sierra Nevada were not only valued for medicine and food by the early settlers but for many other uses. Firewood was obviously cut and gathered, and settler livelihoods depended on being able to cut posts and rails for fences and corrals and to shape working implements and household utensils from roundwood. The winter holidays depended on Christmas trees and bough greenery. Masonry for fireplaces and even cabins required the collection of local rocks. While many such forest resources were undoubtedly collected, few have been documented. Nevertheless, as the legacy for native food and medicinal plants indicates, California settlers undoubtedly depended on many special forest products both familiar and unknown to us today.

Data Limitations and Information Needs

Special forest product collection continues in the Sierra Nevada today but by a wide range of consumers. Some harvesting is for incidental use while other gathering is carried out for commercial, cultural, or recreational purposes. Anecdotal evidence indicates that considerable ethnic and regional variation exists in what products are collected and by whom. It appears that some historical patterns of special forest product continue while others have changed. For example, residents' dependence on Sierra

Nevada plants for medicinal purposes has obviously declined since the 1800s but it has not disappeared. While some individuals may gather medicinal plants in the Sierra for their personal use just as miners and settlers did a century and a half ago, most medicinal plants are more likely to be gathered by herbalists who conduct plant tours or offer seminars and workshops. The degree to which commercial harvest of native Sierra plants for the herbal or pharmaceutical market occurs is unknown since, as other researchers have noted, data on these industries are extremely difficult to obtain (Schlosser and Blatner 1994).[2]

Changes in special forest product harvesting would not be unexpected given the land tenure shifts in the Sierra Nevada and the growth of population in California since 1849. It is well documented that the loss of control over their native lands to private landowners and public agencies has contributed to the limitations on Native American forest product collection (e.g., Blackburn and Anderson 1993). However, it is not clear to what extent land consolidation in the Sierra Nevada and the expansion and diversity of California's residential population may have also constrained special forest product collection by nonNative Americans. Although product collection probably occurs on small private tracts, such collection is unlikely to be significant in temporal and spatial terms on the larger landscape. Similarly, while small-scale collection may be culturally important, it is unlikely to have great commercial impact on Sierra Nevada communities if it is confined to household or incidental use.

[2] Several calls were made to Bay Area and Los Angeles companies which specialize in developing pharmaceutical products from known medicinal herbs and forest plants, but data could not be obtained.

The collection of products from large areas of public and private land, however, may be significant today in ways that forest product collection of yesteryear was not. This has long been recognized by the Forest Service which has issued permits to individuals seeking to gather forest products since the turn of the century. Hence, permit trends may reflect cultural and social patterns of special forest product harvesting, which in turn may have both direct and indirect social and ecological impacts on Sierra Nevada forests. These potential social and ecological trends have in part been recognized by past and existing forest management policies, which have attempted to address minor product harvesting through regulation.

Conflicting policies for special forest product management on national forest lands extends to the Forest Reserve Act of 1891 and the Forest Management Act of 1897. The 1891 preservation act mandated the protection of forest resources while the 1897 act insured their availability to the greatest number of people possible. In attempting to specify how the Forest Service should uphold the two acts and the conflicting principles of preservation and use, Gifford Pinchot, first national forester of the Forest Service, issued *The Use Book* of 1905 (published in 1906) in which he instructed that

> The timber, water, pasture, mineral, and other resources of the forest reserves are for the use of the people. They may be obtained under reasonable conditions without delay. Legitimate improvements and business enterprises are encouraged. Forest reserves are open to all persons for all lawful purposes. Persons who wish to make any use of the resources of a forest reserve for which a permit is required should consult the nearest forest office (USDA Forest Service 1906, 11).

In establishing the permit system, the Forest Service was obliged to recognize the legal claims of those with title to lands within the forest reserves but was also given the jurisdiction to grant special privileges in the form of "applications for permission to occupy or use lands, resources, or products of a forest reserve" including "the purchases of sand, clay, gravel, hay, and other forest reserve products" (USDA Forest Service 1906, 27-28). As a designated "special privilege," forest product permits could be issued "unless otherwise specifically fixed by regulation" and "may be granted by the Forester for any term consistent with forest reserve interests" (USDA Forest Service 1906, 29). In issuing the permit, the Forester (later the ranger or district ranger) was expected to charge reasonably for the permit and to submit all payments to the "Special Fiscal Agent, Washington D.C." or the national office. Finally, in administering permits, forest officers were reminded by Pinchot that they were

> servants of the people. They must answer all inquiries concerning reserve methods fully and cheerfully, and be at least as prompt and courteous in the conduct of reserve business as they would in private business.. Information should be given tactfully, by advice, and not by offensive warnings (USDA Forest Service 1906, 18).

However, when tact and information fail and permit violations occur, "all forest officers are directed to be vigilant in discovering violations of forest reserve laws and regulations and diligent in arresting offenders" (USDA Forest Service 1906, 92).

Little has changed since the turn of the century. District rangers are still charged with carrying out these competing policies of serving the public, enforcing the law, and

returning the receipts to Washington, D.C. Because the districts are not allowed to retain the receipts for administering special forest product permits, few financial resources exist to administer special forest product management. Currently, permits special forest products are written out by hand rather than entered on computer. Hence, no automated databases currently exist to systematically track and analyze types and amounts of products harvested. Permit records are maintained at both the district and the forest level in order to account for permit receipts to the national office. Thus, permits are stored only until annual audits are completed and then discarded.

Because of the limitations of the national forest permit system for nontimber products, our current knowledge of special forest product gathering is limited not only by the lack of historical records but by current constraints on available data. In California, large private corporations like Georgia Pacific also issue permits for the collection of special forest products, but these are not maintained in an automated database and often do not designate the particular product for which the permit is requested. Most Georgia Pacific permits are issued only for hunting and fishing, and in the last decade fewer than 20 have been written for collection of special forest products like cones or mushrooms. In addition, only employees and customers are allowed to cut firewood (Angie Pasazza, Resource Department, Georgia Pacific Corporation, 28 June 1995).

Given these data limitations and information needs, this assessment aimed to systematically analyze current special forest product permit records for national forests in the Sierra Nevada. Trends in types and amounts of special forest products gathered and special interests and concerns about collection were examined.

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## METHODS

Because historic trends in special forest product harvesting appear to have shifted in the last century, this assessment aimed to provide descriptive quantitative and qualitative data for current trends in special forest product collection, particularly by different cultural user groups, across the Sierra Nevada and, especially, from the national forests. It also aimed to examine special concerns and interests as reflected in the case study of the Eldorado National Forest.

### Sierra Nevada National Forest Survey Data

In August 1994, I developed a brief electronic mail (DG) questionnaire that was revised and distributed by cooperators in the Region 6 office in September[5] and sent to the nine Sierra Nevada national forests.[4] The questionnaire requested special forest product permit summary data and anecdotal concerns and information concerning special forest productsAggregate annual data for specific measures were sought including measures on the types of product permitted, the amounts for which the permit was issued, and the fees charged for the permit . Qualitative comments were also requested on the

[5] I would like to especially thank Brian Stone and Anne Bradley for their help.
[4]The nine forests were the Modoc, Lassen, Plumas, Tahoe, Eldorado, Stanislaus, Sierra, Sequoia, and Inyo National Forests.

sociocultural characteristics of permittees and specific concerns about special forest product collection.

Since permits are maintained on a fiscal year (1 October through 30 September) basis, data were requested for the previous four fiscal years (1990 through 1993) since most permit records are saved for a maximum of four years. Because the questionnaire was sent at the peak of fire season and at the start of a new fiscal year, data were not requested for 1994. Forest personnel were asked to complete and return the questionnaire to the regional office by the end of October.

By November 1994 most forests had responded and by January 1995, eight responses had been received.[6] Several forests delegated the data collection to their ranger district offices and others returned questionnaires directly from the forest supervisor's office. Quantitative permit data were compiled from those forests submitting district-level data in a forest-wide summary and all data were entered and analyzed in a database program (Microsoft Access). Qualitative comments about sociocultural user groups and patterns of harvest were reviewed and trends and concerns were summarized.

Limitations and Assumptions of the National Forest Survey

In general, record information is vital for virtually all phases of program evaluation and impact assessment. However, while record information may be adequate for routine administrative functioning, it may not necessarily be sufficiently accurate for program monitoring (Burstein and Freeman 1985). This caveat is even more significant given the fact that the aggregate permit records were obtained indirectly via survey.

[6] Responses were received from all the forests except the Inyo National Forest.

questionnaire. Thus, several limitations exist in using permit records as a measure of special forest product collection activity in the national forests of the Sierra Nevada.

First, permits are only issued to those individuals who take the trouble to seek them and do not reflect unpermitted gathering. The degree to which forest users comply with national forest regulations to secure a permit for special forest product collection is unknown.

Second, it must be assumed that the permit data reported in the survey reflect all the permit records from every district in every forest. Because permits are usually issued and regulated from the district office, forests for which incomplete district data were received may not be adequately represented or missing districts may not have issued special forest product permits.

Third, both types and amounts of special forest products vary by code and unit of measure. For example, biomass may reflect green or dry biomass and may otherwise be reported as cull logs or saw logs. In addition, biomass permits may be issued in units of tons, cubic feet, cunits, or even pickup loads. Much of the challenge in compiling the permit record data for the eight Sierra Nevada forests was in tracking the different categories for any given product and its unit of measure.

Fourth, even though a permit may be issued for an amount as large as 500 tons, it is not necessarily the case that 500 tons was actually harvested. Similarly, no data are available to determine whether any permitted amounts of a product were exceeded.

Finally, different forest personnel encounter different aspects of managing special forest product use so that information gaps often exist. Many permits are issued through

the district or forest timber management office via the reception desk. However, specific concerns about ecological impacts for any given product may be raised to the forest botanist, ecologist, or archaeologist rather than the office which maintains or issues the permit records. Because of the number of office networks and functions, information concerning special forest product use may not be transmitted to those completing the survey questionnaire for the regional office.

Special forest product permits are issued according to national forest boundaries and usually, for only select areas within each forest. For example, firewood collection may be allowed only in areas where timber has been harvested and only for dead and down logs. In addition to this spatial variation within the forest, collection areas may vary temporally from year to year. Even if individual collection maps (often attached to a product permit) were available for the years studied, the limitations of time and funding would not allow for such data to be collected. Furthermore, one would have to assume that permittees collect in only designated areas, which may or may not be true for any given product on any given forest.

Finally, special forest products are generally assessed by forest community habitat type rather than by watershed drainage boundaries (Schlosser and Blatner 1994). Hence, it is not possible to systematically extrapolate from the data used for this study to the watershed level. Because habitat types shift from north to south, trends in special forest product harvesting can be characterized from the national forest data by gross boundaries of north, central, and south Sierra Nevada subregions. Patterns in collection trends are reflected in the data for the subregional scale of the Sierra Nevada. National forest

boundaries often overlap in terms of ecological community types and gathering practices so that subregional differences become more apparent as the boundaries are aggregated into larger ecological and institutional units.

Because data were only available for a very narrow, four-year period at most, it is not possible to extrapolate to previous years of special forest product gathering in the Sierra Nevada. The limitations of such a narrow window are many given the cycles of drought and flood characteristic of the region and given the rapid pattern of settlement and resulting environmental changes in the last century and a half. Despite these limitations, it should be stressed that this survey is the first systematic compilation and analysis of special forest products across national forests for the Sierra Nevada. As a result, it provides initial baseline data of what products are being collected and by whom for the region.

Eldorado National Forest Case Study Data

For the Eldorado National Forest case study, numerous forest and district personnel cooperated in providing both quantitative and qualitative information.[7] Where the permit survey for the Sierra Forest provided only aggregated permit data, individual permit data were obtained for fiscal years 1991 through 1993 and entered into a database (Mircosoft Access). These data generally included the name and address of the permittee and the type, amount, and price (fee) of the product for which the permit was issued.[8]

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[7] Thanks are extended to Rex Baumback, Bob Jessen, Susan Yasuda, Barbara Rabinsky, Mike Foster, Bonnie Tolbert, Vicki Ethier, Annette Parsons, Joanne Fites, and all the others who helped from the Eldorado National Forest.

[8] For the sake of confidentiality, permittee names and addresses were not analyzed and hence not reported.

Specific measures used from these data included type, amount, and price of product and geographic affiliation of the permittee. Permittee affiliation was obtained by coding permit addresses as to geographic affiliation, i.e., local, regional (Sacramento or Bay Area), or extraregional (North Coast, South Coast, and by state if out of state).

District and forest personnel most frequently reported public and management concerns about mushroom collection on the forest. To identify the nature of these concerns and issues, all public comment letters (n=28 excluding 27 identical form letters) were analyzed, and specific ecological and social concerns were identified from the letters. These concerns were compiled as a coding sheet based on standard content analysis procedures as described in Krippendorff (1980) and Holsti (1969). The letters were then coded by three independent judges, all graduate students of ecology at UC Davis, as to the presence or absence of the concerns. The use of three independent judges is consistent with established content analysis methodology (McCullough 1993). Coded responses were then assigned a single response based on the rating for which a minimum of two out of the three judges agreed. Concerns were then tabulated and graphically analyzed for frequency. In addition, the addresses of the letter writers (n=55 including form letters) were coded for geographical regional affiliation, and the regional affiliations of the letter writers were compared with those of the mushroom permittees on the forest.

In addition to the content analysis of public comment letters, a local commercial mushroom picker who has actively worked with the Eldorado National Forest in developing its wild mushroom policy provided field assistance and background information. Finally, internet messages by representatives of North American

Mycological Society groups provided additional contextual information for understanding wild mushroom harvesting on the Eldorado National Forest.

Limitations and Assumptions of the Eldorado Case Study

The limitations and assumptions of permit data for the regional, aggregate permit data also exist for the Eldorado National Forest individual permit data. These include the assumptions about compliance, completeness, uniformity, and internal validity described above. Individual records were obtained directly from the supervisor's office so that any measure error introduced by obtaining data by survey was avoided. In addition, the qualitative data provided by numerous forest personnel in different functions contribute to completeness and internal validity. However, the problems of compliance and uniformity remain.

Because of geographic location, different user groups may use one particular national forest in ways unique to that forest so that generalizing to the rest of the national forests in the Sierra Nevada is limited. Thus, the Eldorado case study is most limited in its external validity. However, qualitative data provided by the regional survey contribute to the general comparisons for sociocultural user groups and special forest product concerns on the Eldorado National Forest. In addition, the Eldorado case study provides valuable information on at least one commercially valuable special forest product, wild mushrooms, which are gathered annually from western forests as a multimillion industry (Schlosser and Blatner 1994). Thus, this initial assessment is a significant first step in establishing baseline data for future monitoring of special forest product collection in the

Sierra Nevada and for evaluating current management of existing products susceptible to harvesting pressure.

Supplemental Special Forest Product Use Interviews

A limited number of supplemental special forest product use interviews were conducted in conjunction with the Eldorado National Forest case study and the general survey of national forests in the Sierra Nevada. Because of the historical importance of medicinal and food plants and the perception that different commercial and ethnic uses of special forest products in the Sierra now exist, ethnic herbal and pharmaceutical companies and businesses were contacted by phone or through interviews to determine to what extent these enterprises were distribution outlets for special forest products from the Sierra Nevada. In addition, University of California Cooperative Extension (UCCE) personnel who actively worked with different ethnic groups in the central Sierra Nevada counties were interviewed and contributed data to this assessment.[3] These interviews supplemented the review of literature concerning special forest product use in the Sierra Nevada. Data obtained from these sources are referenced throughout this report.

[3] The assistance of Sua Yang, Maria Hernandez, Joanne Sutherlin, Aaron Nelson, and Joanne Ikeda is gratefully acknowledged.

## RESULTS

### National Forest Survey

A wide range of special forest product permits were issued by the national forests of the Sierra Nevada for the four-year period beginning in fiscal year 1990. The quantities of products collected varied greatly, but the units of measure for which the permits were written were exceedingly diverse from forest to forest and even district to district (table 3). Hence, it is not possible to aggregate the total amount of special forest products collected for the time period of the study.

Table 3
Total Amount of Special Forest Products for Which Permits were Issued from National Forests in the Sierra Nevada FY90-FY93

| Forest | *Academic Plants* | Plants |
|---|---|---|
| Eldorado | *Total* | 14 |

| Forest | *Bark* | Pickup Loads | Pounds | Lin Ft |
|---|---|---|---|---|
| Tahoe | | 2 | 0 | 0 |
| Sierra | | 4 | 300 | 0 |
| Sequoia | | 0 | 0 | 2000 |
| | *Total* | 6 | 300 | 2000 |

| Forest | *Bees* | Colonies | Site |
|---|---|---|---|
| Tahoe | *Total* | 300 | 1 |

| Forest | *Biomass* | Tons | MBF | Pickup Loads |
|---|---|---|---|---|
| Modoc | | 83721 | 0 | 0 |
| Lassen | | 0 | 4378 | 0 |
| Plumas | | 8345 | 0 | 0 |
| Tahoe | | 0 | 0 | 2 |
| Sierra | | 0 | 2250 | 0 |
| Sequoia | | 1900 | 0 | 0 |
| | *Total* | 93966 | 6628 | 2 |

| Forest | *Boughs* | Tons | Pieces | Cords | Cu Ft | Lin Ft |
|---|---|---|---|---|---|---|
| Modoc | | 1 | 0 | 0 | 0 | 0 |
| Lassen | | 34 | 0 | 0 | 0 | 0 |
| Plumas | | 1726 | 0 | 0 | 0 | 169 |
| Tahoe | | 17.5 | 1000 | 18 | 0 | 8000 |
| Eldorado | | 0 | 0 | 0 | 2896 | 183 |
| Sierra | | 1 | 645 | 0 | 1534 | 0 |
| Sequoia | | 0 | 0 | 0 | 6700 | 1000 |
| | *Total* | 1779.5 | 1645 | 18 | 11130 | 9352 |

| Forest | *Christmas Trees* | Trees | Lin Ft |
|---|---|---|---|
| Modoc | | 3719 | 0 |
| Lassen | | 38911 | 0 |
| Plumas | | 36484 | 0 |
| Tahoe | | 4280 | 0 |
| Eldorado | | 0 | 6895 |
| Sierra | | 1975 | 160 |
| Sequoia | | 3490 | 0 |
| | *Total* | 88859 | 7055 |

| Forest | *Cones* | Tons | Bushels | Pieces | Sacks |
|---|---|---|---|---|---|
| Lassen | | 220 | 515 | 0 | 0 |
| Plumas | | 0 | 0 | 4341 | 0 |
| Tahoe | | 101.5 | 0 | 33100 | 0 |
| Eldorado | | 0 | 0 | 0 | 771 |
| Sierra | | 0 | 0 | 65000 | 0 |
| Sequoia | | 4 | 0 | 1000 | 7 |
| | *Total* | 325.5 | 515 | 103441 | 778 |

| Forest | *Ferns* | Sacks | Pieces |
|---|---|---|---|
| Tahoe | | 4 | 0 |
| Sierra | | 0 | 2522 |
| | *Total* | 4 | 2522 |

| Forest | *Firewood* | Cords |
|---|---|---|
| Modoc | | 42828 |
| Lassen | | 46630 |
| Plumas | | 58389 |
| Tahoe | | 11071 |
| Eldorado | | 50755 |
| Stanislaus | | 45240 |
| Sierra | | 45559 |
| Sequoia | | 23118 |
| | *Total* | 323590 |

| Forest | *Native American Plants* | Unreported |
|---|---|---|
| Tahoe | | 0 |
| Sierra | *Total* | 0 |

| Forest | *Ladybugs* | Unreported |
|---|---|---|
| Tahoe | | 0 |
| Eldorado | | 0 |
| | *Total* | 0 |

| Forest | *Lichen* | Tons | Cu Ft |
|---|---|---|---|
| Modoc | | 0 | 6000 |
| Plumas | *Total* | 500 | 6000 |

| Forest | *Manzanita* | Cubic Feet | Tons | Lin Ft | Pieces |
|---|---|---|---|---|---|
| Modoc | | 1000 | 0 | 0 | 0 |
| Tahoe | | 0 | 4.5 | 4000 | 0 |
| Eldorado | | 0 | 0 | 0 | 2660 |
| Sierra | | 0 | 0 | 0 | 0 |
| Sequoia | | 1200 | 0 | 21500 | 0 |
| | *Total* | 2200 | 4.5 | 25500 | 2660 |

| Forest | *Mistletoe* | Cu Ft |
|---|---|---|
| Sequoia | *Total* | 20 |

| Forest | *Moss* | Pounds |
|---|---|---|
| Tahoe | | 26 |
| Sequoia | | 67 |
| | *Total* | 93 |

| Forest | *Mushrooms* | Days | Month | Season |
|---|---|---|---|---|
| Lassen | | 1 | 0 | 0 |
| Eldorado | | 0 | 0 | 49 |
| Stanislaus | | 35 | 2 | 0 |
| | *Total* | 36 | 2 | 49 |

| Forest | *Needles* | Pounds |
|---|---|---|
| Sierra | *Total* | 1038 |

| Forest | *Rock* | Tons |
|---|---|---|
| Sierra | *Total* | 1 |

| Forest | *Roundwood* | Pieces | MBF | Lin Ft | Cords | Tons |
|---|---|---|---|---|---|---|
| Lassen | | 1100 | 10 | 0 | 0 | 0 |
| Tahoe | | 455 | 0 | 1188 | 2 | 0 |
| Eldorado | | 2015 | 27 | 0 | 0 | 0 |
| Sierra | | 18568 | 0 | 0 | 0 | 1 |
| Sequoia | | 11051 | 0 | 0 | 0 | 0 |
| | *Total* | 33189 | 37 | 1188 | 2 | 1 |

| Forest | *Sawdust* | Tons |
|---|---|---|
| Sierra | *Total* | 3 |

| Forest | *Seeds* | Pounds |
|---|---|---|
| Tahoe | *Total* | 600 |

| Forest | *Specialty Wood Parts* | Pieces | Tons | Cords | Cu Ft |
|---|---|---|---|---|---|
| Lassen | | 200 | 2 | 0 | 0 |
| Tahoe | | 300 | 0.75 | 52 | 0 |
| Eldorado | | 440 | 0 | 0 | 0 |
| Sequoia | | 0 | 0 | 0 | 200 |
| | *Total* | 940 | 2.75 | 52 | 200 |

| Forest | *Transplants* | Pieces |
|---|---|---|
| Lassen | | 0 |
| Plumas | | 84 |
| Tahoe | | 132 |
| Eldorado | | 100 |
| Sierra | | 566 |
| | *Total* | 882 |

In addition to widely varying units of measures, fee structures by which forests and districts charged for special forest product permits also differed greatly. Some permits were issued for free use and others were issued for a fee. Fees in turn could vary depending on the unit of measure, the year, and whether the permit was being issued to an individual or a nonprofit organization. For example, Christmas tree permits could be issued for free use or could be charged $1 per ft or anywhere from $1 to $10 for a whole tree depending on the permittee, the unit of measure, and the district or forest permit policy.

Because of a consistent unit of measure, dollar amounts for the total number of fees charged can be aggregated. For the four-year period of the study, $3,347,634 was collected in permit fees for special forest products from the eight national forests in the survey. Of this amount, 61% was charged for firewood, 20% was charged for Christmas trees, and 16% was charged for biomass. The remaining 3% of total fees was charged for all other special forest products (table 4).

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Table 4
Total Fees and Total Number of Permits Issued by National Forests in the Sierra Nevada FY90-FY93

| Product | Total Fee ($) | Total Permits (n) | Fee-to-Permit Ratio ($:n) |
|---|---|---|---|
| Firewood | 2,043,613 | 97,249 | 21 |
| Christmas trees | 680,622 | 68,697 | 10 |
| Biomass | 545,231 | 150 | 3,635 |
| Cones | 63,574 | 96 | 662 |
| Roundwood | 4,084 | 206 | 20 |
| Boughs | 3,455 | 252 | 14 |
| Manzanita | 2,112 | 49 | 43 |
| Lichen | 1,225 | 12 | 102 |
| Specialty wood | 1,061 | 23 | 46 |
| Mushrooms | 1,040 | 67 | 16 |
| Transplants | 790 | 47 | 1,681 |
| Bees | 330 | 4 | 83 |
| Bark | 140 | 20 | 7 |
| Ferns | 140 | 2 | 70 |
| Seeds | 105 | 13 | 8 |
| Moss | 72 | 3 | 24 |
| Ladybugs | 30 | 10 | 3 |
| Mistletoe | 10 | 1 | 10 |
| Academic plants | 0 | 14 | 0 |
| Native American plants | 0 | 8 | 0 |
| Needles | 0 | 6 | 0 |
| Rock | 0 | 1 | 0 |
| Sawdust | 0 | 3 | 0 |
| Total | 3,347,634 | 166,933 | 20 |

The minor proportion of fees collected for special forest products other than firewood, Christmas trees, and biomass is reflected in the total number of permits issued for the same period. Because a permit must be obtained not only to collect an initial amount of product but also to collect additional amounts of product once the maximum amount has been collected, permits do not proportionally represent mutually exclusive permittees. In other words, a single permittee may have been issued multiple permits and many or few such permittees may be represented in the total number of permits. Although the total number of permits does not represent the total number of permittees harvesting products, it is a measure of collection activity and hence, with limitations, of amounts harvested. Thus, the total number of permits should be directly correlated with the sum total of permit fees collected for that product. This is the case since the most frequently permitted products, firewood and Christmas trees, together represent 99% of the total number of permits issued (58% and 41% respectively) and 81% of the sum total of fees charged (table 4).

The economic value of permitted special forest products should be reflected in the fee-to-permit ratio since permits represent the amount which each collector can harvest. The fee-to-permit ratio illustrates the value of many "minor" special forest products despite the fact that together, they are worth less than 3% of the total amount of fees for the four-year period (table 4). Biomass is the most valuable product since each permit issued during the period was worth $3,635 of the total amount of product. However, other products such as transplants, cones, lichen, bees, ferns, specialty wood products, manzanita, and moss are all worth more than the mean fee-to-permit ratio of $20.

Firewood is just above average with a fee-to-permit ratio of $21 and Christmas trees are well under average with a fee-to-permit ratio of only $10.

Although the fee and permit aggregate data indicate that firewood, Christmas trees, and biomass are the dominant special forest products collected in the Sierra Nevada, these aggregate data alone do not represent either the sociocultural significance of many minor products nor their economic value to particular individuals, groups, or communities who may rely on these products as a main or supplemental livelihood. The $78,168 in fees for these minor special forest products does not represent the income earned from directly selling the products or from adding further value to them through various production and distribution channels. In addition, the 837 permits issued for these products do not represent the total number of permit requests for *other* products for which permits were not issued. The sum total of permits also does not reflect the amount of unpermitted collection that may have occurred during this period. Finally, all three measures, i.e., amount of fees, number of permits, and fee-to-permit ratio, best represent previous demand rather than present or future demand for special forest products across the Sierra Nevada.

Such representation requires both temporal and spatial data. Temporal trends in demand for products are indicated by the trends in the number of permits issued for each product over the four year period. Spatial trends in demand are indicated by the concentration in the total number of permits issued for each product by each national forest for the period. Products are considered in order of the total amount of fees collected for the four-year period (table 4) and for the national forests reporting data

(table 3). These two measures are considered in the context of qualitative accounts of special forest product harvesting reported in the national forest survey and in interviews.

Firewood

Firewood permits have generally declined on the national forests of the Sierra Nevada since 1990 (figure 1). The greatest amount of firewood has been harvested in the northcentral Sierra Nevada forests including the Lassen, Plumas, Eldorado, and the Stanislaus and in the southern Sierra Nevada on the Sequoia (figure 2). The least amount of firewood has been collected from the Modoc, Tahoe, and Sierra. On all the forests, firewood is cut for both commercial and household use. From north to south, firewood collection patterns vary.

On the Modoc National Forest, primarily local residents cut firewood. Personal use is limited to 10 cords per household and is allowed all year except when fire conditions are high and soil moisture conditions may cause resource damage. To protect wildlife habitat, no snags except juniper (*Juniperus* spp.) and lodgepole pine (*Pinus contorta*) may be cut and wood removal is allowed in designated areas only. In addition to juniper and lodgepole, species harvested include ponderosa pine (*Pinus ponderosa*), white fir (*Abies concolor*) and incense cedar (*Libocedrus decurrens*). Small commercial permits range from 10 to 25 cords maximum with no more than 5 permits or 125 cords allowed per permittee in a given year. On the Lassen National Forest, 10 cords are allowed per household for domestic use. Numerous violations of firewood cutting regulations have been reported. These include cutting wood without a permit, exceeding diameter limits, exceeding the allowable quantities for personal use, cutting live trees,

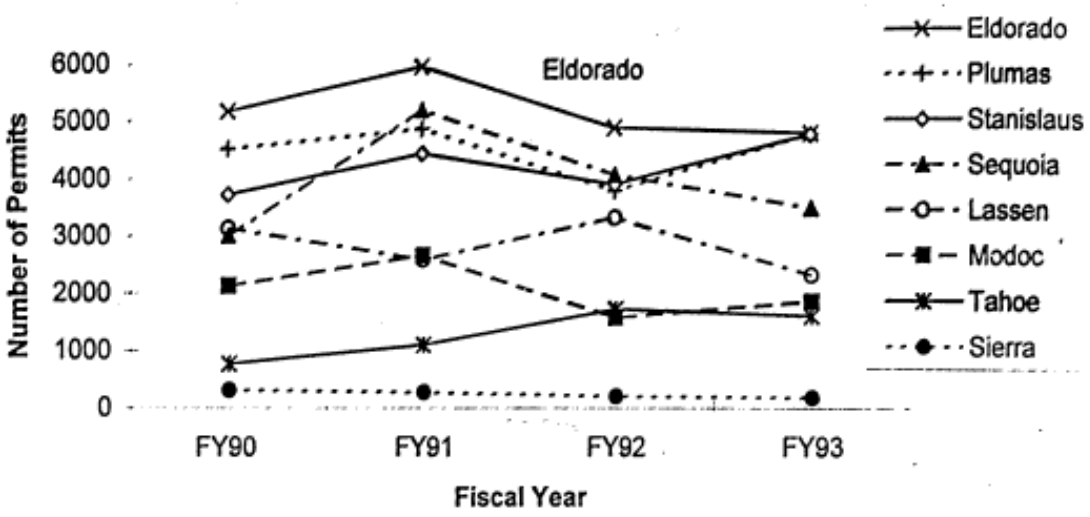


Figure 1
Trends in Firewood Permits by National Forest FY90-FY93

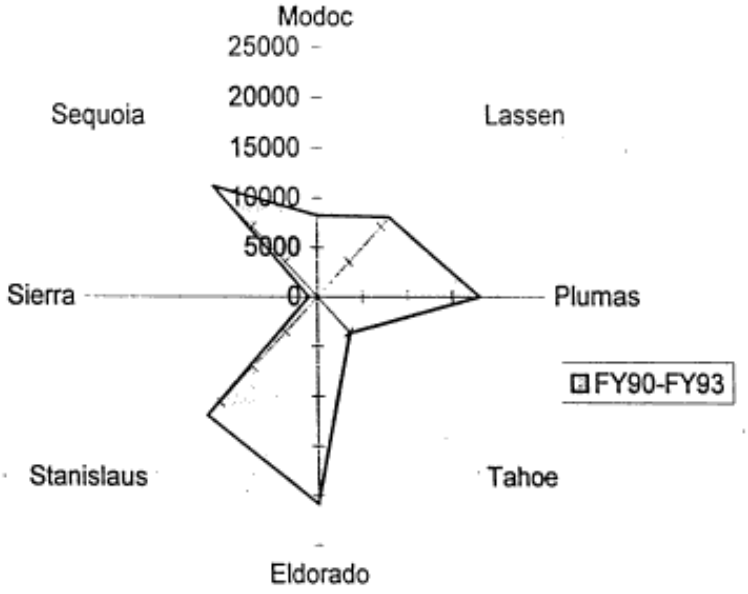


Figure 2
Total Number of Permits for Firewood by National Forest FY90-FY93

and cutting standing hardwood. Conflicts with local Native Americans were noted. As one employee is reported to have said:

> For years, it has been part of their culture to collect and sell wood for the public. Whole families live off this. The Forest Service keeps careful track of 'them' to make sure no one family gets more than 10 cords, no matter how many are in the [extended tribal] family.

On the Eldorado National Forest, almost all firewood is from cull logging decks. Most wood is harvested by local loggers and commercial firewood cutters although some collection, including illegal cutting, occurs for personal use. Commercial firewood may also be sold as pulp, cull, or fuel logs as well as for firewood. Species harvested include hardwoods such black oak (*Quercus kelloggii*), madrone (*Arbutus menziesii*) and manzanita (*Arctostaphylos* spp.) as well as ponderosa pine, incense cedar and white fir. Because firewood can only be collected from dead and down trees and in designated areas, firewood cutting on the Eldorado has declined since 1988 with the reduction in logging. This trend appears to be the case for the other Sierra national forests as well.

Unlike the other Sierra forests, firewood permits on the Sequoia are sold by the cord on a bid basis so prices and amounts vary by permittee. Firewood is collected primarily for heating local homes, particularly since many of the local communities do not have natural gas and would have to depend on relatively expensive propone fuel or electricity to heat their homes if firewood was not available.

Christmas Trees

Despite the large number of Christmas trees harvested from seven of the national forests in the Sierra Nevada, only the three northern forests have each issued more than 25 permits in the last four years (figure 3; see also table 3). The Modoc, Lassen, and Plumas National Forests have all issued thousands of Christmas tree permits in this period (figure 4). The remaining central and southern forests have all sold several thousand trees each but issued fewer than 24 permits on each forest for the same period (figure 4; see also table 3).

The greatest number of permits has been issued by the Plumas National Forest. On the Plumas, Christmas trees have been sold from the clearing limits along roads as part of road maintenance. Christmas tree permits are issued to nonprofit groups like schools and local fire departments for annual fund raising sales. On the Lassen, most Christmas tree permits are purchased by private individuals, nonprofit organizations, and small commercial cutters from the area. Nonprofit groups buy trees at the reduced rate of $1 while small commercial trees range from $0.90 to $3.90 per tree. On the Modoc, a maximum of two trees is permitted per household and each tree requires a permit. Commercial cutting is not allowed, and all trees must be 6 in diameter with stumps no greater than 12 in high. Cutting is allowed anywhere on the forest except within prohibited wood cutting areas, tree plantations, and within 200 ft of campgrounds and roads. Permittees are generally local residents.

On the central and southern forests where only a few permits have been issued, most permittees are nonprofit organizations and commercial cutters. On the Eldorado,

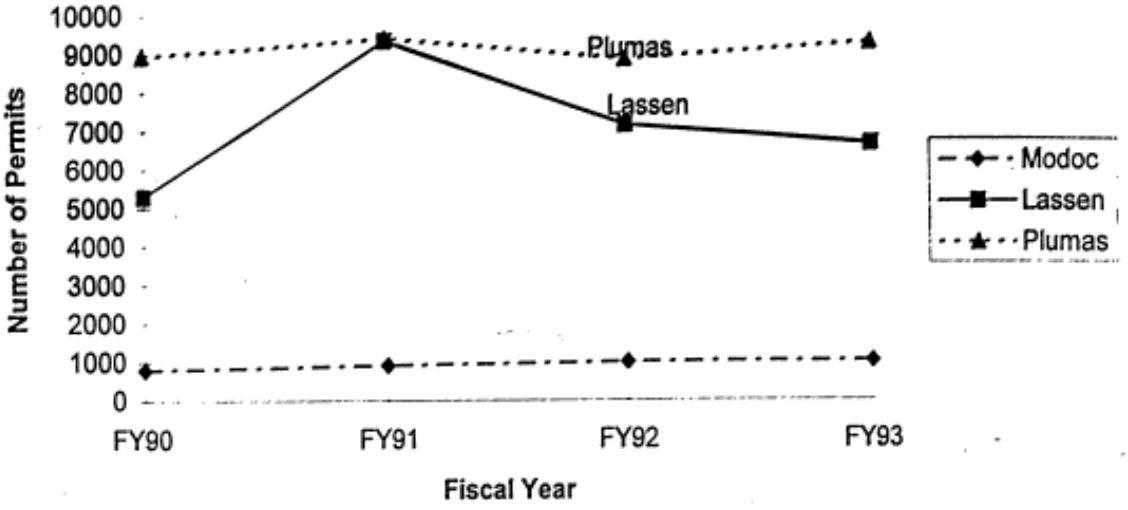


Figure 3
Trends in Christmas Tree Permits by National Forest FY90-FY93

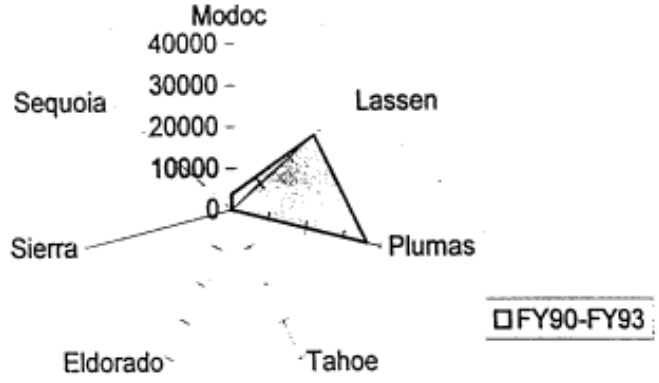


Figure 4
Total Number of Permits for Christmas Trees (n >25) by National Forest FY90-FY93

most permits are issued in logging slash areas, which are declining in number. Some Christmas tree cutting is also done to thin sapling stands. Permit prices vary by the linear foot from $0.30 for red fir (*Abies magnifica*), $0.20 for white fir, and $0.10 for all other species. On the Sierra National Forest, only a few free-use, administrative permits are issued per year to local nonprofit groups including one for the local town tree on one district. Few permits are issued because of silvicultural reasons and time constraints. One employee noted that

> folks are very selective about the trees they want. They are doing us a favor of sorts by helping us thin stands that would otherwise be thinned through service contracts.

On the Sequoia, Christmas tree permits are sold on contracts subject to sealed bids.

Biomass

The sale of biomass permits has been somewhat erratic over the last four years as the cogeneration plant demand for wood chips has been relatively volatile (figure 5; see also table 3). The two northern forests, the Modoc, Lassen, and Plumas, have not only issued the largest number of permits but have also sold the greatest amount of biomass (figure 6; see also table 3).

On the Lassen National Forest, local landowners and small logging operators remove dead biomass from thinning operations, which are cleared for fire hazard reduction, and as salvage. Most biomass is shipped to local cogeneration plants. On the Modoc, cull logs are sold to Oregon and California logging companies as dry biomass. Some districts have issued free permits for thinning salvage biomass, and other districts

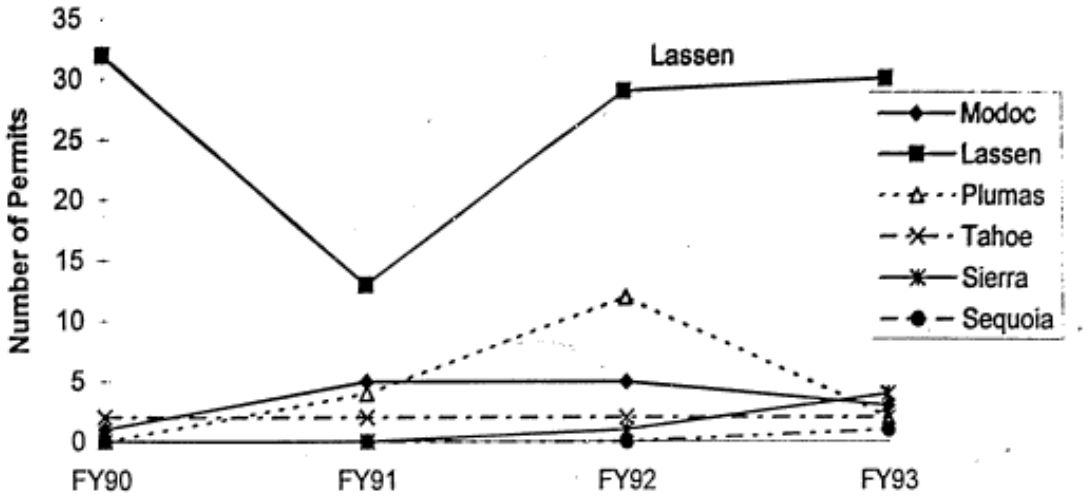


Figure 5
Trends in Biomass Permits by National Forest FY90-FY93

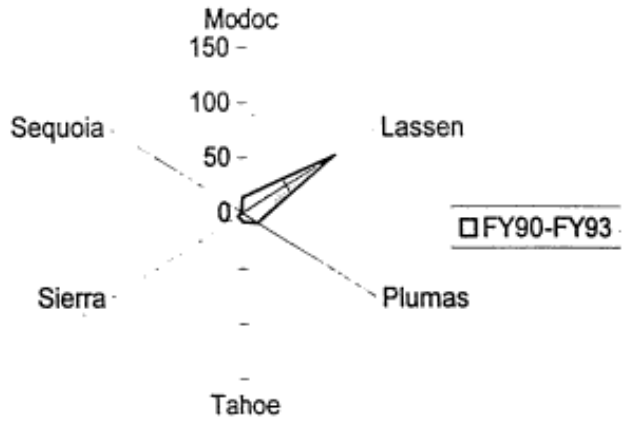


Figure 6
Total Number of Permits for Biomass by National Forest FY90-FY93

have issued thinning service contracts for green biomass, which has been sold as fuel to a local cogeneration plant.

To the south, the Stanislaus National Forest does "not consider biomass to be a special forest product" and did not report biomass permits. On the Sierra National Forest, local contractors buy cull log decks and thinning material as biomass for local cogeneration plants. Some districts would like to accelerate issuing biomass permits to accomplish fuel reduction projects, but the chip market has fallen because four local cogeneration plants closed in 1994.

Cones

While not as economically significant in terms of a net fees as firewood, Christmas trees, and biomass, cones are high in fee-to-permit value (see table 4). In general, permits to gather cones have declined in recent years except on the Sierra National Forest where sugar pine (*Pinus lambertiana*) cone collecting has become commercially more important (figure 7). In general, cones are more important as a minor special forest product on the central forests of the Sierra Nevada (figure 8; see also table 3).

On the Sierra National Forest, most permittees, including local public schools, collect cones for resale. A commercial cone buyer places ads in the local papers to solicit cones for purchase. The Sierra sells cones at $0.01 a piece for 4,000 cones per permit. Sugar pine cones are the most commonly gathered. Cones can only be picked from the ground. Some local residents also collect cones for decorative crafts. On the Sequoia,

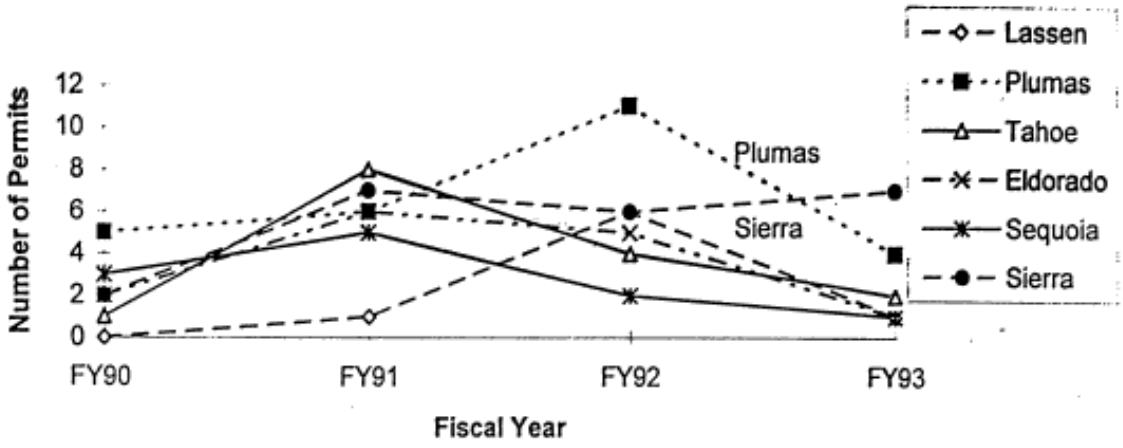


Figure 7
Trends in Cone Permits by National Forest FY90-FY93

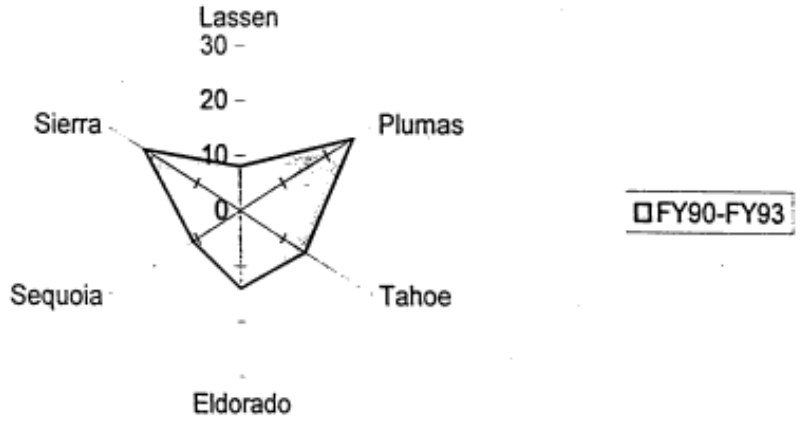


Figure 8
Total Number of Permits for Cones by National Forest FY90-FY93

National Forest, dry cones are collected for Christmas wreaths, and green sequoia (*Sequoiadendron giganteum*) cones are also gathered for resale for seed germination. Although the Stanislaus did not report any permits for cones, the forest does receive "an estimated three or four requests a year for decorative pine cones, which we sell for $1 per 100 lb bag. Actual amounts collected are probably far less than the $10 minimum charge." On the Eldorado, sugar pine cones are the most commonly gathered cones.

To the north, permittees on the Lassen National Forest collect cones for buyers from southern Oregon who then sell them to florists and wreathmakers. On the Lassen, Plumas, and Tahoe forests, local craftspeople also collect cones, particularly lodgepole pine cones, for decorative products such as wreaths.

Roundwood

Roundwood consists of posts, poles, and rails. In general, roundwood permits are limited in number. On the Sierra National Forest, roundwood permits were once in demand but they have declined substantially (figure 9; see also table 3). Most roundwood permits are issued by the Sierra, primarily for incense cedar posts and rails for a state historical park and Native American roundhouses (figure 10). On both the Sierra and Sequoia, post permits are also sold for fencing.

To the north, posts and rails on the Eldorado National Forest are cut from thinning areas principally by ranchers and home improvement users. On the Lassen, posts and poles are collected mainly from dead lodgepole pine and incense cedar trees for fences, corrals, and woodsheds. Problems have been reported with illegal cutting, slash

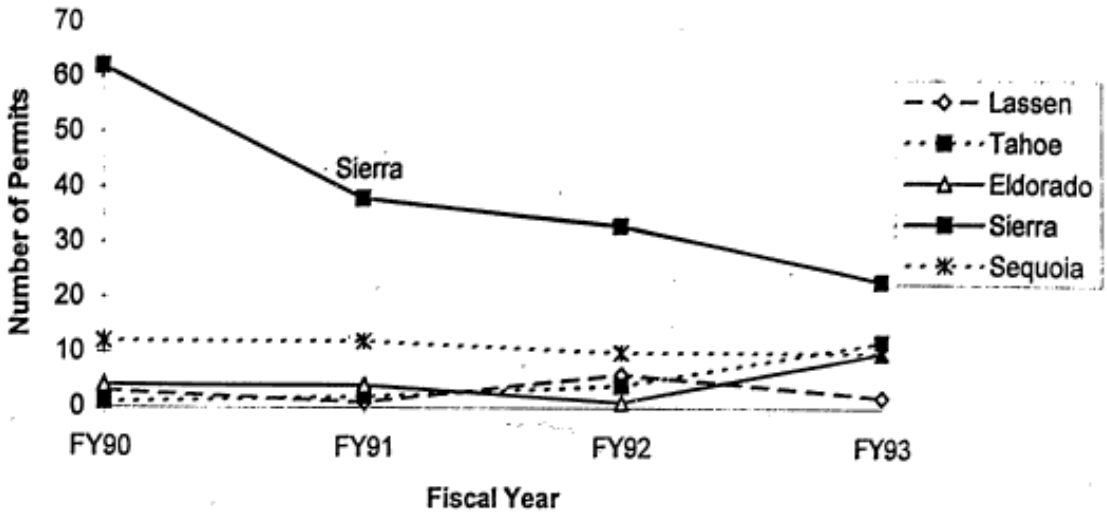


Figure 9
Trends in Roundwood Permits by National Forest FY90-FY93

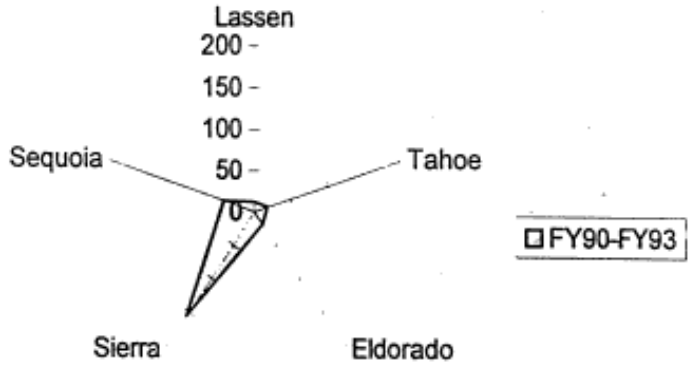


Figure 10
Total Number of Permits for Roundwood by National Forest FY90-FY93

accumulation, and vehicle ruts in wet meadow areas. On the Plumas, incense cedar posts can only be taken from dead and down trees.

Boughs

Unlike cone permits which are issued throughout the Sierra Nevada, bough permits are primarily requested on the northcentral forests and mainly for white fir and incense cedar limbs. Trends in bough permits are mixed (figure 11). On the Sierra, Tahoe, and Modoc National Forests, bough permits have increased while elsewhere in the Sierra Nevada, they have declined. The greatest number of bough permits has been sold by the Plumas National Forest (figure 12; see also table 3). However, little information about bough collecting on the Plumas was reported.

On the adjoining Tahoe National Forest, evergreen boughs are collected for wreaths and some are sold wholesale by a local family business. On the Lassen, bough cutters from southern Oregon buy permits for boughs, which they resell to commercial florists and wreathmakers. Overcutting of incense cedar limbs has been in a problem in the past so permits are strictly limited and monitored, and references from permittees are required. A few permits for juniper boughs are also sold primarily to nonlocal residents on the Modoc. Permit requests for dogwood (*Cornus* spp.) boughs are also reported to have increased on the Plumas, Lassen, Tahoe, and Eldorado National Forests.

Further south, boughs are collected for both commercial and private use on both the Sierra and the Sequoia National Forests. On the Sierra, permits for boughs are sold primarily to nonprofit organizations such as schools. Some permits for incense cedar boughs have also been bought by a private contractor who is trying to expand his supply

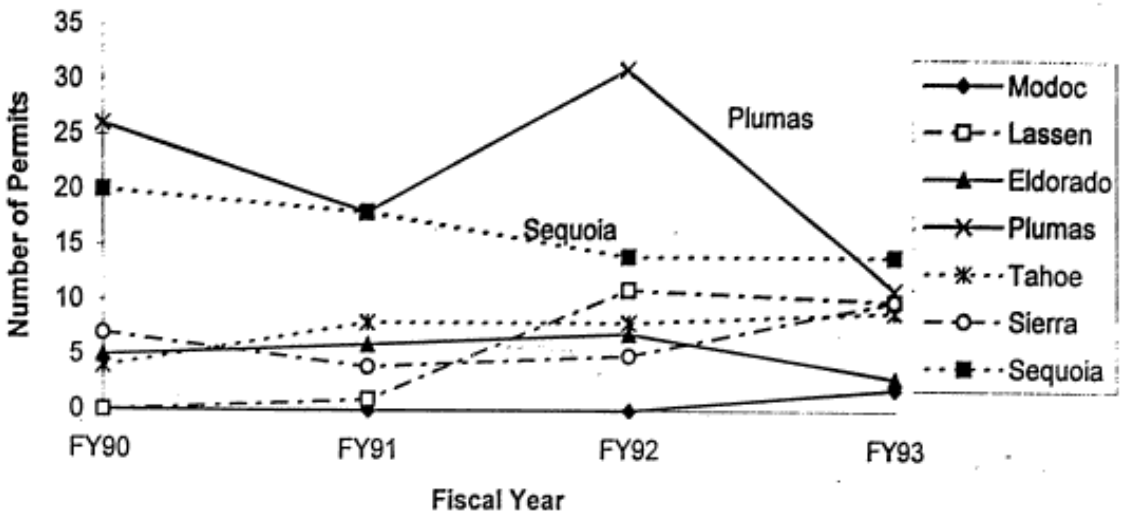


Figure 11
Trends in Bough Permits by National Forest FY90-FY93

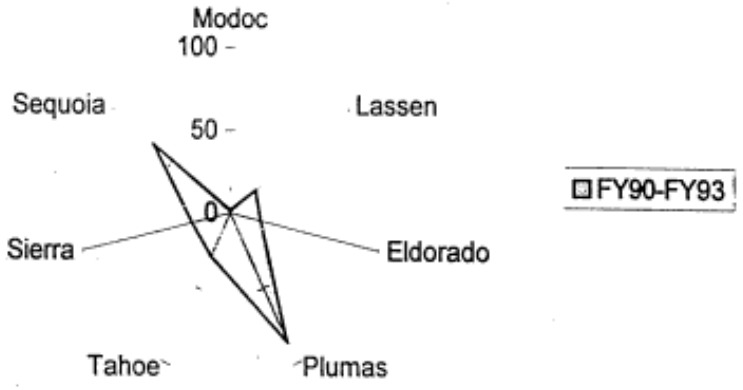


Figure 12
Total Number of Permits for Boughs by National Forest FY90-FY93

sources. In the past, he has mainly bought boughs from forests in southern California, but reportedly "the supply is getting scarce and restrictions on collection are becoming burdensome."

Manzanita

Manzanita boughs are collected primarily for pet bird perches and for floral displays. Trends have been erratic since few permits in general are written specifically for manzanita branch collection (figure 13). Most permits have been issued by the Sequoia National Forest, primarily to one individual who makes a part-time job out of collecting and selling the material to pet and bird stores (figure 14; see also table 3). Elsewhere on the Eldorado, Tahoe, Plumas, and Modoc National Forests, manzanita branches are also collected by local craftspeople for their own business or resale elsewhere. Manzanita is also cut for firewood.

Mushrooms

Over 50 permits have been issued for mushroom collection on three national forests in the Sierra Nevada, but almost all have been written in only one year so annual comparisons are not possible. Most of these permits were issued on the Eldorado and Stanislaus National Forests for morel (*Morchella* spp.) mushrooms during the spring following the wildfires of 1993 (figure 15; see also table 3). In addition, the Eldorado did not begin requiring permits for wild mushrooms until 1993. The 1993 permit allowed a maximum limit of 50 pounds of mushrooms for the annual (fiscal year) season. The Stanislaus National Forest issued daily, weekly, monthly, and seasonal permits.

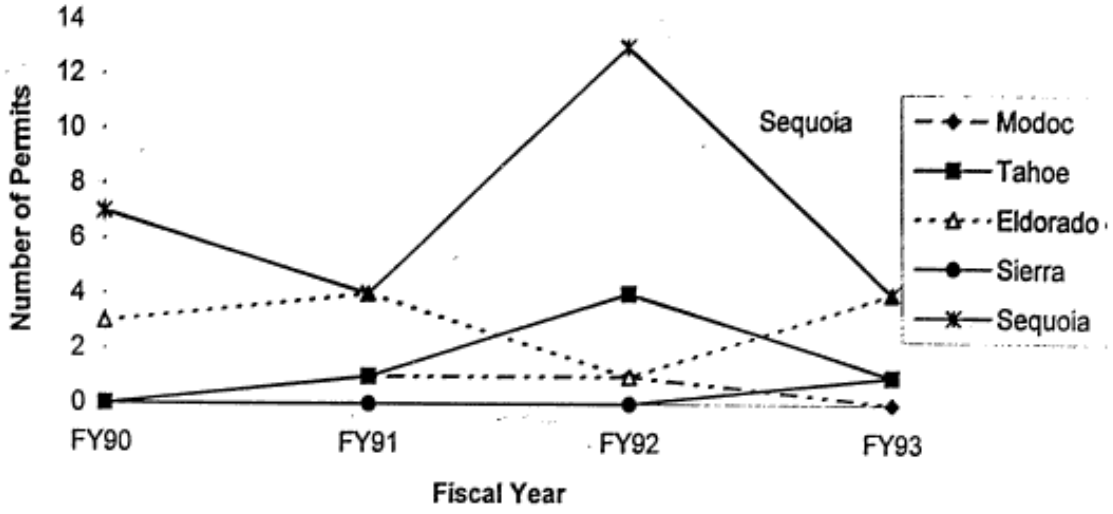


Figure 13
Trends in Manzanita Permits by National Forest FY90-FY93

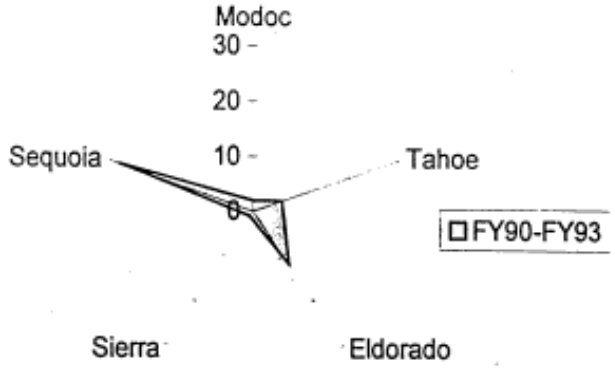


Figure 14
Total Number of Permits for Manzanita by National Forest FY90-FY93

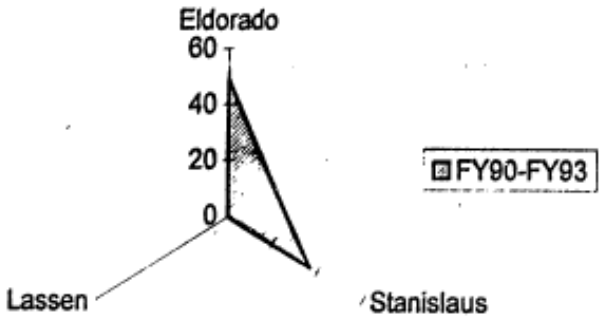


Figure 15
Total Number of Permits for Mushrooms by National Forest FY90-FY93

The northern forests have also reported interest in wild mushroom collection. Requests for matsutake (*Tricholoma magnivelare*) mushroom permits have been reported from the Modoc, Lassen, and Plumas National Forests, and requests for puffball mushrooms (*Lycoperdon* spp.) have been noted on the Modoc. Because of the increase in morel mushroom gathering on private land following the 1993 Fountain Fire, the Lassen expects mushroom collection to increase substantially following wildfires there. TheTahoe National Forest also reports that people collect mushrooms, especially morels, for personal use although no permits are issued. Both the Eldorado and Tahoe National Forests report that some gatherers may also be commercially selling morels harvested from national forest lands.

Other Minor Products

Permits for the remaining special forest products from table 3 numbered fewer than a dozen for the four-year period. With such a small number of permits, trend patterns over the period cannot be accurately assessed. However, aggregate totals do indicate some regional trends for several products. These include stumps, burls, root wads, and other specialty wood products which are generally sold to small local businesses. Most of these specialty wood products have been collected primarily on the northern forests, especially on the Tahoe National Forest where pitch stumps, manzánita burls, and incense cedar root wads are collected for decorative wood products (figure 16). On the Sequoia National Forest, pine knots are gathered for wood carvings and on the Lassen, burls are often collected by nonprofit organizations for large-scale barbeque cooking for fund-raisers and for manufactured specialty products like burl tables.

Transplants for home and commercial landscaping are also collected from national forest lands in the Sierra Nevada. Most permits have been issued by the Plumas and Sierra forests for landscape purposes (figure 17). On the Lassen National Forest, transplants have been dug to revegetate the landscape around government buildings. On the Plumas, a local resident is issued a permit and guidelines for digging transplants for his native species nursery. On the Eldorado National Forest, commercial harvesters collect juniper, white pine (*Pinus monticola*), and lodgepole pine for bonzai trees.

Other minor products are collected from a few national forests. Bark from dead trees and laying at the base of trees is gathered for landscaping purposes from the Tahoe, Sierra, and Sequoia National Forests. On the Sierra, permits for lodgepole pine and

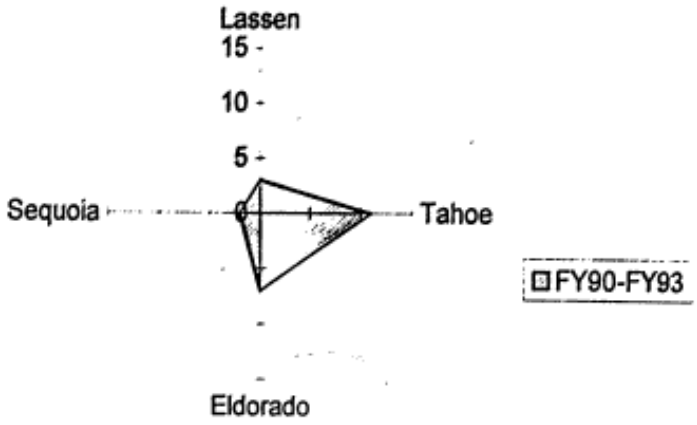


Figure 16
Total Number of Permits for Specialty Wood by National Forest FY90-FY93

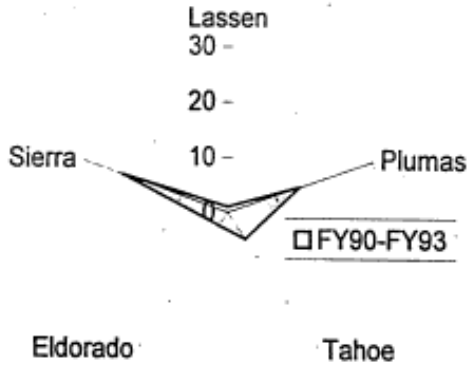


Figure 17
Total Number of Permits for Transplants by National Forest FY90-FY93

incense cedar bark are also issued for traditional Native American structures.

Bees, presumably honeybees (*Apis mellifera*), are collected from the Tahoe National Forest, but little information about bee collection was reported. Permits for the common garden variety ladybug beetle (*Hippodamia convergens*) have also been issued on the Tahoe, and additional requests for ladybug permits have been reported by the Eldorado and Stanislaus National Forests. Collectors claim that ladybugs are harvested from the Plumas and Lassen National Forests. Ladybugs usually congregate in canyons and along streams with openings and pine trees, and collectors take the insects from the same site several times in a season. Collections occur in the fall and late spring and are generally done by hand. The ladybugs are then transported and put in cold storage before being sold. A large number of the insects reportedly die because they are stored too long or under inappropriate conditions. While the Tahoe National Forest does not permit the actual collection of the insects, it does issue a permit for the operation of the commercial ladybug enterprise on national forest land.

Permits have been issued by the Tahoe and Sierra National Forests for "fiddeheads" or bracken ferns (*Pteridium aquilinum*). On the Tahoe, fiddlehead collection has occurred for many years. Most collectors are Asian and come in the spring to collect the ferns when they have just emerged in the "fiddlehead" stage. The ferns are picked just below the head, steamed, and eaten as food. Some of the ferns are resold to restaurants, and others are gathered only for private household use. Collectors take as many bags as they can fill. On the Sierra National Forest, most collectors are Southeast Asians, especially the Hmong, who collect ferns each May for ceremonial banquets. Both

the Tahoe and the Sierra National Forests report that collectors come in large numbers and "collect wherever they want, including non-Forest Service lands as well as private lots. They don't understand they need a permit."

In addition to ferns, both lichen and moss collection has been permitted in several national forests of the Sierra Nevada. In the northern Sierra, lichens are gathered on the Modoc, Lassen, and Plumas National Forests. On the Modoc and the Lassen, lichen is collected on basalt or "flat" rock for resale to the Bay area. On the Modoc and the Plumas forests, lichen is also gathered for the dry floral market. Little was reported about moss collection, but permits to gather moss have been issued by the Tahoe and Sequoia National Forests. Mistletoe has been collected by permit on the Sequoia as well.

Sawdust and native seeds have also been collected by permit on the Sierra and Tahoe National Forests for landscaping and restoration purposes respectively. Quartz crystals are reportedly gathered from the Tahoe and Eldorado National Forests as well. Permits for river rock and decomposed granite have also been issued on the Sierra National Forest.

Permits for pine needles, primarily for decorative purposes and Native American basket weaving, have been issued on the Plumas, Stanislaus, and Sierra National Forests. The Modoc, Plumas, Tahoe, and Sierra National Forests all report that many native plants are gathered both by permit and without permit by Native Americans for basket weaving, medicines, and food. In addition, the Plumas National Forest has reported increased permit requests for beargrass (*Xerophyllum tenax*), a Native American basket weaving material, from commercial collectors.

Eldorado National Forest Case Study

Permits for special forest products on the Eldorado National Forest were primarily issued for firewood collection during the fiscal period of 1991 through 1993. Of the total number of permits (N=459), 72% were issued for firewood. The remaining permits were written for a variety of special forest products, most of which were mushrooms (figure 18).

Individuals obtaining special forest products from the Eldorado National Forest during the three-year period were primarily local residents. Of the 459 permittees, 68% were local residents (figure 19). These were followed by permittees from the Sacramento and Bay areas respectively. A smaller number of permittees were from areas of California north of the Eldorado National Forest and from out of state, including Oregon, Nevada, and Utah.

Regional affiliation varied according to the particular product for which the permit was written. All the permits for Christmas trees on the Eldorado National Forest were issued to local residents. Similarly, most firewood permits were written for local residents (figure 20). Roundwood permits were also issued primarily to local people. In contrast, permits for boughs (figure 21) and cones (figure 22), were issued to individuals from the northern part of the state or out of state. Because most boughs and cones are used in the Christmas floral green industry, it is not surprising that most of these permits went to areas such as northern California and Oregon where the floral green industry is well developed. In contrast to bough and cone permits, most mushroom permits were issued to individuals from the Bay area (figure 23). The remaining special forest product


Figure 18
Distribution of Special Forest Product Permits (Excluding Firewood) Issued by the Eldorado National Forest FY91-FY93

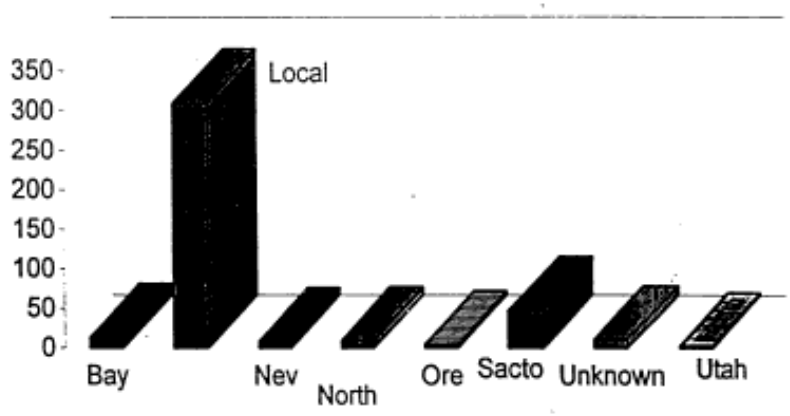


Figure 19
Regional Affiliation of Permittees of Special Forest Products on the Eldorado National Forest FY91-FY93

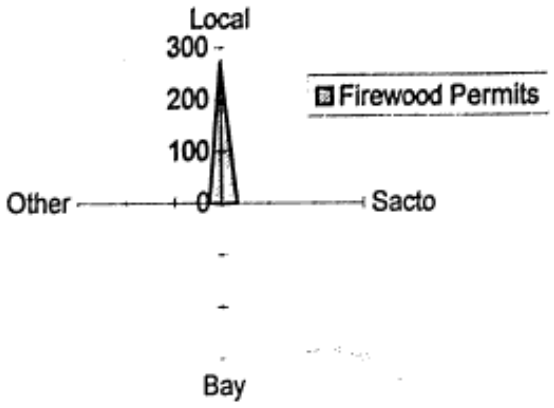


Figure 20
Regional Affiliation of Individuals with Firewood Permits on the Eldorado National Forest FY91-FY93

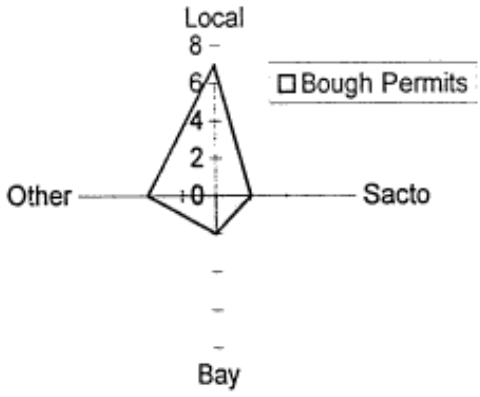


Figure 21
Regional Affiliation of Individuals with Bough Permits on the Eldorado National Forest FY91-FY93

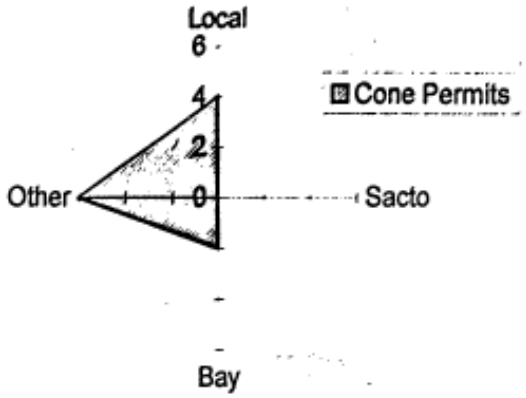


Figure 22
Regional Affiliation of Individuals with Cone Permits on the Eldorado National Forest FY91-FY93

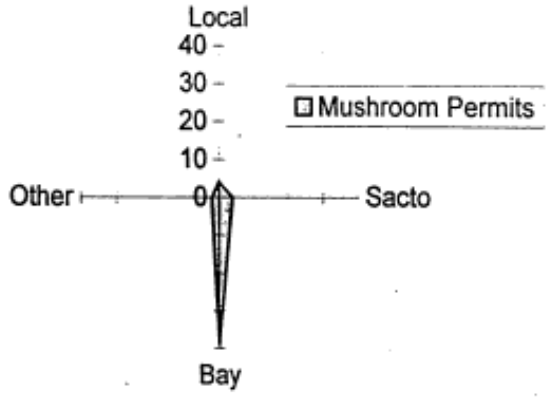


Figure 23
Regional Affiliation of Individuals with Mushroom Permits on the Eldorado National Forest FY91-FY93

permits were too few in number to adequately represent the regional affiliation of the permittees.

Concerns about Special Forest Products on the Eldorado National Forest

Interviews with forest and district personnel indicated that a wide variety of concerns existed about both the direct and indirect effects of special forest product harvesting. The major product harvested was firewood, and some personnel said that they believed illegal cutting was increasing because of the decline in timber harvest since 1984 and hence a reduction in designated wood cutting areas on the forest. Illegal fuelwood cutting was considered especially problematic in the black oak belt on the ridgetops close to the roads. Some illegal ladybug collection had also been documented, and the jurisdictional ambiguity of permitting the enterprise but not the product was of administrative concern.

Several concerns about wildlife existed in conjunction with special forest product permitting policy on the forest. Permits for porcupine (*Erethizon dorsatum*) quills have been requested by both Native American and non-native American basket makers, and there was uncertainty as to how such requests should be considered. In addition, grey squirrel (*Sciurus griseus*) harvest was considered a major impact as a result of Southeast Asian hunting although licensing and monitoring of squirrel hunting was the jurisdiction of the California Department of Fish and Game. There were also accounts that Asian harvesters were cutting willows for basket making without a permit. In general, however, the greatest controversy related to special forest products concerned the harvest of wild mushrooms on the forest.

Wild Mushroom Harvesting on the Eldorado National Forest

After the Cleveland Fire of 1993, numerous requests were received by the Eldorado National Forest for permits to harvest morel mushrooms the following spring. Morels typically fruit in abundance following wildfire, in part perhaps because the formation of sclerotia may be induced as a result of root mortality from severe disturbance (Miller, Torres, and McClean 1994). Because the Cleveland Fire had occurred in a steep area heavily checkerboarded with private timber company land, forest personnel were concerned about the possibility of large numbers of mushroom pickers inducing further soil erosion and creating conflicts with private landowners. In addition, little information is known about the role of morels in the recovery of a forest ecosystem following a fire. Some forest biologists were concerned about losing the ecological nutrient-cycling function of fungi if the harvesting pressure on morels in the burn area became too great. As a result, $20 permits were sold for personal collection of a maximum of 50 lb of mushrooms for the season and for only certain designated areas within the Cleveland Fire burn area. To minimize the impact of monitoring the harvest, morel gathering elsewhere in the forest was prohibited.

Because of the public interest in the morel harvest, a letter was issued by the acting forest supervisor on 22 February 1994 requesting public comment on the implementation of the Eldorado National Forest's mushroom harvesting policy. Well over half of those responding during the public comment period were from the Bay area (figure 24). This regional representation of letter writers directly correlates with the

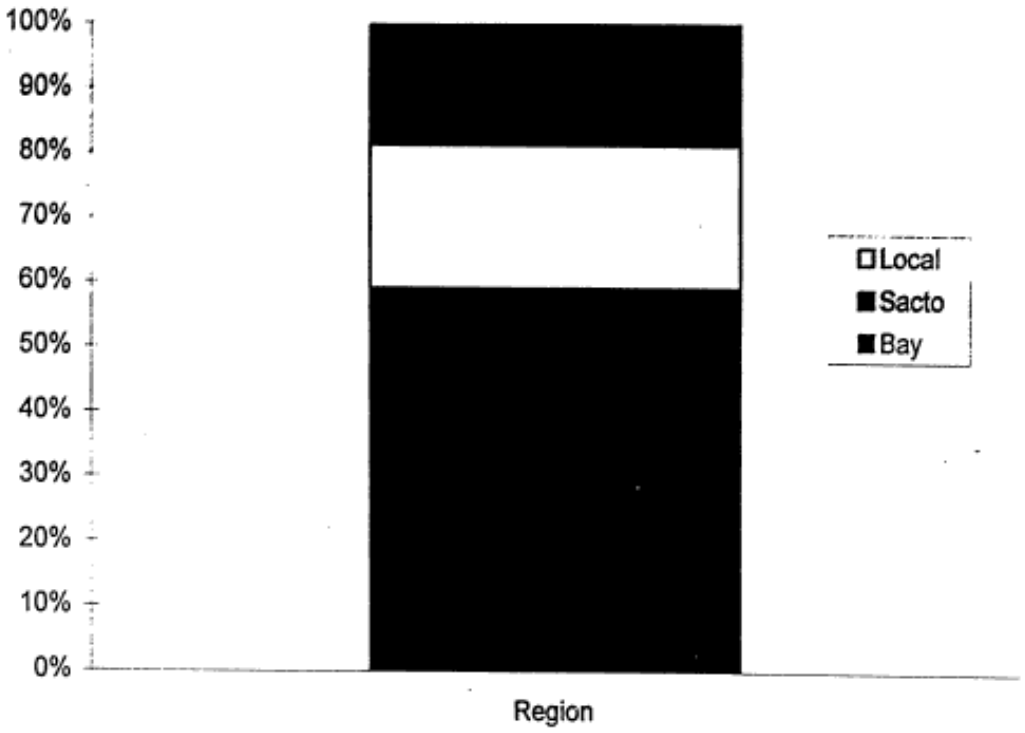


Figure 24
Regional Affiliation of Individuals Writing Public Comment Letters on the 1994 Eldorado National Forest Mushroom Harvesting Policy

geographic origin of the mushroom permittees, the majority of whom were also from the Bay area (figure 23).

The letter writers represented several non mutually exclusive social roles (figure 25). Just under half were mushroom society members and/or individual letter writers only. Only 4% identified themselves as environmentalists, 14% identified themselves as conscientious forest users, and 39% represented themselves as experienced mushroom pickers, and 11% indicated they were mushroom experts. In contrast, 18% indicated that they were proponents of the timber industry.

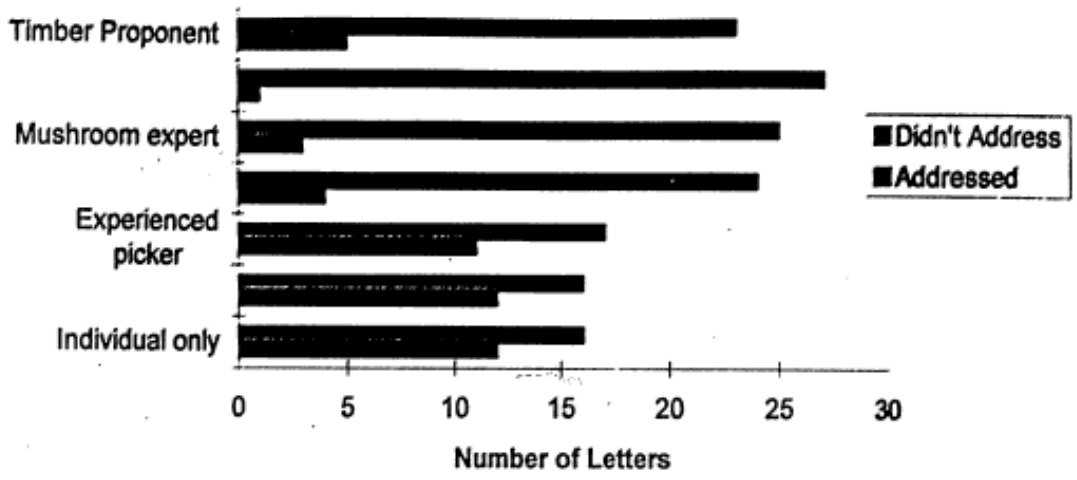


Figure 25
Social Roles Assumed in Public Comment Letters on the 1994 Eldorado National Forest Mushroom Harvesting Policy

Relatively few letters addressed concerns about surface impact to the soil (18%) and impacts on other users (4%) . As shown in figure 26, most letters addressed possible risks to morel regeneration following harvest (64%) with many of the letters claiming that overharvesting did not pose a serious problem for future regeneration of the species. Other writers referred to both the recreational (32%) and monitoring (29%) benefits of allowing mushroom harvesting, and many wrote that they thought a greater amount of mushrooms should be collected for a lower fee. This was reflected in the fact that half (50%) of the letters criticized the forest's mushroom management policy as too restrictive (figure 27). The second most frequent criticism was that pickers were overregulated (39%). About one-third of the letter writers indicated that they thought the Eldorado National Forest's mushroom management policy was a waste of taxpayer's money while only 14% claimed that they thought some form of mushroom monitoring was necessary

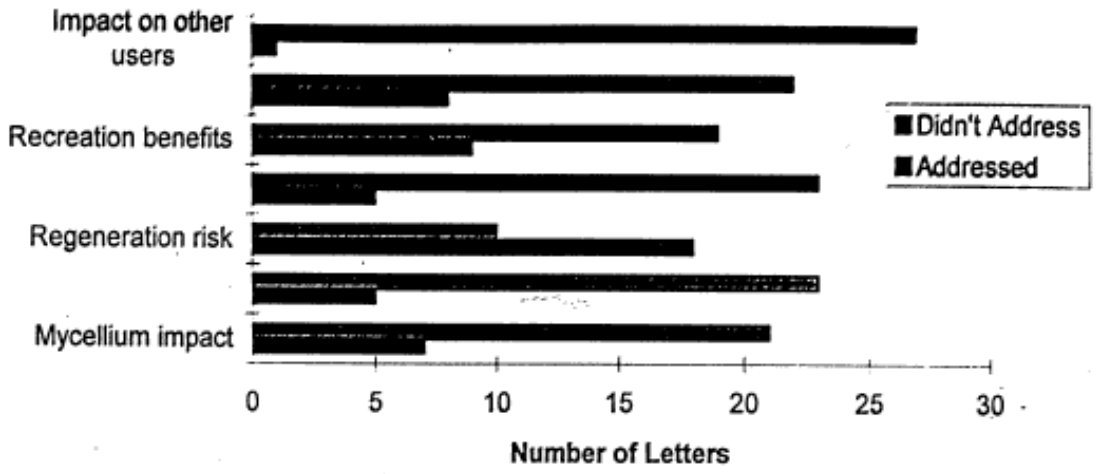


Figure 26
Concerns about Personal Mushroom Harvesting in Public Comment Letters on the 1994 Eldorado National Forest Mushroom Harvesting Policy

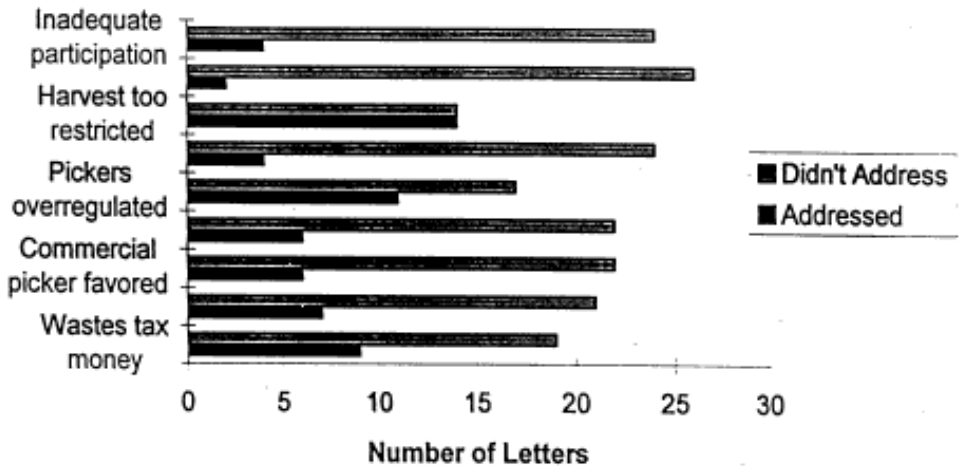


Figure 27
Concerns about Mushroom Management in Public Comment Letter on the 1994 Eldorado National Forest Mushroom Harvesting Policy

## CONCLUSIONS

Through a review of the literature and from the national forest survey and the Eldorado National Forest case study, this assessment addressed three key questions:

1. What has been the historic pattern of non-Native American special forest product collection?
2. What special forest products are currently collected from the Sierra Nevada national forests?
3. What are the trends in current special forest product policy and management and how do they affect special forest product collection?

In addressing these questions, findings from this assessment provide baseline data for policy development toward the ecological, social, and economic sustainability of special forest products.

Patterns of Special Forest Product Collection

Historical patterns of special forest product collection in the Sierra Nevada by early settlers were primarily utilitarian. Early settlers collected wild plants to supplement their diets, heal them in the absence of modern treatments and cures, and serve their labor as household fuel and work implements. As the findings from the regional survey and the Eldorado case study demonstrate, people today use special forest products from the Sierra forests for some of these same purposes. However, they also collect forest resources for very different reasons than their forebears did a century and a half ago. This general finding is supported by interviews with botanists, biologists, timber management officers and other personnel on all eight of the Sierra Nevada national forests which responded to

the survey. They are also supported by data and observations from cooperative extension personnel, mushroom collectors, medicinal plant distributors, and many others contacted for this assessment.[9] These views all inform the interpretations and conclusions presented here.

It should be stressed that these interpretations are often speculative at best given the paucity of data and the difficulty in obtaining confirmatory information from a wide range of sources. Nevertheless, the intent of this study was to provide a broad, regional description of special forest product collection in the Sierra Nevada, including historic, contemporary, and future trends. While speculative, it is the intent of this discussion to present the opportunities which special forest products hold for the Sierra as well as the limited knowledge we currently have of real conditions.

Fuelwood

Of the greatest historic and contemporary importance are the special forest products collected in the Sierra Nevada for fuelwood. The collection of firewood continues to be the most economically significant and most frequently harvested special forest product from the region today. As the permit data for the Eldorado National Forest indicate, the most frequent demand for firewood in the Sierra Nevada is from local residents. However, in recent years, firewood collection appears to have declined. Because most firewood collection is limited to areas in which logging or thinning has already occurred, mountain communities may experience increased future firewood

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[9] I would like to thank Tom Ratcliff, Beth Corbin, Linnea Hansen, Kathy van Zuuk, Mike Foster, Tom Beck, Joanna Clines, Steve Anderson, Scott Jackson, Andy Dyer, John Russmore, Kevin Fort, Tuo Lee Xiong, and many others who aided this assessment.

restrictions on national forest fuelwood collection as timber harvests decline. A 1986 report indicates that mountain region residents comprise less than 5% of the total population of California but use well over half of the firewood since

> (t)hey have large heating requirements, alternative heating fuels are expensive, and relatively inexpensive firewood can be collected from the National Forests and from some private land. For most of these residents, heating with firewood makes good financial sense (Doak and Stewart 1986).

The legal alternative for those seeking firewood at a relatively low cost is to replace national forest fuelwood with either increased purchases or harvests of firewood from private lands. If private land should also become more unavailable to firewood cutting, the current problems with illegal harvest of fuelwood from national forests might accelerate, especially if Forest Service monitoring and enforcement were reduced.

In recent years, technological and forest management changes have created markets for new fuelwood products like biomass for wood chip energy production. In 1986, there were 72 biomass projects in California using forest or mill residues for power generation. Of these, 66 were cogeneration plants (Doak and Stewart 1986). Since 1986, some of these plants have failed and others have been close to closing. At the same time, new plants have been activated. Because the collection of biomass is directly related to the market for cogeneration plant energy, biomass harvest has been erratic. The uncertain market for biomass fuel has posed management problems for the Sierra national forests which have come to depend on biomass removal as a no-cost fire-prevention and forest health thinning tool. On the Lassen National Forest where the greatest amount of

biomass has been harvested, contractors may have to be paid to thin forest stands in lieu of buying permits for biomass if the local cogeneration plants shut down. Similar concerns are expressed in the south on the Sequoia and Stanislaus National Forests.

In the north, the Modoc National Forest has not only relied on biomass removal as a fire prevention strategy but as a means of improving wildlife habitat on juniper woodlands as well. Collector interest in harvesting juniper for biomass fuel as well as for fences, firewood, and ornamental wood working has apparently increased. Demand has been stimulated by the chip market for local cogeneration plants including a new plant in Klamath Falls, Oregon. Chip harvesting has accelerated on private land with ranchers receiving $10 per acre for juniper removal. Juniper removal on the forest could reduce the current juniper cover from over 60% to about 40% for improved wildlife habitat. Juniper is currently removed by hydraulic shears at ground level, but different harvesting methods are being explored. Leaving boughs and limbs on the ground may be more important since recent data indicate whole juniper tree removal can result in an undesirable net export of plant nutrients from the juniper grassland ecosystem (Miller and Rose 1995).

Christmas Trees, Floral Greens, and Dry Floral Ornamentals

Historically, Christmas trees were undoubtedly harvested from the Sierra Nevada by early Euro-American settlers. In terms of net fee receipts, Christmas trees are currently the second most important economic product from the national forests from the region. However, permit demand has not dramatically increased relative to market demand from the population growth in the state. Several factors may contribute to this phenomenon.

Only the northern forests of the Sierra Nevada continue to issue large numbers of Christmas tree permits to individuals while permit numbers on Christmas tree cutting have increasingly been restricted by the central and southern forests. This is illustrated by the Eldorado National Forest where permits for Christmas trees have been increasingly limited to nonprofit organizations since the private "choose-and-cut" operations were established in the region in the early 1950s. To avoid competition with commercial growers, forests like the Eldorado have restricted the numbers of Christmas tree permits and the conditions under which they are issued. With the continued growth in the private Christmas tree industry, it is unlikely that permit numbers on the national forests will increase. The Christmas tree harvest will likely decline even on the northern forests as small, private "choose-and-cut" operations continue to presumably expand. Because Christmas tree cutting may also serve as a thinning tool, these restrictions further constrain another forest fuel load management option, particularly as many observers note, there is not much market for small trees.

Of emerging importance in the Sierra Nevada is the collection of floral products not supplied in large quantities from private lands. These include cones, boughs, and mistletoe for Christmas floral greenery, manzanita branches for floral arrangements, and lichen and moss for the dry floral industry. An emerging market for dogwood boughs for floral displays is indicated by the increased number of permit requests on many forests. While trends in the harvest of these floral products appear too erratic to determine whether demand for floral products from the Sierra Nevada is expanding, it does appear that the floral industry plays a significant economic role for a limited number of

community residents and out-of-area commercial harvesters in the region. As the permit data for the Eldorado National Forest indicate, nonlocal harvesters collect more floral products from the Sierra Nevada than any other group of products, except wild mushrooms. It is unlikely that the floral industry as a whole will diminish. Floral greens have been commercially harvested from the Pacific Northwest since at least the 1930s (Robbins 1988). Moss has been marketed in the decorative trade since at least 1902 (Nelson and Carpenter 1965), and lichens have been popular as Christmas decorations for centuries in Scandinavia where they have been imported from the United States since 1935 (Llano 1948).

At this point in time, harvesting for the floral trade in the Sierra Nevada appears to be limited and poorly positioned to compete with that of the Pacific Northwest. Ecological conditions, especially moisture, constrain the type and amount of typical floral green products available in the Sierra Nevada. It is also likely that the special forest product floral industry in the Sierra will be limited by the same or similar economic factors which constrain the growth of the industry east of the Cascades and in the western Rockies. These factors include lower product prices to harvesters, certain permit restrictions, and a lack of investment capital and market development (Schlosser and Blatner 1994). Nevertheless, it appears that the northern forests of the Sierra are already becoming linked to the Pacific Northwest floral industry through cone, bough, and lichen collection. In addition, the increase in number of permit requests for beargrass, a major component of the Pacific Northwest floral industry, indicates that the industry in the northern forests may be poised for limited expansion and integration.

In the southern forests of the Sierra Nevada, the floral industry appears to be indigenous and currently weakly developed. This may be changing as the southern Sierra forests may be absorbing some of the harvesting pressure from the forests further south where increasing restrictions may be shifting demand northward. At least one community in the southern Sierra has explored expanding local economic opportunities by either collecting wild plants and/or cultivating wild plants for the trade (e.g., Mater Engineering 1993). In addition, unique products such as sequoia cones and large amounts of other desirable products not found in quantity elsewhere, such as sugar pine cones, may allow the floral industry in the southern Sierra Nevada to expand. The southern forests may also be well positioned for an expansion of the trade because of their proximity to southern California markets and because of the available labor pool of experienced special forest product collectors.

Ethnic diversity within the floral special forest products industry is likely to continue to increase. Hispanic and Southeast Asian harvesters increasingly engage in commercial special forest product harvesting of juniper boughs, wild mushrooms, and other plants throughout the Pacific Northwest (Richards in press). These groups appear to have extended harvesting to the northern national forests of the Sierra Nevada. Many of these harvesters are California residents (Richards and Creasy in press), and it is not unlikely that these groups will exert increased pressure to collect floral plant products in all the forests of the Sierra Nevada if market conditions develop.

Wild Edible Plants

While wild edible plant foods were important dietary supplements a century and a half ago, they do not appear to be widely collected by non-Native Americans in the Sierra Nevada today. Permits are not currently issued by national forests in the Sierra Nevada for wild edible plants except wild mushrooms and ferns.[10] Permits are not currently required to gather food such as blackberries, wild grapes, and wild strawberries. Few reports have noted berry or grape picking or the digging of roots such as wild onions, arrowhead, or other plants (see table 1). However, the numerous publications written for backpackers or "survivalists" who are interested in wild plant foraging attests to the interest of an unknown population who may still collect historically important food plants in the region (see, for example, Elias and Dykeman 1990 who describe many wild edible plants which grow in the Sierra Nevada). Currently, the demand for wild edible plants by "foragers" in the Sierra Nevada is unknown. Similarly, any future demand for a wild edible plant industry in the Sierra is unpredictable.

Although few records exist about settler or Native American consumption of wild mushrooms, there are reports that Native Americans harvested morels and other species in California (Blackburn and Anderson 1993). Wild mushrooms have also been gathered for many years by immigrants and settlers. Several members of ranching families who graze cattle on the Sierra and Stanislaus National Forests indicate that their families have long picked morels and continue to do so today. On the Eldorado National Forest, an

[10] Pinon (*Pinus edulis*) cone seeds ("pinons") are collected on the east side of the Tahoe National Forest, but permits were not reported. Pinon permits may also be issued on the Inyo National Forest, which is not represented in the survey.

experienced mushroom picker reports that elderly Italian American men continue a long tradition of gathering *porcini* or bolete (*Boletus* spp.) mushrooms as well as Caesar amanita (*Amanita caesariana*) mushrooms from the forest. This observation is supported in a letter to the Eldorado National Forest with an enclosed photograph copied from the Placerville *Mountain Democrat* of an overall-clad gentleman drying bolete mushrooms in 1915.

Despite historical local use, most demand for wild mushrooms today is from urban, nonlocal wild mushroom afficionados, especially members of wild mushroom clubs and societies. These collectors harvest wild mushrooms, primarily morels, from only a few forests in the Sierra Nevada and particularly, following a major wildfire. Findings from the content analysis of the public comment letters to the Eldorado National Forest indicate that wild mushroom collecting is a highly valued activity by these harvesters and one in which they maintain an intense interest.[11] The current harvesting of wild mushrooms in the Sierra Nevada appears to primarily consist of both traditional and newly emerging recreational harvesting for personal use. Although commercial harvest of wild mushrooms has not yet become a major activity in the Sierra Nevada, it may periodically increase following a series of future wildfires.

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[11] This has also been recently demonstrated by the Internet postings on 9 February 1995 by North American Wild Mushroom Association members soliciting input to the public comment period on the special forest product draft management strategy plan from the Forest Service national office.

In contrast, fiddlehead fern collection is dominated solely by Asian harvesters who apparently collect for both personal and commercial use.[12] Permit numbers are very low, but the intensive harvesting in the spring by a particular ethnic group makes fern collection a particularly salient feature of the special forest product industry in the Sierra Nevada. Since bracken fern can be an invasive weed in conifer plantations, encouraging fiddlehead collection in plantations may serve a positive silvicultural management function for forests in the Sierra.

Fern harvesting reflects the growing ethnic diversity of the national forest users of the Sierra Nevada. Studies indicate that 44% of Hmong housewives in San Joaquin, Merced, and Fresno counties reported that someone in their home hunted animals and brought them home to eat. Deer (*Odocoileus hemionus*) was most frequently hunted, followed by squirrel and pheasant (*Phasianus* spp.) (Ikeda et al. 1991). Similar trends are reported for the Mien and other Southeast Asians living in the Central Valley. On the Sequoia National Forest, wildlife poaching by Southeast Asian harvesters has occurred with a recent capture of about 50 pond turtles (*Clemmys marmorata*), a category two sensitive species and a Southeast Asian banquet delicacy. Since Southeast Asian populations are among the most rapidly increasing in central California, the trend in fern collecting, hunting, and other forms of forest resource use is likely to increase, particularly in the central and southern Sierra Nevada forests, in the future.

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[12] In northeastern North America, settlers and Native Americans alike have eaten ostrich fern fiddleheads (*Matteuccia struthiopteris*) for generations (von Aderkas 1984) and in western Washington, bracken fern fiddleheads have provided starch and fiber in the diet of native tribal people there (Norton 1979).

Wild Medicinal Plants

Medicinal wild plants were historically collected to supplement pioneer diets. Today, permits are not generally requested nor required for the collection of medicinal wild plants from national forests in the Sierra Nevada. Nevertheless, a few reports indicate that some collection of medicinal plants is occurring in the region today. An emerging commercial herbal market may play a more significant role in special forest product gathering in the Sierra Nevada in years to come. A growing consumer interest in alternative herbal medicine is demonstrated by the growth of the Herb Research Foundation, whose mission includes conducting and supporting quality research on medicinal plants, promoting the informed use of herbs in preventive medicine, and supporting the development of herbs as cash crops. Interest in herbal medicine is also indicated by a wide array of books, including publications devoted to the harvesting of wild medicinal plants (Castleman 1991, Moore 1993). Several herbal medicine practitioners already gather plants from the Tahoe National Forest. The growth of California herbal products like a local Sacramento enterprise which produces an herbal "anti-allergy" cookie from imported *Ephedra* spp.(also known as Mormon tea) is an indication that a future market may exist in the herbal industry for wild plants from the Sierra Nevada (Philp 1995). Demand for medicinal plants from the Sierra may increase, particularly in the northern and central forests where communities like Nevada City and Truckee attract those seeking alternative lifestyles.

The ethnic use of wild medicinal plants may expand in the Sierra Nevada. Mexican herbal medicine shops (*botanicas*) are common in the valley cities like Fresno

where a major U.S. distributor of Mexican botanical herbs, Vida Mex, is located. According to the distribution list provided by the company, 240 products are available to botanicas. Of these, 30 are purchased from the United States, 174 are supplied from Mexico, and the remainder come from all over the world. Of these 240 products, many are plants listed in table 1 and grow in the Sierra Nevada. These include *cola de caballo* or horsetail rush (*Equisetum* spp. ), *bolsa de pastor* or shepherd's purse (*Capsella bursa-pastoris*) chia (*Salvia columbariae*) *enebro* or juniper berries (*Juniperus* spp.) *estafiate* or mugwort (*Artemisia* spp.), *gordolobo* or mullein (*Verbascum thapsus*), *hojas de fresno* or ash leaves (*Fraxinus* spp.), *llanten* or plantain (*Plantago* spp.), *milerana* or yarrow (*Achillea* spp.), *mirto* or California laurel (*Umbellularia californica*), *ortiga* or nettle (Urtica spp.), *poleo* or pennyroyal (*Monardella* spp.), *raiz angelica* or angelica (*Angelica* spp.), *salvia* or sage (*Salvia* spp.), and *uva ursi* or bearberry (*Arctostaphylos uva-ursi*). The extent to which Mexican Americans and other Hispanic groups in California buy products from botanicas or gather medicinal plants in the wild for either commercial or personal use is unknown. However, the expected increase in the Hispanic population and the large demand for medicinal plants by Hispanics in the state may mean that the market for some medicinal plants may be supplied to some extent by collection for either personal or commercial use from the Sierra Nevada in the years to come.

Given the historical importance of several of the wild medicinal plants which grow in the Sierra Nevada, potential demand may yet emerge for certain plants unexpectedly in the future. Canchalagua (*Centaurium venustum*) was hailed as a miracle drug by nineteenth century Californians. Pacific yew (*Taxus brevifolia*) is the source of

natural taxol which emerged as a cancer-treatment drug in the 1980s and grows in limited numbers in the forests of the Sierra Nevada. Similarly, a future plant may yet be found in the Sierra Nevada to meet the needs for new pharmaceutical compounds (Bates 1985). Should such a plant be located in considerable quantities, global data indicate that the value of such a single species would be worth over $203 million (Farnsworth and Soejarto 1985).

Finally, the monitoring of any potential growth in the demand for wild medicinal plants by the national forests in the Sierra Nevada will be all the more important given the fact that some historically important medicinal plants may include sensitive or endangered species. For example, of the plants listed in table 1, several groups may include rare or endangered species, namely, *Angelica callii*, *Trichostema ovatum*, *Trifolium bolanderi*, *T. lemmonii*, *T. macilentum* var. *dedeckerae*, *Ribes menziesii* var. *ixoderne*, *R. tuberense*, *Delphinium recurvatum*, *Monardella stebbinsii*, *Chenopodium simplex*, *Chlorogalum grandiflorum*, *Scirpus subterminalis*, *S. elementis*, and *Allium sanbornii* var. *sanbornii* and var. *congdonii* (Skinner and Pavlik 1994).

Woodworking, Landscaping and Restoration

The harvest of roundwood, including posts, poles, and rails, was historically necessary for ranching, mining, and logging, the main economic occupations of the Sierra Nevada. In recent years, demand for roundwood has appeared to decline. Like firewood, the harvest of roundwood products is generally restricted to collection areas designated after timber harvest or thinning. However, demand for roundwood may also be decreasing because of alternative fencing and building materials.

Home decorating, landscaping, and revegetation trends have recently provided markets for specialty wood carvings, bark mulch, landscape rock, transplants, and native seed. While these products do not appear to be extensively collected on the basis of permit numbers, demand may be considerable and future collection pressure may increase. Specialty wood carvings appear to be a limited but important economic opportunity for those in mountain communities who can successfully market their handicrafts. Trends in community interest in value-added wood working also appears to be increasing with small-scale furniture or cabinetry efforts reported on the Modoc and Sierra National Forests.

Mineral resources are often permitted under mineral law and are not generally reported as a special forest product. Tons of lichen-covered flat rock have been annually removed for years from the BLM district of Susanville for the urban landscape market (Richards forthcoming). With the expansion of the urban landscaping industry in California, demand may increase for rocks of different types from Sierra national forests. Rock removal and its associated impacts from archaeological, riparian, or sensitive plant areas may be particularly problematic in the future.

Transplants for gardens and collections are also a concern on many forests. Some report problems with live plant collectors digging lady slipper orchids (*Cypripedium* spp.), most of which are sensitive or endangered species. Bonzai tree transplants are also considered problematic. Although some forests have issued bonzai permits, the number of permits has been restricted since the number of plants with classic bonzai landscaping value is limited.

Although the number of permits issued for native seed collection for shrub and grass restoration projects has been low, the demand for native seed is expected to grow on several forests. The northern forests have seen an increase in native seed collection, especially bitterbrush (*Purshia tridentata*) for range and forest rehabilitation. Commercial native seed is a profitable industry in the Great Basin with commercial collectors earning $8 a pound on average for bitterbrush seed (Richards forthcoming). While commercial seed collection is not generally permitted on national forests in the Sierra Nevada, demand for commercial seed permits may increase in the future, particularly in years when widespread wildfires require extensive revegetation seedings and seed collection is profitable. Most seed is presently collected and germinated by the Forest Service, but several forests report increasing private and public partnerships in restoration seed collections and plantings. Some also note that seed collections may be limited to one forest and then planted on many other forests so that a regional gap exists in adhering to the Forest Service guidelines of the Regional Native Seed Species Policy of 1995 for collecting and using native seed for revegetation.

Trends in Special Forest Product Policy and Management

In general, this assessment indicates that public demand for special forest product collection will probably not decline in the near future in the Sierra Nevada. The permitted supply of some products like Christmas trees and firewood is expected to decline even as demand remains steady or increases. In addition, the permitted supply of a diverse group of other products, both old and new, is increasing under current special forest product policy. Demand for special forest products is likely to become more

complex as personal use diversifies with the growing ethnic and urban population and the accompanying shifts in cultural values. At the same time, commercial use may become more extensive with local and out-of-region harvesters often competing for the same products. Native American concerns about special forest products are reported to be increasing on several forests, particularly the Plumas, Sierra, and Tahoe National Forests. Traditional Native American basket weaving and medicinal plants are seen as particularly vulnerable to overharvesting pressure by commercial collectors. These problems are not unique to the Sierra Nevada but exist in forest regions outside the Sierra Nevada as well (Richards and Creasy in press).

Some forests report that special forest product requests and concerns will become more numerous and diverse as the American public turns to its national forests not only to make a living but for cultural alternatives and social experiences like medicinal herb interpretive tours and specialized morel collecting trips of the mushroom societies. The biggest constraint to managing this expansion in special forest product gathering is forest system funding since permit fee receipts continue to be forwarded directly to the Treasury in Washington, D.C. as they have been since 1906. Funding for special forest product management and monitoring continues to decrease on the national forests as the population continues to increase and demands for natural resources grow.

Funding constraints are recognized in the special forest products draft management strategy plan recently released by the national office (U.S. Forest Service 1995). The plan also acknowledges that existing policies are "vague, confusing, and incomplete" especially in terms of units of measure, pricing, and administration of

commercial and noncommercial harvests. While not "establishing resource policy", the management plan outlines six major goals for national forests to meet, namely to

1. Link forest land management to the needs of the people, including technical assistance to rural communities and sensitivity to the traditional religious beliefs of American Indians;
2. Integrate special forest product resources into ecosystem management, including maintenance of biodiversity;
3. Identify international, national, regional, and local policies that influence special forest product resources, including the national and regional directives and guides in managing products;
4. Integrate special forest product species into inventorying, monitoring, and research activities across functional boundaries, including better database and geographic information systems (GIS) vegetation information;
5. Develop biological models of species distribution and productivity that can be linked with economic and market probability models, including better databases for buying, processing, and selling of nontimber commodities;
6. Provide for and engage in interagency technology transfer across boundaries, including interagency workshops and international exchanges (U.S. Forest Service 1995).

This assessment has indicated that the first step in meeting some of these goals for the Sierra Nevada is to develop improved special forest product databases. Without consistent and currently updated data, it will be extremely difficult to address the

questions that remain to be answered, especially whether economic and biological models can be developed to better understand supply and demand cycles for special forest products within the ecological constraints of their distribution and growth requirements. In addition, better databases are needed to assess to what extent the economic needs of rural communities and the different cultural values of special forest product user groups conflict and whether special forest product demand can be met not only by the national forests but by private lands. Without a systematic database for better inventorying and monitoring special forest products harvested in the Sierra Nevada it will not be possible to determine whether certain special forest products are sustainable in terms of fulfilling economic needs, cultural values, and ecosystem functions. For example, data currently available from several agencies may exist that could be linked to indicate whether biomass removal can be both an economic product and a fire management tool while improving wildlife habitat and maintaining long term ecosystem health through continued nutrient cycling. Similarly, while the public may view the removal of river rock and wild transplants as benign, and even as positive "natural" landscaping. data may be tracked to identify the extent to which such collection methods impact the watersheds and plant communities of the Sierra. As the case study of the Eldorado National Forest mushroom policy illustrates, a particular social group's interest in a product may result in that product being culturally disproportionate significant relative to its actual economic value or its ecological contribution on any given forest. Conversely, the role of socioeconomic needs for certain special forest products like firewood, including insecure land tenure or access, and their resulting ecological and land management impacts are not as well

studied in western North America as they have been overseas (see Belsky 1994; Peluso 1992; Ireson 1991).

Such a database will need to be developed in the context of new and emerging uses and values in relation to special forest products if these resources are to be managed for a large number of different user groups. Thus, the role of special forest products in the management of Sierra Nevada ecosystems may be more complex than many scientists and laypeople realize. A regional database of special forest products to track vegetative and socioeconomic information would go a very long ways toward explaining that complexity. This will only be possible when forests are adequately funded to maintain management programs; administrative data from these program are reported consistently regionwide; ecological plant association data include special forest products; and administrative, ecological, and sociocultural and economic data are collected, linked, and monitored as part of the forest management system.[13]

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