

JASPER RIDGE BIOLOGICAL PRESERVE

STANFORD UNIVERSITY

RESEARCH REPORT NO. 8

LAND USE HISTORY
OF
JASPER RIDGE BIOLOGICAL PRESERVE

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INTRODUCTION

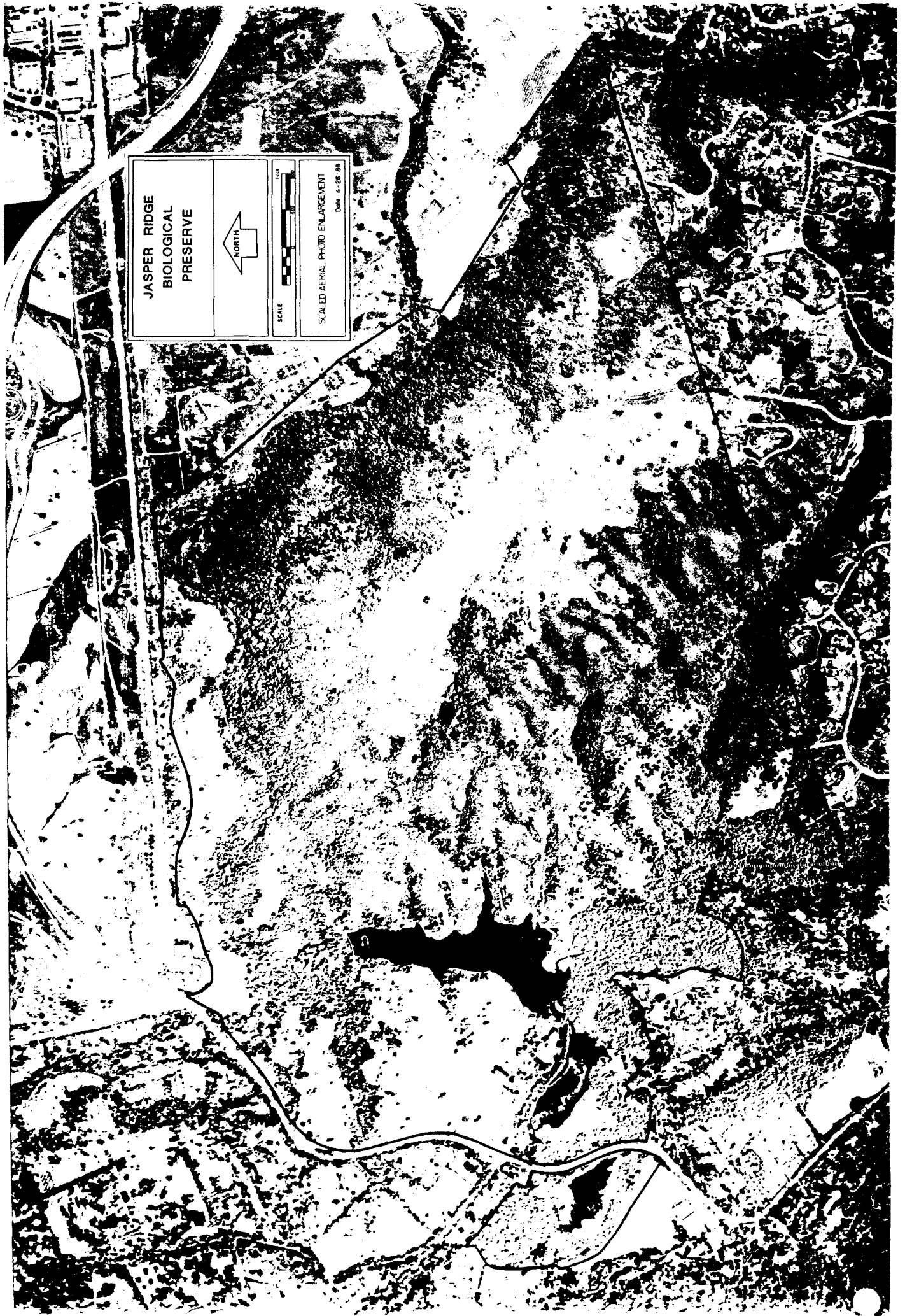
This monograph is a synthesis of recent archival, archaeological, and ecological studies of the area now known as the Jasper Ridge Biological Preserve (see Map 1). These studies began in autumn of 1988 as part of a larger project in historical ecology directed by Steven Hamburg of the University of Kansas. In addition to Jasper Ridge, the historical ecology project involves researchers at Harvard Experimental Forest in Massachusetts, Hubbard Brook Experimental Forest in New Hampshire, La Selva Biological Station in Costa Rica, and Luquillo Experimental Forest in Puerto Rico.

One of the project's original goals was to determine the history of human impacts and their significance for biological research at each site. Because sites like Jasper Ridge are now closed to the public, visitors often view them as wilderness areas. Jasper Ridge in some ways is representative of San Francisco Peninsula landscapes before Spanish explorers arrived in 1769. However, cattle and sheep grazing introduced by the Spanish have completely altered species composition in the Jasper Ridge grassland. In addition, 19th-century logging all but eliminated an extensive redwood forest to the west of the site. Because significant research is conducted at Jasper Ridge and similar reserve areas throughout the world, we hope to demonstrate here that the ecology of modern-day systems cannot be understood without considering the cumulative effects of past human activities.

At Jasper Ridge, land use history actually begins in prehistoric times with the earliest evidence of Native American occupation on the San Francisco Peninsula. During the subsequent Spanish period, laborers from Franciscan missions cut timber on Jasper Ridge and used its open lands for grazing. At the outset of the Mexican period in the early 1830's, Jasper Ridge lands became part of a vast rancho or land grant. The Mexican grantees continued raising cattle and grain crops. Meanwhile, new foreign residents from England and the United States steadily expanded the redwood logging operations.

Starting in 1850, these timber resources brought hundreds of entrepreneurs to the Jasper Ridge area as California's statehood coincided with the Sierra Nevada Gold Rush and San Francisco's rapid growth. The redwood forests were gone by the 1870's. As more land became available, local farmers began investing in orchards, dairies and increasing varieties of crops to supply the San Francisco market.

In the early 18⁹00's Leland Stanford purchased Jasper Ridge and in 1886 began plans for the new university. Needing a substantial water supply the Stanfords embarked on a series of negotiations to control the headwaters of San Francisquito Creek



MAP 1. Aerial photo of Jasper Ridge Biological Preserve

and the future reservoir of Searsville Lake. From this point on, Jasper Ridge history is inseparable from that of Stanford University. As early as 1910, research programs conflicted with agricultural leases and recreational opportunities in the Jasper Ridge foothills. Later, with post-World War II population growth, thousands of visitors began hiking, swimming, and horseback riding in and around Jasper Ridge. Security for researchers was increasingly compromised. Heightened awareness of the area's scientific value led to its dedication as the Biological Preserve in 1973. Jasper Ridge is now closed to the public except to visitors on popular, docent-guided tours.

Our goal in this manuscript is to outline the history of human activity throughout what is now the Biological Preserve. Since the mid-1800's Jasper Ridge has been subdivided into various parcels that have somewhat different histories of land ownership and land use. To provide readers with a common vocabulary as we refer to each parcel throughout this paper, the parcels (numbers shown on Map 2) will be referred to as follows.

Main parcel: parcels #91 and 92;

Northwest corner: #96, between Searsville Lake and main parcel;

Southwest corner: #90, between Searsville Lake and main parcel;

West side: parcels 97, 101-102, 105, and 108 on the west side of Searsville Lake;

North side: parcels 85-86, and 89 north of San Francisquito Creek -- only the land adjoining the creek is inside the preserve boundary.

East side; parcel 93-95 east and downstream outside the boundary of the preserve.

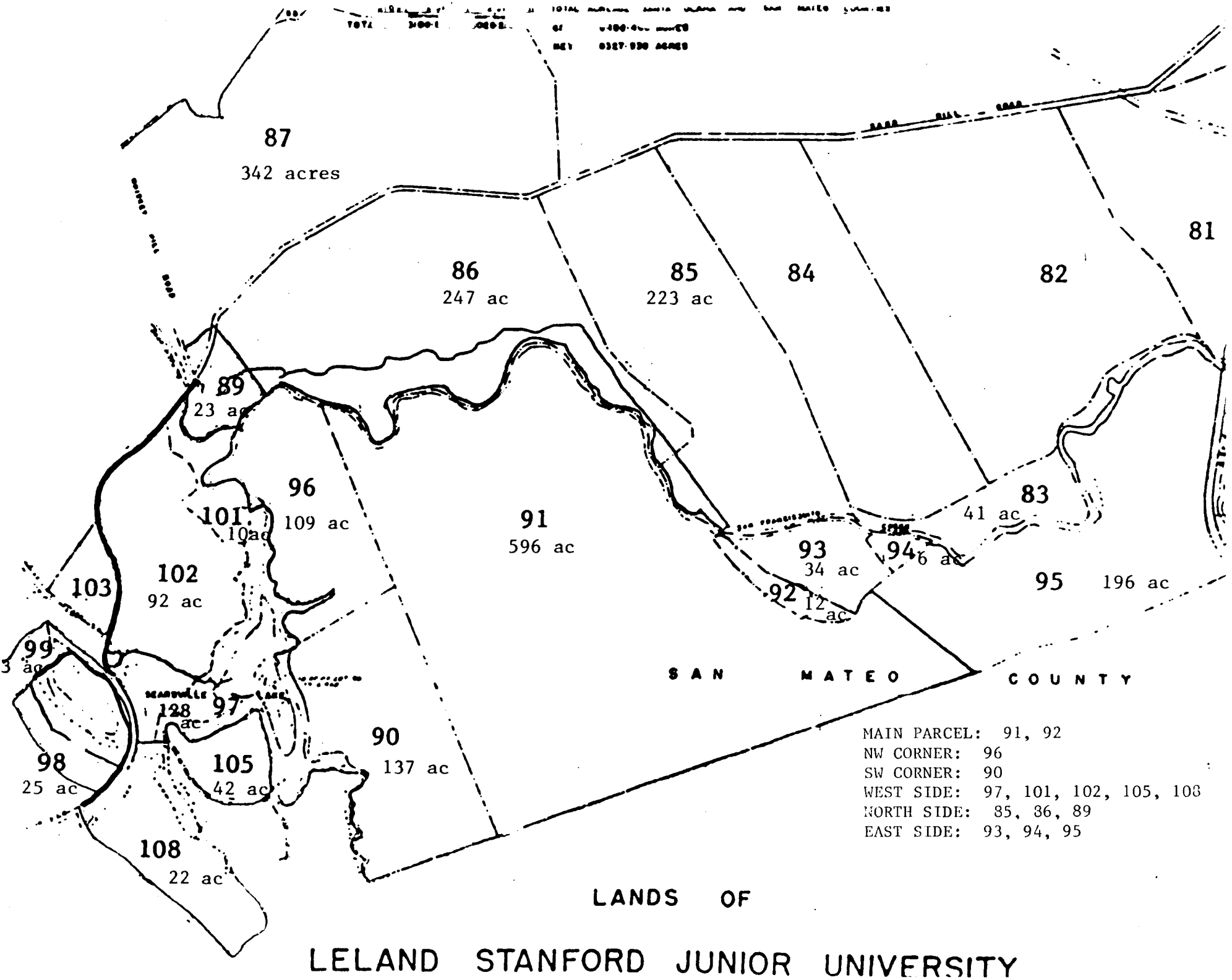
The land ownership sequences for each parcel were reconstructed by Reese (1991) on the basis of County of San Mateo Deed Books and other archival sources.

JASPER RIDGE ENVIRONMENT

The Jasper Ridge Biological Preserve is located in the eastern foothills of the Santa Cruz Mountains on the San Francisco Peninsula in central California (37°24' latitude, 122°13' longitude; see Map 3). Preserve lands comprise 480 ha of the watershed of San Francisquito Creek, one of several intermittent streams that originate in the Santa Cruz Mountains and flow westward to the southern arm of San Francisco Bay. The

TOTAL ACRES 6327.930 ACRES

MAP 2. San Mateo County Parcel Numbers and Jasper Ridge Area Designations.



MAIN PARCEL: 91, 92
 NW CORNER: 96
 SW CORNER: 90
 WEST SIDE: 97, 101, 102, 105, 103
 NORTH SIDE: 85, 86, 89
 EAST SIDE: 93, 94, 95

San Francisquito watershed ranges between sea level and about 600 m in altitude; elevations within the Preserve range between 65 and 200 m.

The geological formation known as Jasper Ridge is an inclined mass of serpentine and related Franciscan rocks that projects about 125 m above the surrounding terrain (Page and Tabor 1967). In addition to the Ridge and plateau to the south, the Preserve includes approximately 8 km of riparian corridor areas and an 40-ha lake and marshland. San Francisquito Creek borders the Preserve on its north and east sides, with tributaries Bear Creek and Corte Madera on the west side. Searsville Lake, a fluctuating reservoir inundated each year during the winter rainy season, was created by a dam built on Corte Madera Creek in the 1890's. These features can be seen on the aerial photo in Map 1.

Within the Preserve are seven of the ten plant communities of central California's coast ranges, lacking only those associated with the Pacific coast. In addition to the freshwater marsh and aquatic plants of Searsville Lake, Jasper Ridge contains large expanses of broadleaf or mixed evergreen forest, chaparral, and grassland, and smaller areas of riparian woodland, oak woodland, and stands of redwood forest (Brown 1981). Altogether, vascular plants representing 82 families, 273 genera, and over 500 species are found in the Preserve. This diversity in part reflects the complex geology of Jasper Ridge; there are seven principal rock types and three soil orders within its borders. In addition the Preserve contains several minor faults and overlaps slightly on its western edge with the San Andreas Fault Zone (Chiariello 1990).

Like the rest of the Bay Area, the San Francisco Peninsula has a coastal mediterranean climate, a Csbn or moderate-summer regime (Kesseli 1942). Summers are semi-arid; winters are cool and humid, and more than 80% of the year's precipitation occurs between November and March. Average monthly temperature in Palo Alto, a few km east on San Francisquito Creek and 12 m above sea level, ranges from 8.2 to 19.1° C (see Table 1, below). Annual precipitation averages 406 mm (Table 1). Precipitation increases sharply with altitude, such that the average at 150 m elevation is about 790 mm, and at the 610-meter summit of the Santa Cruz mountains, more than 1390 mm (Cooper 1922; Thomas 1961). Annual rainfall at Jasper Ridge (about 110 m elevation) has averaged 580 mm over the over the last 15 years (Chiariello 1989). Multi-year droughts are common, and both the timing and amount of precipitation are extremely erratic (see coefficients of variation below).

Table 1 Average Monthly Precipitation (mm) and Temperature (C°)at Palo Alto, California, Based on 42-year weather records (NOAA 1940-82)

	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
Precipitation													
Mean	86.6	63.6	55.4	30.9	15.0	1.7	0.8	1.0	4.3	25.9	49.9	77.1	406.1
S.D.	57.1	51.5	34.3	30.6	42.5	2.9	2.1	3.6	10.2	45.5	43.2	61.0	138.5
CV (%)	66	81	62	99	283	164	263	360	237	176	87	79	34
Temperature													
Mean	8.2	10.5	11.9	12.7	15.1	18.1	18.4	19.1	18.5	15.3	12.0	9.2	14.1
S.D.	1.2	1.3	1.1	1.1	1.3	1.3	0.8	0.8	1.0	0.5	1.1	1.3	1.4
CV (%)	14	13	9	8	8	7	4	4	6	3	9	15	10

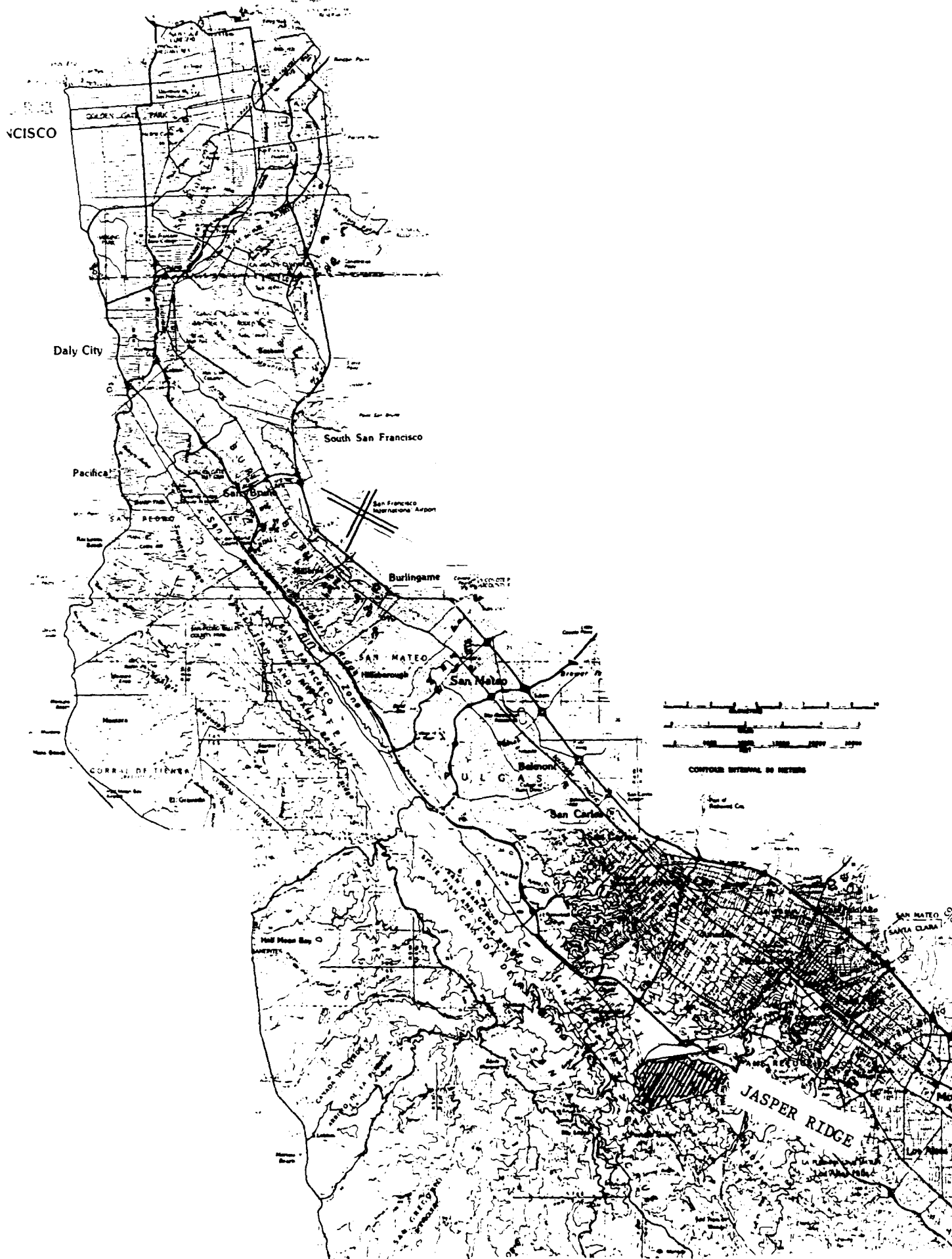
Early Environment

This section examines the evidence for local environmental changes that may have affected Jasper Ridge climate and vegetation since the end of the Pleistocene. Land use history, beginning with American Indian occupation, is discussed in the following sections.

The greatest changes in the post-Pleistocene environment of the San Francisco Bay Area are those related to the Bay itself because until relatively recently the Bay was a broad river valley. This valley was formed in the middle Pleistocene during repeated, large-scale faulting episodes (Hinds 1952). Rivers draining the Sacramento and Santa Clara valleys to the east and south converged in the center of what is now the Bay and emptied into the Pacific Ocean through Golden Gate Canyon. By about 10,000 years ago, rising ocean waters first entered the Golden Gate. The former river valleys were slowly inundated until five or six thousand years ago, when sea level in the Bay reached within a meter or two of its present elevation (Lajoie 1972; Story, Wessels and Wolfe 1966).

The next major change to the Bay occurred during the late 1800's, when millions of cubic meters of debris were deposited in its waters as a result of hydraulic mining in the Sierra Nevadas (Gilbert 1917). This influx of sand, silt and clay obscured the natural substrate and accelerated salt marsh expansion, especially in the south bay where tidal action deposits most silt and clay particles.

We can expect that changes in the size and depth of the Bay have influenced temperature and humidity in the surrounding area,



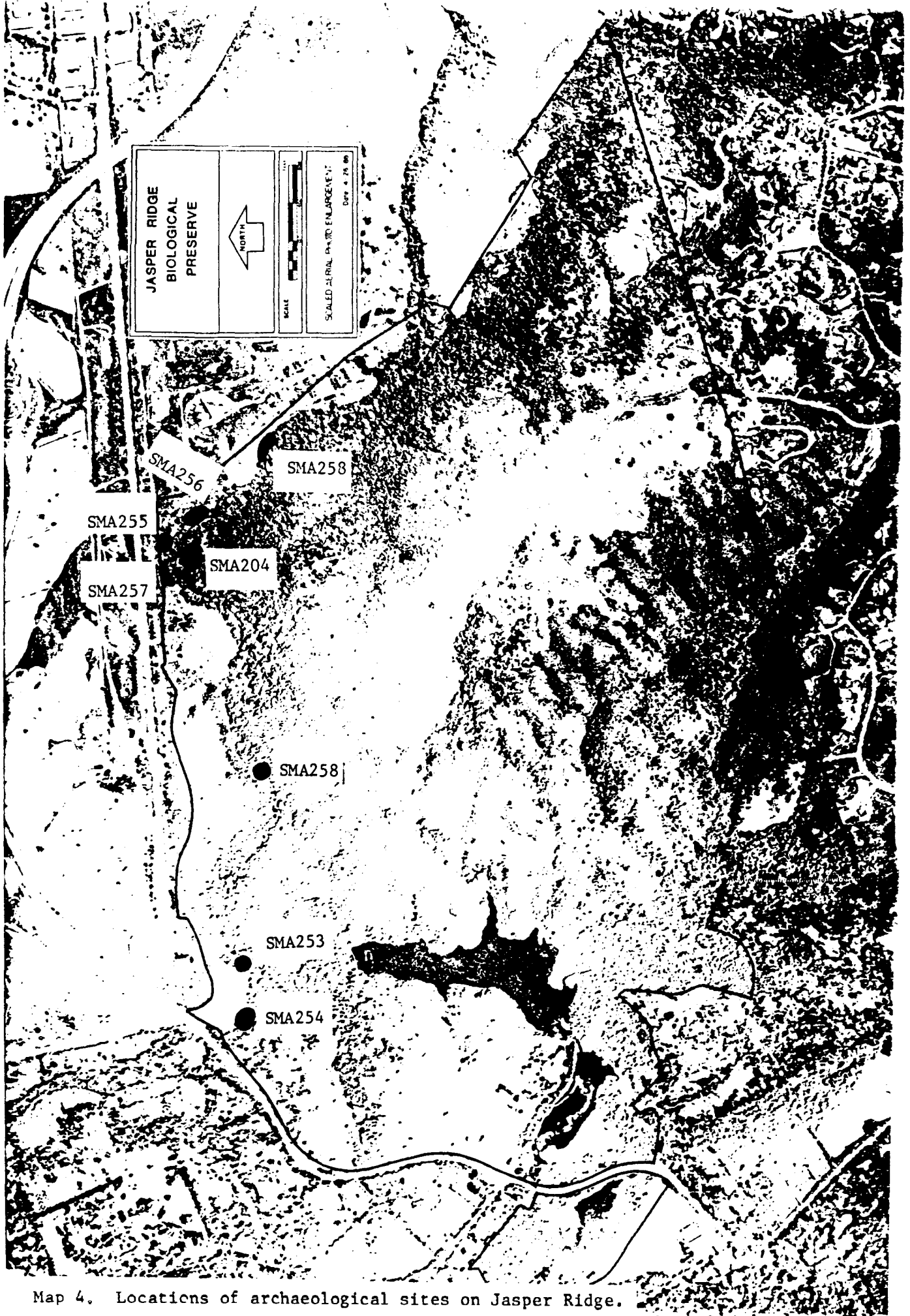
MAP 3. Location of Jasper Ridge on the San Francisco Peninsula (shaded area).

especially during the early Holocene. For the 5000-year period since bayshore stabilization there is conflicting evidence about local climate. Most pollen, plant fossil, sediment, and climate control data indicate that mediterranean temperatures and seasonality patterns have prevailed since the end of the Pleistocene at least (Johnson 1977; La Marche 1973; La Marche and Mooney 1967). In contrast other studies suggest that the summer drought pattern developed only recently, since 2500 B.P. (Heusser 1978). Dendroclimatic data may reflect alternating cool/moist and warm/dry periods during the last 600 years (Johnson 1977). These trends did not create conditions dramatically different from those of today, rather reflecting "increased fogginess, slightly cooler (though still mild) temperatures and...increased precipitation -- though not enough to leach carbonates from the soils" (Johnson 1977:171).

Since the Jasper Ridge Preserve is surrounded on three sides by streams or former watercourses, it is important to understand their seasonality. San Francisquito Creek is described today as an intermittent stream that flows during the winter and spring months, depending on rainfall in the Santa Cruz Mountains. However, many of San Francisquito's higher-elevation tributaries continue flowing, at low water levels, throughout the rainless summer months in all but the driest years. Minimal water is lost to percolation at higher elevations because the creeks flow rapidly, at a steep gradient over impermeable bedrock. Leaving the foothills, where the grade is less steep, these streams lose velocity and much of the water begins to percolate downward into underground stream courses that feed into the bay. There is also greater precipitation at higher altitude, as already mentioned.

Historically, surface water has not been available for summer irrigation in the Bay Area (Clark 1924; Crippen and Waanenen 1969). This seasonal drought pattern was first observed by early Spanish explorers reviewing proposed mission sites around the Bay. On November 28, 1774, one party encountered "three arroyos during the day, two without water and the other containing it only in pools" (Palóu 1930:410). On March 26, the Anza expedition found the San Francisquito arroyo full of water; they also located "a small spring of water, like a well, very near to the water of the estuary" (Font 1930:326-327). Other early observers corroborate these findings, and note that "the further inland one goes, the more frequent and abundant is the running water" (Crespi 1927:31). A late-summer survey of the creek bed at Jasper Ridge described it as follows:

In the creekbed at the [Searsville] damsite water was found on Aug 11th 1888 standing in small pools full of leaves and water moss, a very small amount of water could be seen trickling between boulders from pool to pool... It thus appears that the visible flow of the creek at that time was...about 4800 gallons per 24



Map 4. Locations of archaeological sites on Jasper Ridge.

hours (SU Archives, SC-12 Box 2, G.H. Allardt and C.E. Grunsky, "Inspection of San Francisquito Creek", August 1988).

Since the construction of Searsville Dam, the lower channel of San Francisquito Creek is usually dry by late May, while water continues to be available -- in much reduced quantities -- throughout the summer in the foothills.

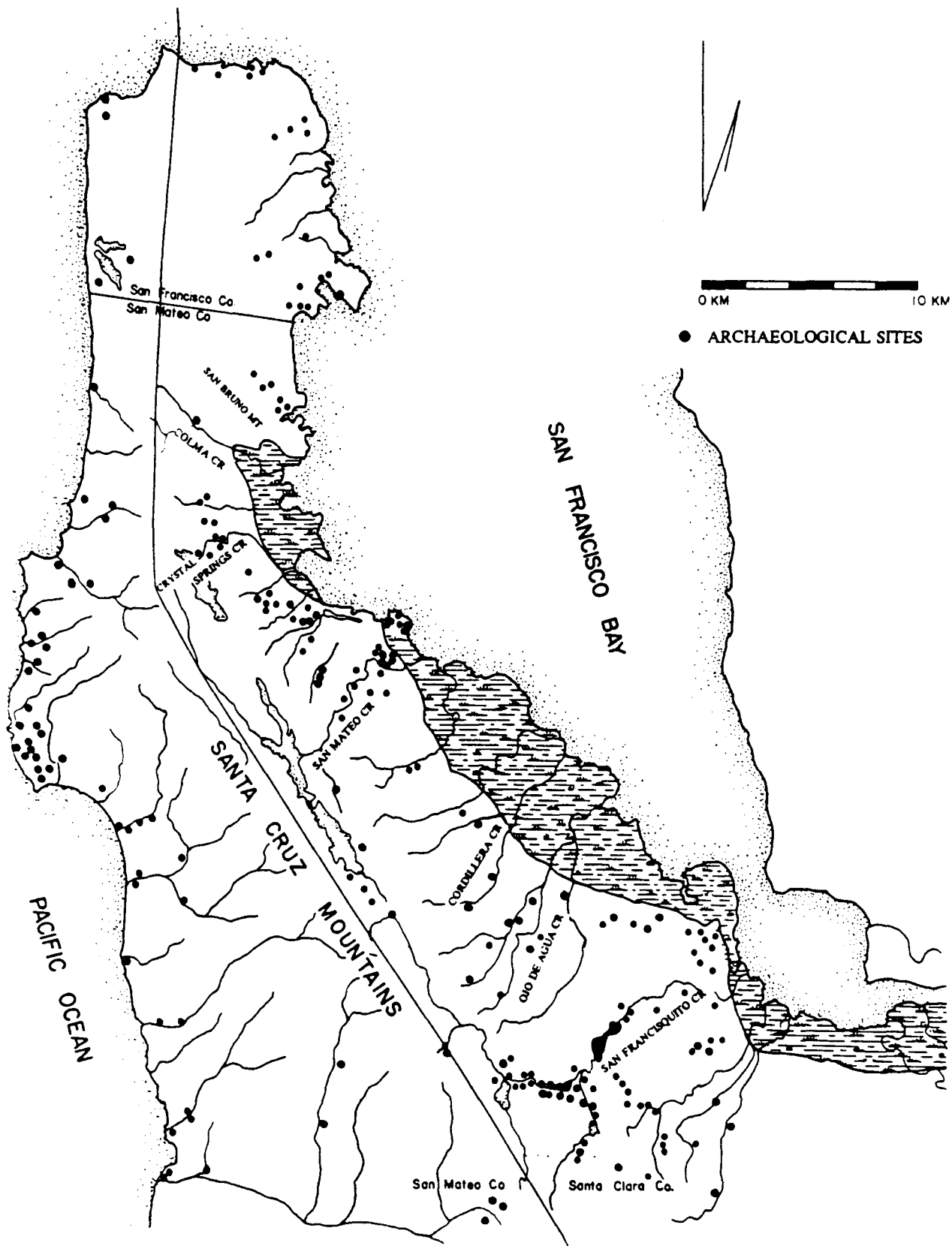
PREHISTORIC HUNTER-GATHERERS OF JASPER RIDGE

Ethnographic Background

Jasper Ridge lies within the area once occupied by the Costanoan or Ohlone Indians, semi-sedentary hunting and gathering peoples native to central coastal California. Eight archaeological sites, inhabited by Costanoan Indians or their ancestors and dating from 2,000 to 600 years ago, are found within the Biological Preserve (Map 4). At the time of first European contact in 1769, Costanoans occupied the entire area from San Francisco south to Point Sur and from the Pacific Coast inland to the Diablo Range. Ethnographic information about central coastal California is scarce, especially for the San Francisco peninsula, although archaeological sites are relatively numerous (see Map 5). The following summary is based on Brown (1974), Harrington (1921-38, 1942), Kroeber (1925), Levy (1978), and Milliken (1983).

No one is certain when Costanoan-speaking peoples first arrived in the San Francisco Bay region. In general, archaeological data confirm that central California was populated soon after the end of the Pleistocene, certainly by about 10,000 years ago. The earliest radiocarbon dates on the San Francisco Peninsula -- 5,000 and 4,000 years ago -- come from the sites of Stanford Man I and II on San Francisquito Creek (see Table 2, below). These were deeply buried sites, 6.1 and 5.2 m below surface, and it is likely that contemporaneous and even older sites exist on the Peninsula but have not been identified thus far. As the list of radiocarbon dates also shows, there has been continuous occupation of the Peninsula during the last few thousand years, especially at lower elevations near the bay and ocean coasts. Most dates from foothill sites (including those on Jasper Ridge) are more recent, within the last thousand years. The Adobe Creek site lies a few km south of Jasper Ridge in the foothills of this neighboring stream drainage. Its two relatively old dates (730 and 1310 B.C.) indicate that the foothills have been inhabited as long as many bayshore areas.

Population slowly increased throughout prehistory until by 1770, 10-15,000 Costanoans inhabited the central California coastal area described above. The population was divided into



MAP 5. Locations of recorded archeological sites on the San Francisco Peninsula.

approximately fifty independent tribes including ten on the Peninsula. Two -- the Puichón and possibly the Olpén or the Guemelento -- held territories in parts of the San Francisquito watershed. Costanoan tribes were small, even for central California; they averaged 40-200 persons, divided among one to five villages within each tribal area. Although anthropologists usually refer to these groups as "tribelets" because of their size, the groups were fully autonomous, land-holding polities, and they represented the largest units of political organization found in California before European contact.

In addition to the 12 sites in Table 2, approximately 300 other prehistoric sites have been recorded from San Francisco and San Mateo Counties. Overall central California had a fairly dense population compared to most world areas with similar hunter-gatherer economies. Plant resources, including numerous types of seeds and acorns, were the dietary staples. To collect, process and store large quantities an elaborate technology was developed, especially for the very small seeds of grasses, legumes, composites and so forth. Hunting, fishing and shellfish collecting supplemented the diet. In most cases, every tribal member held rights in the resources of their group's territory and boundaries between groups were strictly maintained. Extensive trade networks moved foods and raw materials throughout the Costanoan area and beyond to neighboring tribes.

Table 2 Selected Radiocarbon Dates for Jasper Ridge* and San Francisco Peninsula

Site #	Date	Lab #	Age	Site Name
SCL-287	AD 1580	WSU4289	370± 60	Sand Hill Rd.
SCL-464	AD 1510	WSU3434	440± 90	Stanford West
SMA-125	AD 1450	I-07192	500±110	Filoli
SMA-204	AD 1335	WSU2993	615±170	Jasper Ridge*
SMA-256	AD 1280	WSU4152	670± 80	SLAC2*
SMA-256	AD 1230	WSU4208	720± 90	SLAC2*
SMA-257	AD 1160	WSU4210	790± 60	SLAC3*
SMA-256	AD 1140	WSU4151	810± 60	SLAC2*
SMA-125	AD 960	I-06687	990± 90	Filoli
SMA-204	AD 940	BETA3786	1010± 70	Jasper Ridge*
SCL-464	AD 920	BETA6694	1030± 60	Stanford West
SCL-562	AD 895	WSU4287	1055± 65	Radar 515B
SMA-125	AD 895	I-06688	1055± 90	Filoli
SMA-204	AD 890	BETA3787	1060± 60	Jasper Ridge*
SCL-464	AD 795	WSU2994	1155± 55	Stanford West
SCL-464	AD 650	WSU3919	1300± 65	Stanford West
SMA-257	AD 500	WSU4288	1450± 70	SLAC3*
SCL-464	AD 350	WSU3955	1600± 95	Stanford West
SCL-561	70 BC	WSU4298	2020± 80	Radar 515A
SMA-257	190 BC	WSU4209	2140± 85	SLAC3*
SCL-623	400 BC	WSU3653	2350± 80	Children's Hosp
SCL-354	730 BC ²	UCR419A	2680±170	Adobe Creek
SCL-464	1240 BC	WSU3435	3190±200	Stanford West
SCL-354	1310 BC ²	UCR419B	3260±170	Adobe Creek
SCL-613	1650 BC	UCR1781	3600±150	St. Man II
SCL-613	2400 BC	UCLA1425B	4350±135	St. Man II
SCL-613	2450 BC	UCLA1425A	4400±270	St. Man II
SFR-28	2950 BC	W-2463	4900±250	BART Sta.
SMA-269	3180 BC	UCLA1861	5130± 70	St. Man I

By 1800, the Spanish had established seven missions among the Costanoan Indians. Land uses during the mission period are discussed in detail in a later section, but for the original inhabitants, the main impacts of missionization were disease, forced resettlement and rapid loss of their lifeway. The population was reduced to fewer than 2,000 by the early 1830's. By the early 1900's, only a few elderly persons could remember hearing about life before the missionaries arrived. Today, several hundred Costanoan descendants continue to live in the San Francisco and Monterey Bay areas.

Major Plant and Animal Resources

Each of the communities in the Biological Preserve -- mixed evergreen forest, chaparral, oak woodland, grassland, riparian forest, and marshland -- supports animals and plants that were

economically important resources throughout the millennia before European contact. In the mixed evergreen forest, dominant species are the madrone (Arbutus menziesii), tanbark oak (Lithocarpus densiflora), redwood (Sequoia sempervirens) and Douglas fir (Pseudotsuga menziesii). This forest was probably the least important plant community in the vicinity of Jasper Ridge for prehistoric food production, partly because of its species composition, and partly due to steep slopes and inaccessibility throughout much of the forested areas (Lewis 1973). The single most important food would have been tanbark oak acorns. Although other oaks (Quercus spp.) were harvested as well, tanbark acorns were valued for their high oil content, and because they are large and have a thick shell, making them suitable for long-term storage (Wolf 1945).

In addition to oak species, ethnobotanical research has identified 45 common plants of the modern forest community with dietary, medicinal, or raw-material uses recorded for native Central Californian peoples. These include ferns, horsetails (Equisetum) and herbs also found in riparian forest, plus nut- or berry-producing shrubs (Corylus, Gaultheria, Ribes, Rubus).

The California chaparral, is a "dense, dwarf, and one-layered" evergreen brushland that covers large patches along the lower flanks of the Santa Cruz Mountains. Ceanothus, Adenostoma, and Arctostaphylos are the dominant shrubs, depending on soil and exposure. Recurrent fire is the major cause of secondary succession in chaparral (Hanes 1977; Sweeney 1956). The densely interwoven dead wood typical of mature chaparral is extremely flammable and many species' dry, leathery evergreen leaves contain volatile oils. Typically, fire is necessary either to stimulate sprouting from rootstocks or to crack seeds, allowing germination. Soon after fire, even in the dry season, herbs and forbs invade newly burned areas. These are supplanted by grasses after about four years, and by root-sprouting shrubs after another four years or so. As discussed under Land Use Practices, below, California Indians were well aware that repeated burning could prolong the highly productive herbaceous stage in chaparral succession. As a result it is difficult to reconstruct the amount of area dominated by chaparral at any point in time on Jasper Ridge.

Unlike the forest and woodland areas where acorns are produced, the chaparral has no single outstanding plant food resource. Rather there are total of 68 species with known aboriginal uses. Many of these are herbs with medicinal uses (Angelica, Eriogonum, Paeonia, Trillium); others are shrubs with edible seeds or fruits (Prunus, Sambucus), or woody stems and roots used in baskets or other products (Adenostoma, Cercis). More than half of the important chaparral plants are also common in the oak woodland and grassland communities.

There are two phases of oak woodland in the San Francisquito watershed, both of which may vary from dense woodland to more open savannah with occasional trees. At lower elevations the valley oak (Quercus lobata) phase is more common, replaced at higher elevations including Jasper Ridge by a blue oak (Q. douglasii) phase. The latter incorporates significant local stands of coast live oak (Q. agrifolia) and black oak (Q. kelloggii) (Cooper 1926; Porter 1962). While the acorns of nine oak species were used as foods, the four species mentioned here plus the tanbark oak were the most important sources throughout California, due to taste and productivity. The tanbark oak is not present in the Biological Preserve today although large stands are found at higher elevations in the watershed.

As a dietary staple, nutrient composition studies indicate that acorns were a high-calorie food source, low in carbohydrates and protein, high in fat and fiber (Wolf 1945). In addition to its oaks, the oak woodland community has 72 trees, shrubs, grasses and other herbaceous plants with known pre-contact uses. Some of the most important are the buckeye (Aesculus californica) and bay laurel (Umbellularia californica), both widely distributed, sagebrush (Artemisia), soaproot (Chlorogalum pomeridianum), and medicinal herbs like Gnaphalium and Verbena.

Widely distributed throughout the coast ranges prior to European contact, the California grassland or prairie has been significantly reduced in size and altered in species composition (see Ranching and Farming, below). The original community was composed of dominant perennial bunchgrasses with associated annuals; important species include needlegrass (Stipa pulchra), wild rye (Elymus), bluegrass (Poa scabrella), native oatgrass (Danthonia californica), and Festuca, Melica and Deschampsia species (Beetle 1947; Heady 1977).

The associated broad-leaved herbs and forbs of the grassland included numerous legumes, composites, mints, and other species with edible seeds, bulbs and/or leaves. Many had medicinal uses as well. A total of 60 grassland species have been recorded and undoubtedly, many have been overlooked. Although small -- even minute, the seeds of many grassland and woodland species were sufficiently abundant and valuable to be gathered and stored in bulk, and used as staples of the diet. In the San Francisco Bay Area, in fact, seeds may have rivaled acorns in terms of total dietary contribution.

They never toasted the seed of the pil (Calandrinia ciliata) in sand, for the seed is finer than the sand... She would put flour paste all over [a basket] and would then take amol (Chlorogalum pomeridianum) and grind it up and put the ground-up amol on top of the paste, it stuck better than glue... And then she made a good fire and...and at once the pil used to turn

white...she would pound up the toasted pil in a mortar until it was very fine. And then she would make little cakes (Informant unknown; Harrington 1921-1938).

The two remaining communities are riparian forest and marshland, with which several important aquatic and semiaquatic plants are associated today. As suggested previously, the uppermost corridor of San Francisquito Creek was probably a perennial water source before dams and logging activity upstream altered the nature of the watershed. The present-day marsh surrounding Searsville Lake, on the other hand, dates from Searsville Dam construction in the late 1890's, so its aquatic resources would not have existed in prehistory. Corte Madera Creek and several smaller streams would have met in the canyon now underlying Searsville Lake. For this reason the resources available to Costanoan inhabitants includes only those common to riparian habitats, about 44 species in all. Trees and shrubs furnished foods and raw materials; important species include Acer, Alnus, Corylus, Rosa, Rhamnus and Salix. Basketry used roots, leaves and stems of many ferns, rush-like plants (Juncus, Scirpus, Typha) and horsetails (Equisetum). Woodland and grassland plants with medicinal uses are also found along streambanks; some used by Costanoan healers and not mentioned above include Clematis, Helenium, Navarretia, Senecio, and Viola.

Land Use Practices

Historically, native peoples of western North America have been referred to as hunters and gatherers because the plants and animals they exploited did not include fully domesticated species, completely dependent on human intervention. On the other hand, hunting and gathering did not mean simply foraging (Bean and Lawton 1976). There is increasing evidence that in precontact California, gathering relied on numerous horticultural techniques such as "coppicing [stem-cutting close to ground level], weeding, above and below ground pruning, digging, selective harvesting, burning and sowing" (Anderson 1989:110).

Many practices, such as burning and selective harvesting, increased the yield, productivity and ease of access to important plant species. Other practices affected individual shrubs and trees in various ways. For example, basket-makers among Anderson's Miwok informants have traditionally coppiced redbud (Cercis occidentalis), deerbrush (Sambucus sp.) and willow (Salix spp.) to encourage vegetative sprouting and to control specific traits of new shoots, as follows:

Color; size (length, diameter), number of leaf scars of other blemishes; texture; flexibility; ease of bark removal; ease of splitting; number of lateral branchings; kinks or bends; pith size (Anderson 1989:129).

Similar efforts focused on roots of species such as sedge (Carex spp.) or bulrush (Juncus spp.).

One advantage of going back every second year...to a good root-digging place is that you keep the roots from getting over-abundant... When you run into roots of other plants, you should take them out so the sedge roots can grow without competition, much as you weed a garden... As certain root areas or gardens are cultivated regularly...the roots become longer and longer and easier to get out...the sedge roots grow back quickly after being taken out -- as long as you leave some in the ground (Allen 1972:18-19).

Throughout California native peoples cultivated wild tobacco (Nicotiana bigelovii), even tribes where few other horticultural practices are recorded. Common practices included field burning and other preparation of the ground, saving and sowing tobacco seeds, and pruning the nearly mature plants.

It was relatively late in the summer when the women embarked upon a series of prunings of the individual tobacco plants and may have done some weeding at the same time. There were three prunings a week apart... On each occasion the small weak leaves, the new growth at the junctures of the large leaves and stalks, and the flowering tops were broken off [leaving] only the large healthy leaves on the stems (Zigmond 1981:43-44).

The use of fire is probably the best-documented management practice of aboriginal Californians (Lewis 1973; Reynolds 1959; Sampson 1944; Stewart 1951). Studies by ethnographers, foresters and others list numerous reasons that Indian informants offer for burning vegetation, such as to increase seed yields; drive game; stimulate wild tobacco growth; make foods more accessible; remove or thin forests, increasing other vegetation; improve visibility; improve forage quality or speed its growth in spring; expel snakes or insects, including plant pests; and to facilitate travel (see Reynolds 1959:139 and Anderson 1989:138-143).

"The heathen are wont to cause these fires because they have the bad habit, once having harvested their seeds, and not having any other animals to look after except their own stomachs, they set fire to the brush so that new weeds may grow to produce more seeds, and also to catch the rabbits that get confused and overcome by the smoke" (Monterey, 1774; in Lewis 1973).

Woodland was burned to clear the ground under oak groves. In both woodland and grassland, fires encouraged new growth of

grasses and forbs. Mature chaparral was burned to clear areas for hunting; by repeated burning, dense stands herbs and forbs could be maintained beyond their normal four to five year period in post-fire succession. Although fires undoubtedly escaped at times and burned across large areas, the plots deliberately burned by native Californians appear to have been small. Whether they understood "edge effect" is unknown, but small burned areas of two to four ha produce the greatest increases in bird and mammal population density after fire (Biswell 1967).

Whether or not they recognized that the protein quality of browse is improved after fire, they certainly observed that new resprouting shoots were available beyond the normal spring growth period. Overall the result of burning could be to increase the number of quail by two and a half times, deer by four times and jackrabbits by four and a half times as abundant as populations in unburned areas (Biswell 1967).

Burning, pruning, thinning and other practices were common throughout the state. Although relatively small plots were affected at any one time, this type of land use may have continued for many thousands of years. Overall there must have been marked effects, at least locally, on plant propagation and morphology as well as on the range of certain species. As a result California Indian economy is often described as resource management, rather than resource harvesting, and as quasi- or proto-agricultural rather than hunting and gathering (Bean and Lawton 1976; Ziegler 1968).

It is often assumed that the American Indian was incapable of greatly modifying his environment... In fact he possessed both the tool and the will to use it. The modification of the American continent by fire...was the result of repeated, controlled, surface burns on a cycle of one to three years, broken by occasional holocausts from escape fires and periodic conflagrations during times of drought... So extensive were the cumulative effects of these modifications that it may be said that the general consequence of the Indian occupation of the New World was to replace forested land with grassland or savannah, or where the forest persisted, to open it up and free it from underbrush (Pyne 1982: 71, 79).

Setting fires was probably the most widespread and influential human disturbance to the landscape before the arrival of European settlers. Some researchers assert that oak savannah originally characterized much of California that now is covered with chaparral (Stewart 1951). On the other hand, some scholars argue that overall Indian population density was too low, and their technology too simple, to have caused significant impacts (Burcham 1974; Sampson 1944). We do know that in 1793 the

Spanish Governor of California issued a proclamation forbidding the Indians to burn fields (Dodge 1975:16), so fires must have been fairly frequent and destructive, in European eyes at least.

The debate over the Indians' impact may never be resolved in the absence of physical evidence indicating fire frequency before and during human occupation of California. Some studies, as cited by Dodge (1975:5), indicate that fires have occurred in the central Sierra Nevada Mountains once every eight years, on the average, since AD 1540. This rate has undoubtedly increased during the last 10,000 years with the Holocene's drier climate, and the arrival of hunters and gatherers throughout the New World. The Indians used fire to attain certain goals; on the other hand, California's grassland, chaparral and woodland communities were already preadapted to regular fire. Either way, fire has been an essential part of California ecology for as long as its mediterranean climate and plant communities have co-existed here, which certainly predates human occupation.

There have been other, long-term, and at least initially, unintentional effects on plant populations. For example, the native California walnut (Juglans hindsii) is almost inevitably found near old Indian village sites (Munz and Keck 1959). Over several thousand years, there must have been numerous instances of dropped or discarded walnuts as well as other fruits and seeds, later germinating near villages or along trails between villages and harvesting areas. Technology also played a role; the seed-beater baskets used to gather grass and other seeds resulted in seed dispersal throughout the collection area (Anderson 1989:158). Repeated selection of bigger, more palatable, or more easily collected plants, while not resulting in fully domesticated species, may have affected the size or other features of frequently harvested plants.

Compared to the effects of plant gathering, there was little direct impact to the landscape from hunting and fishing other than the use of fire -- to facilitate travel and to provide new forage for game. In addition California Indians used fire to drive deer or small game like rabbits through the brush, and to drive colonies of ground squirrels from their burrows. Other than that, most hunting relied on nets, traps, snares, and decoys. Fish in the shallow waters of San Francisco Bay were taken with spears. In streams like San Francisquito, however, the most common fishing method was to create a pool with a temporary rock dam and then poison the water, using preparations made from amol, or soaproot (Chlorogalum) or other plants.

She had gathered the amol in the hills and brought a big bunch of it roots stalks and all home. She took it to a good sized posa [waterhole] in Carmel river and near that posa she pounded the amol... Then she put the bruised amol in a gunny sack...so the [foam] would

come out into the water. The fish came to the surface, borrachos [drunk]... (Harrington 1921-1938).

One indirect result of regular deer hunting in and around Jasper Ridge might have been to encourage oak regeneration. Oak seedlings and stump-sprouts are browsed by deer as well as cattle (Mensing 1977). To the extent that small mammals cause oak seedling mortality (Griffin 1980), systematic hunting of small mammals might have had the same effect on oak regeneration as deer hunting.

Jasper Ridge Archaeological Sites

Of the eight prehistoric sites in the Jasper Ridge Biological Preserve, five are villages, or occupation sites, based on the overall size of their prehistoric deposits and the range of artifacts they contain. The villages are Bear Creek (CA-SMA-254), 100 m upstream from the confluence of Bear and San Francisquito Creeks, and four sites 1.5 km downstream, including the Jasper Ridge, SLAC1, SLAC2 and SLAC3 sites (CA-SMA-204, -255, -256, -257). The SLAC sites are named for the Stanford Linear Accelerator Center which borders the north side of the Preserve (see Map 1). Each of these villages is situated within a few meters of the creek bank as are most archaeological sites on the San Francisco Peninsula. The vegetation on site is grassland (largely introduced Avena, Hordeum, Lolium) with occasional oaks or chamise brush, bordered by riparian woodland.

Three other archaeological sites in the Preserve contain materials suggesting "special use", non-residential functions. One of these is Rattlesnake Rocks (CA-SMA-253), an area of massive sandstone outcrops and tumbled boulders covering the northwest corner of the Ridge. There are 37 bedrock mortars (grinding holes) found throughout the rocks, both at the base of the rocks and on narrow ledges near the summit, 50 meters above. Eroded chambers in the sandstone form several shallow rockshelters here, but none have evidence of use although artifacts are occasionally found in the brush nearby.

A second special use site, Big Biface (CA-SMA-258), named for an obsidian spearhead found on the surface. This site is in the redwood stands on the south bank of San Francisquito Creek between Bear Creek and the Jasper Ridge/SLAC sites. Surface materials are limited to burned rock and stone tool fragments, and the absence of shell and bone fragments suggests a non-residential function for this area. One possible use may have been creek-side tasks such as washing, leaching acorns, trapping fish, and so forth. This is one of few locations where the creek flows over exposed bedrock, with high points that serve as a natural ford when the creek is too deep to cross elsewhere.

Finally, the Dennis Martin site (CA-SMA-291) is the least

well known. It is located in an area affected by European settlers' activities beginning in the mid-1840's; today there are only a few prehistoric artifacts scattered on the surface.

Several other archaeological sites are located within a km of Jasper Ridge. In the hills near the Stanford Linear Accelerator are a few flake scatters and quarry sites, where raw materials for stone tools were extracted. Downstream in the Webb Ranch area are another dozen sites. Some are villages; the others are vast scatters of stone tool material covering as many as 9 ha. Taken together, the adjoining Jasper Ridge and Webb Ranch lands have a higher density of archaeological remains than any other area of similar size on the San Francisco Peninsula. While we will never be certain of the population size here in prehistory, the number of villages and the presence of other, specialized activity sites reflects repeated if not continuous use by a substantial group of people throughout the last thousand years before European contact.

Three of the eight sites in the Biological Preserve have been excavated and data relevant to prehistoric land use will be summarized here. The Jasper Ridge site consists of a 5000-m² midden deposit with a large bedrock outcrop containing 45 mortars. This site sits on a broad, level terrace at the foot of the Ridge, several meters above the south bank of San Francisquito Creek. SLAC2 and SLAC3, directly opposite on the north bank, lie on an outward curve of the creek channel. These sites were probably as large as the Jasper Ridge site, but both have been badly eroded by the creek. The SLAC sites have also suffered greater disturbance from post-contact activities beginning with the 1840's purchase of the land north of the creek by settler Dennis Martin (see Logging, below). The Jasper Ridge site, protected by the deep creek channel on one side and the Ridge itself on the other, was never used as intensively.

The Jasper Ridge site was excavated in 1980, 1981, and 1982 by students in Stanford University field methods courses (Bocek 1987). Two sites in the same cluster, SLAC2 and SLAC3, were excavated in 1990 by students in Stanford's Continuing Studies Program (Bocek n.d.). While several thousand artifacts were recovered by these projects, the following discussion will focus on ecofacts, or the remains of animals and plants, and their implications for aboriginal land use. Animal bone fragments and the few plant materials larger than 0.6 cm were recovered by passing all excavated soil through 1/4-inch hardware cloth. Smaller bone fragments, and most carbonized plant remains (seeds, nutshells, etc.) were recovered by other sampling methods including soil flotation (Bocek 1987).

As listed in Table 2, most of the radiocarbon dates from Jasper Ridge, SLAC2, and SLAC3 suggest relatively recent occupation, beginning about a thousand years ago. Note that the

A.D. 1335 date from Jasper Ridge is problematic; it was based on a small charcoal sample and has a standard error of 28%. Of all Jasper Ridge sites the dates from SLAC3 are most interesting because of the significantly earlier sample from 320 B.C. This is the earliest evidence of occupation in the Preserve thus far and it indicates that the Preserve has a longer period of continuous occupation than we previously suspected.

Botanical and Faunal Remains

Table 3, below, lists the plants identified thus far among the carbonized materials from the Jasper Ridge and SLAC sites. Only three taxa (Lithocarpus, Mentzelia, Nicotiana) are not found today within the Biological Preserve. The habitats of the others are noted, as well as whether or not the plants are fire-followers, and what their uses were in pre-contact times.

Botanical remains are crucial for understanding subsistence and for determining seasonality despite numerous problems with the analysis and interpretation of such materials. Due to soil and moisture conditions, in central California archaeological contexts plant remains only survive if they are completely carbonized. Such remains include burnt seeds, wood charcoal, charred bulb fragments, and burnt hulls and kernels of nuts and other fruits. Soft or fibrous plant materials do not preserve as well as seeds, hulls or wood; plants which never come into contact with fire, accidentally or deliberately, are not preserved at all.

There are many different processes by which plant materials may be burned and subsequently incorporated into a midden. Plant products were cooked and used as fuel; they also furnished raw materials for houses, baskets, and numerous other objects that could burn accidentally or could be discarded in a fireplace. Plant material in the context of a hearth or earth oven may be assumed to have been burned on purpose. But because most charred plants are found dispersed throughout an archaeological deposit, and not inside a hearth or oven, plants burnt by accidental fires cannot be distinguished from those used as food or fuel. This is particularly true in areas like Jasper Ridge where natural fires were frequent in the native plant communities.

Table 4A and 4B, below, follows standard procedure by distinguishing between small seeds and larger fruits or shell fragments. This allows us to compare percentage contributions by count for seeds, which are whole but inevitably weigh less than .01 g, and by weight for larger plant parts which are inevitably fragmentary. Percentages are shown in descending order for the Jasper Ridge site which had the largest samples; SLAC2 and SLAC3 (combined) are here compared with Sand Hill and Stanford West, two lower-elevation sites, 2 1/2 km farther downstream on San Francisquito Creek east of the Biological Preserve.

It is important to remember that many variables affect the frequency of excavated plant remains. For example, the most abundant category by weight at Jasper Ridge was the hazelnut (Corylus cornuta). Hazelnut fragments outweigh acorns (Quercus and Lithocarpus) by almost 5 to 1; in addition the numerous unidentified nutshells are more likely to be hazelnut than acorn fragments. Since acorns were a well-documented dietary staple in pre-contact California their relative scarcity here is somewhat surprising. However, there are several possible explanations. First, hazelnut hulls are thick and dense relative to acorn hulls; more hazelnuts might survive in the archaeological record. Second, the abundance of hazelnuts might reflect summer as opposed to fall seasonality; today hazelnuts ripen in July, acorns in late September or October. Third, relative abundance could reflect different processing and storage procedures. If hazelnuts were scorched before cracking, or if hulls were cracked into larger pieces, more hazelnut than acorn remains would be preserved.

Animal bone from inland archaeological sites on the San Francisco Peninsula generally consists of small fragments, where most fragments are burnt and those unburnt are badly eroded. Presumably the lack of preservation reflects butchering, cooking, and waste disposal methods, as well as rodent disturbance and soil pH (7.2-8.2, neutral to slightly alkaline). There is little evidence of gnawing, crushing, or butchering marks on the bone but most pieces are too eroded for surface features to be visible. Due to fragmentation and burning, less than 5% of more than 20,000 bone fragments recovered were identifiable to the level of species or genus. Table 5, below, lists the vertebrate fauna identified in the archaeological bone samples recovered from Jasper Ridge, the SLAC sites [still in process] and Stanford West.

The invertebrate fauna at Jasper Ridge and other sites along San Francisquito Creek consists of more than thirty marine or brackish-water taxa, plus a few land snails (Helix) and freshwater clams that may be modern. At contemporaneous sites, differences in the proportions of major shellfish foods such as oysters, mussels and horn snails may mean that the inhabitants of each site focused their collecting activities in different coastal microenvironments. For sites separated in time, different proportions may also reflect changes in coastal configuration, especially at stream mouths along San Francisco Bay.

The presence of shellfish species known only from the Pacific Coast is interesting because, while only 17 linear km west of Jasper Ridge, the coast can only be reached by crossing the 600-m summit of the Santa Cruz Mountains. The bayshore is much closer and more accessible. However, the sea mussels and

other ocean species demonstrate that Jasper Ridge inhabitants either traded with ocean-side tribes or traveled to the coast periodically. Additional evidence of exchange with the Pacific coast is the presence of Monterey Banded chert, a valuable lithic raw material, in San Francisquito sites. Monterey Banded is a higher quality chert than the locally available Franciscan material and tends to contribute about 5-10% of the total stone tool assemblage.

Table 3 Habitat and Native Uses for Plants from San Francisquito Creek Archaeological Sites

Genus/Family	Common Name	Where Found at Jasper Ridge	fire- assoc	Costanoan use		
				food	med.	other
Juglans (Juglandaceae)	walnut	Riparian		X	X	
Corylus (Betulaceae)	hazelnut	Riparian, Forest		X		X
Lithocarpus (Fagaceae)	tanbark oak	Not Present		X	X	X
Quercus (Fagaceae)	bl/white oak	Woodl., Forest, Chap.	X	X	X	X
Eriogonum (Polygonaceae)	buckwheat	Grassland	X		X	
Calandrinia (Portulacaceae)	redmaid	Grassland	X	X		
Montia (Portulacaceae)	miners lettuce	Wooded, moist areas	X	X		
Atriplex (Chenopodiaceae)	salt brush	Lake shore		X		
Chenopodium (Chenopodiaceae)	pigweed	Various			X	X
Umbellularia (Lauraceae)	bay laurel	Riparian, Forest	X	X	X	X
Ranunculus (Ranunculaceae)	buttercup	Various	X			
Heteromeles (Rosaceae)	toyon	Chaparral	X	X		
Prunus (Rosaceae)	wild cherry	Riparian, Chaparral	X	X		X
Aesculus (Hippocastanaceae)	buckeye	Riparian, Forest	X	X	X	X
Mentzelia (Loasaceae)	blazing star	Not Present		X		
Marah (Cucurbitaceae)	manroot	Wood., Forest, Chap.	X		X	X
Arbutus (Ericaceae)	madrone	Forest		X		
Arctostaphylos (Ericaceae)	manzanita	Chaparral	X	X	X	
Galium (Rubiaceae)	coyote grass	Grassland, Woodland	X		X	
Phacelia (Hydrophyllaceae)	phacelia	Rocky areas	X		X	
Amsinckia, Plagiobothrys (Boragin.)	fiddleneck	Grassland				
Verbena (Verbenaceae)	verbena	Disturbed areas				X
Salvia (Lamiaceae)	chia, sage	Grasslands	X		X	
Nicotiana (Solanaceae)	wild tobacco	Not Present			X	X
Solanum (Solanaceae)	nightshade	Various			X	X
Plantago (Plantaginaceae)	plantain	Various	X		X	
Sambucus (Caprifoliaceae)	elderberry	Chaparral		X	X	X
Hemizonia (Asteraceae)	tarweed	Grassland	X	X		X
Madia (Asteraceae)	tarweed	Various	X	X		
Asteraceae, other	various	Various				
Hordeum (Poaceae)	wild barley	Grass, dist. areas		X	X	
Phalaris (Poaceae)	maygrass	Riparian				
Poaceae, other*	various	Various				
Carex (Cyperaceae)	sedge	Riparian				X
Chlorogalum (Liliaceae)**	soaproot	Grassland, Chaparral		X	X	X

* Other Poaceae include Bromus, Deschampsia, Elymus spp., final I.D. pending.

** Charred soaproot recovered from large-fraction samples, not flotation. Other Liliaceae or Amaryllidaceae (bulb fragments) remain to be identified.

Sources: Bocek 1984; Chestnut 1902; Mead 1972; Paranal et al. 1990; Porter 1962; see Cowan 1978 for references to use of Phalaris sp. as food resource.

Table 4 Charred Seeds and Larger Plant Remains from Light and Heavy Flotation Samples; Jasper Ridge Percentages Compared with Other Local Sites

Table 4A Heavy Fraction: Percentage by Seed Count

	J. RIDGE	SLAC2/3	SAND HILL	ST. WEST
Poaceae*	60.7	54.4	47.9	69.7
Asteraceae	13.9	11.4	12.8	7.1
Madia	5.9	1.5	2.8	0.2
Leguminosae	3.5	5.1	.0	0.9
Boraginaceae**	2.9	2.2	0.9	0.4
Phalaris	2.2	2.6	2.4	2.3
Mentzelia	2.1	12.9	19.9	0.9
Chenopodium	2.1	6.6	10.0	2.8
Solanum	1.7	0.7	0.5	0.4
Salvia	1.5	.0	0.5	0.4
Galium	1.2	0.4	.0	1.2
Montia	0.8	0.4	.0	1.1
Plantago	0.6	0.4	.0	.0
Phacelia	0.2	.0	.0	.0
Calandrinia	0.2	1.1	1.4	6.3
Ranunculus	0.1	.0	.0	0.1
Eriogonum	0.1	.0	.0	.0
Carex	0.1	.0	.0	.0
Verbena	0.1	.0	.0	.0
Portulacaceae***	.0	.0	.0	2.2
Chenopodiaceae	.0	.0	.0	0.1
Hemizonia	.0	.0	0.9	.0
Hordeum	.0	.0	.0	0.3
Atriplex	.0	.0	.0	3.8
Nicotiana	.0	0.4	.0	.0
Total counts	892	272	211	2160

* Includes Bromus, Deschampsia, Elymus spp.; final identifications are pending.

** Includes Amsinckia and/or Plagiobothrys. *** Either Montia or Calandrinia.

Table 4B Heavy Fraction: Percentage by Weight*

	J. RIDGE	SLAC2/3	SAND HILL	ST. WEST
Corylus nutshell	49.0	4.5	.0	(2)
Unid. nutshell	26.6	8.6	2.7	15.1
Quercus acorns	7.3	0.3	24.3	1.3
Prunus nutshell	5.2	0.9	8.1	55.6
Bay nutshell	2.9	1.1	2.7	1.5
Bulbs/corms**	2.5	67.6	5.4	10.2
Quercus/Litho. acorns	1.6	7.8	8.1	4.0
Lithocarpus acorns	1.4	5.7	10.8	1.6
Unid. nutmeat	1.2	2.2	.0	2.8
Unid. fruit (cf. Prunus)	0.5	(1)	5.4	4.1
Marah shell	0.5	0.1	.0	1.2
Heteromeles fruit	0.5	.0	.0	1.0
Aesculus shell	0.4	0.1	10.8	1.8
Arctostaphylos fruit	0.4	0.0	0.0	(2)
Sambucus fruit	(2)	(1)	(1)	.0
Juglans shell	.0	0.9	21.6	.0
Arbutus fruit	.0	.0	.0	.0
Total weights (g)	8.93	5.61	0.37	9.43

* (N) represents counts where weights were less than 0.01 g.

** Liliaceae (soaproot?) or Amaryllidaceae, identifications not yet confirmed.

Jasper Ridge plant remains represent locally available plants that were also common sources of food, medicines and raw materials. Evidence for seasonality includes the carbonized seeds, hazelnuts, and acorn that were collected in late spring, summer and fall. As with plants, animal remains are those of common local resources. Elk and antelope remains were scarce relative to deer, which is logical if deer inhabited the foothills, and elk and antelope the marshland and grassland. Jasper Ridge vertebrates include the animals most often reported for central California sites. Turtle remains are positive evidence that the creek was a permanent water source, since pond turtles are fully aquatic and do not inhabit intermittent streams.

Bay and ocean shellfish indicate that local foothill food resources must have been somehow inadequate -- in quantity, quality or perhaps in dietary variety. Since Jasper Ridge inhabitants chose to import shellfish rather than shift residence closer to a shellfish source, there must have been significant constraints on group mobility. I suggest that a powerful incentive was necessary for people to haul an estimated 2-3 metric tons of shellfish to Jasper Ridge from the bayshore -- to say nothing of resources from the ocean, or of shells discarded off-site. More shell and fish bone are present in bayshore sites, but the Jasper Ridge remains seem abundant for a foothills deposit. Comparative data will become available as more foothill sites are excavated.

Faunal remains support few claims about site seasonality. Chitons, horn snails and sea mussels -- tentative indicators at best -- suggest occupation at different seasons but together these seasons span the entire year. Although fur seals are only present in winter, a single forelimb element cannot be considered evidence of winter occupation. Numerous bat ray and shark vertebrae argue for summer seasonality. Altogether, plant and animal remains suggest spring, summer and fall site use, with no solid evidence for or against winter occupation.

Ethnographic data suggest that thirty to forty people would have occupied a settlement the size of Jasper Ridge's core area. This is well within the range of village populations on the San Francisco peninsula, although more sizeable settlements were also observed by early explorers. If a larger portion of the site than just its central subarea had been used to calculate population, resulting group size would be appreciably larger. Thirty or forty people should thus be considered a minimum. A group of thirty or forty might not constitute a large village, but they would certainly represent three or four extended-family households, and not a temporary camp.

Table 5 Vertebrate Species - Count and Percentage by Number of Elements

	JR ct, %	SLAC ct, %	StW ct, %
Thomomys bottae (pocket gopher)	288		323
Odocoileus hemionus (mule deer)	135		134
Pituophus, Crotalus etc (snakes)	132		82
Citellus, Sciurus etc (nongopher rodents)	78		81
Sylvilagus bachmanii (brush rabbit)	58		49
Myliobatis californica (bat ray)	32		92
Clemmys marmorata (pond turtle)	24		25
Canis, Lynx (coyote, bobcat)	21		108
Triakis, Mustelus, Alopias etc (sharks)	15		6
Aves not waterfowl (quail, owl, hawk)	10		38
Cervus nannodes (tule elk)	7		77
Scapanus latimanus (mole)	7		21
Anatidae, Ardeidae (duck, heron), cormorant	6		10
Ursidae (bears - black & grizzly)	6		28
Otariidae (eared seals & sea lions)	5		5
Lepus and other lagomorphs	3		47
Antilocapra americana (antelope)	2		0
Mustelids (skunk, raccoon, badger, weasel)	1		9
Gerrhonotus coeruleus (alligator lizard)	1		0
Acipenser (sturgeon)	1		1
Bufo, Rana (frogs and toads)	0		7
Enhydra lutris (sea otter)	0		8
Felis concolor (mountain lion)	0		6
Total Counts:	832		1157

Fish scales and vertebrae recovered from flotation samples only:

Atherinidae (topsmelt, jacksmelt)	5	651
Gillichthys mirabilis (longjaw mudsucker)	0	4
Engraulis mordax (n. anchovy)	0	1

The sites discussed above span nearly 5,000 years of prehistory, dating from 3180 BC (Stanford Man) to AD 1510 (Stanford West). Although analysis thus far has focused on spatial distributions, observed site locations may reflect long-term change through time -- in resource structure or in human use of the landscape. Radiocarbon dates for the San Francisquito watershed can help evaluate these possibilities (Table 2).

Dates from bayshore sites span about 2500 years (earliest University Village to latest Hiller, including Tarlton and Greer Road). Earlier bayshore sites probably exist but now underlie salt marsh or landfill at the edge of the bay. Sites in the upper alluvial fans -- Stanford Man, Stanford West and Oak Knoll -- span a much longer 4700-year period because of two early dates from Stanford Man I and II.

We know least about the foothill occupation history. Jasper Ridge dates range from AD 890 to AD 1335, although the latter has a large standard error and may not be accurate. Radiocarbon determinations are also available from three foothill occupation sites in similar creek drainage systems on the peninsula. Two sites, Filoli (SMA-125) and San Bruno Mountain (SMA-100), are contemporaneous with Jasper Ridge. The third site, Adobe Creek (SCL-354), has been dated to 1310 BC and 730 BC.

These early dates are important because Adobe Creek is the next major drainage south of San Francisquito, and Adobe Creek and Jasper Ridge are only 10 km apart. The dates are probably reliable; both samples were taken from material associated with human burials and the dates are supported by Olivella disc bead and charmstone types (S. Heffley, personal communication). Although no early dates are available from the San Francisquito foothills, Adobe Creek suggests that further work is likely to identify contemporaneous deposits in the study area.

It is possible that the lack of early foothill sites reflects a minimal human presence in the San Francisquito foothills before the late prehistoric period. Of four foothill sites on the western peninsula, three date to AD 900 or later. Sites at lower elevations are more evenly distributed across time, considering that earliest bayshore deposits are almost certainly buried below the salt marsh. If pre-AD 900 settlements were limited to lower elevations, the subsequent appearance of foothill villages could reflect increased population density, intensified trade and greater reliance on foothill plant resources, as Moratto (1984:283) and others have suggested.

FIRE HISTORY STUDIES

As the previous sections indicate there is much archival and some archaeological evidence for frequent prehistoric fire

throughout California. Spanish missionaries attempted to stop field-burning practices and were ultimately successful as native populations increasingly came under the missions' control. As following sections will describe, during the mid-19th century both logging and farming involved burning of forested areas and chaparral. By the early 20th century, however, most lands were settled and wildfires were regularly suppressed. For example, there is no written record of major fires on Jasper Ridge since 1928, according to archives at the Woodside Fire Station.

At the outset of this project we had hoped to find evidence of fire use on Jasper Ridge during prehistoric times. We also hoped to document fire frequency during the historic period, especially during the mid-19th century. Lacking written records for this period, we investigated the stems of trees for superficial fire scars, looking at redwoods and madrone as well as oaks. In April, 1991, Steve Hamburg and Barbara Bocek sectioned six recently dead oaks (Quercus lobata and Q. agrifolia) to age the trees and to check for internal fire scars (see McBride 1983:55-57).

As Cottrell (1992) describes in her summary of our fire history research efforts, the trees ranged from 50 to 126+ years old; none showed evidence of fire. However, these ages indicate that even the larger oaks on Jasper Ridge date from the late 19th century and are therefore too young to provide data on the 1840-1860 period.

All six sample trees were cut in the SLAC corridor along San Francisquito Creek, so are not representative of the upland Jasper Ridge areas to the north and west. But surveys of the upland areas identified no trees with fire scars. Nor were many dead trees appropriate for taking sections. Most were already fallen and rotten; the few standing trees were significant habitat sites for birds and could not be cut down, according to Preserve guidelines.

Cottrell next focused on chaparral shrubs, suggesting that stems of nonsprouting species such as Ceanothus cuneatus might date back to the time of the most recent fire in the area. Coring produced no intact samples, so one large shrub was cut and its age indicates that most of this ceanothus on Jasper Ridge is only 30-50 years old, too recent a population for our purposes.

LOGGING

Introduction

Logging of the extensive redwood forests in the Santa Cruz Mountains began in the late 1770's soon after the establishment of the Spanish missions. Lumbering began early in the hillsides west of Jasper Ridge, in the headwaters region of San Francisquito Creek, and continued to be an important activity there for approximately one hundred years. As a result, much of the redwood community in the Jasper Ridge region was deforested by the 1870's.

Redwood stands have been replaced in some areas with a successional mixed-evergreen community; in other areas brushland or oak woodland communities have become established instead. Logging activity also led to the first permanent roads and settlements in the region, as lumber camps became towns and ox-drawn wagon trails became roadways. Finally, a reduction in the summer fog associated with redwood forest may have affected local climate, a point which further research will clarify.

Redwood Forest

The coast redwood (Sequoia sempervirens) is a California endemic found in restricted areas of the state's north and north-central coast ranges, including the Santa Cruz Mountains of the San Francisco Peninsula (Zinke 1988). The climate of the redwood forest regions has moderately heavy rainfall, mild temperatures and summer sea fogs, characteristic of a maritime setting. Summer fog is prevalent in all regions of the state where redwood forests are found (Cooper 1917). The fog layer varies in thickness from 30 to 500 m, and tends to hang 30 m or so above the ground, effectively moisturizing the tops of redwood trees during the otherwise arid summer months of April through October (Zinke 1988).

The redwood is an outstanding forest tree because of its striking appearance as well its remarkable size and growth rate. Redwoods are exceptionally tall, slender evergreen conifers with few limbs, reddish bark and heartwood, and flat needle-like leaves. At a maximum height of 112 m, redwoods rank as the world's tallest species; their growth rate of 42 m³ per ha per year is among the world's greatest (Zinke 1988). The maximum volume cited for a single coast redwood is 361,366 board feet or "sufficient lumber for twenty-two five-room bungalows" (Melendy 1952:13). In addition to their size the longevity of the coast redwood is well-known. Average ages in virgin forest range from 800 to 1,500 years (Melendy 1952).

Because of their extreme productivity, timber yields of redwood forests exceed those of all other American conifers "even

surpassing the Douglas fir of the Northwest" (Show 1932:1). But the greater importance of redwood timber lies in its strength, durability, and resistance to decay. The distinctive reddish color is partly due to abundant tannin, a compound that makes redwoods highly insect-resistant. The wood is fire-resistant as well because redwoods have few resin cells in comparison with other conifer species. Fire is a rare occurrence in redwood forest because of the associated high humidity, but if fire does occur, the trees regenerate by vegetative sprouting. In any case, redwood timber has a great many applications. In addition to home construction, redwoods have supplied ship siding and railroad ties, and served many industrial uses such as tanks, silos and cooling towers (Melendy 1952).

Redwoods are the dominant conifer in the Santa Cruz Mountains forested region -- a region of varying width between 5 and 19 km inland from the Pacific coast. The only associated conifer is the Douglas fir (*Pseudotsuga taxifolia*); the predominant hardwoods are tan oak (*Lithocarpus densiflora*) and madrone (*Arbutus menziesii*). Depending on local topography, exposure and soils, redwoods provide from 50 to 70% of the overstory cover, and the redwood forest may grade into redwood-hardwood, Douglas fir-hardwood or oak-madrone forest. On its eastern border, more than 19 km inland, the forest is increasingly interrupted by coast live oak (*Quercus agrifolia*) woodland and chamise (*Adenostoma fasciculatum*) chaparral.

At the latitude of Jasper Ridge (37°) on the central Peninsula the Santa Cruz Mountains form a single main ridge with projecting spurs separated by stream corridors extending to the east and west. On the east side, forested areas once extended several km beyond the 19-km forest border, along major streams wherever local conditions were favorable.

As the following discussion will demonstrate, logging, fire and farming have severely reduced the redwood forest from its original extent. Today only isolated redwood trees and small stands are found within the Biological Preserve, on the north-facing slope above San Francisquito Creek in parcel 91. The surrounding forest is better described as mixed-evergreen or mixed-hardwood. Dominant species at present are madrone and coast live oak, with tan oaks, Douglas firs, and isolated redwood stands at higher elevations (Sawyer, Thornburgh and Griffin 1988).

Prehistoric Period

As discussed in an earlier section, Costanoan or Ohlone Indian peoples have inhabited the San Francisco Peninsula for at least 5,000 years. There are several hundred archaeological sites on the peninsula, offering evidence of intensive occupation along all major stream channels and on the bay and ocean shores.

There are very few sites in the redwood forest area. In part this may be a result of survey bias; outside of the San Francisquito watershed the steep, heavily forested upper slopes of the mountains have not been systematically investigated.

However, there are many reasons why Indian inhabitants would have avoided establishing villages in the redwood forests. Relative to lower elevation areas, there is little level land for occupation in the forest; there are less diverse plant and animal resources; and there is significantly more rainfall in the winter months (Bocek 1987). There are over three hundred archaeological sites on the Peninsula; only six confirmed locations are found in the redwood forest zone. Spanish records mention that one Indian village (Oromstac) was near "the timber-cuttings in the mountains", but this was located at the extreme lower edge of the redwood forest, on a tributary of San Francisquito Creek (Brown 1966; Milliken 1986).

Because the modern species composition of the forest is considerably altered (see Jensen 1939), it is difficult to reconstruct prehistoric use of forest resources. Based on the resources now available in the mixed-evergreen forest, the single most important food would have been the tan oak fruit or acorn. Tan oak acorns were valued by Indian gatherers because the fruits are larger and have a thicker shell than Quercus acorns. Lithocarpus acorns decay more slowly as a result and resist insect infestations for longer periods, making them more easily stored. On the other hand, these advantages may have been outweighed by the relative difficulty of harvesting acorns from the very steep slopes on which most tan oaks are found today.

The modern forest includes other trees and shrubs that supplied food, medicines and raw materials, including madrone, hazel (Corylus cornuta), maple (Acer macrophyllum), laurel Umbellularia californica, toyon (Heteromeles arbutifolia), salal (Gaultheria) and numerous other berries (Ribes, Rubus, Vaccinium spp.) (Bocek 1984). Redwood bark was used medicinally and sprouts from redwood burls were used in basket-making, but neither redwood nor Douglas fir were used for timber because there was no heavy wood-working industry among the Costanoans. Local architecture consisted of lightly built small houses, framed with willow poles and covered with woven mats. Various ferns, horsetails (Equisetum), and herbaceous species of the forest were also collected; some of the most important are Angelica spp., Asclepias spp., Campanula prenanthoides, Orthocarpus spp., Satureja douglasii, Solanum spp., Trifolium spp., and Vicia gigantea. It is unknown whether these species were as abundant in the climax forest as they are in the more open successional forest of today.

Costanoan hunters undoubtedly frequented the redwood region although most of the large game animals were as likely to be

found in the lower-elevation woodland as in the upper slopes of the mountains. The primary game animal was the mule or black-tailed deer (Odocoileus hemionus), but carnivores were also hunted, as much for fur as for food: the black bear (Euarctos americanus), grizzly (Ursus horribilus), and mountain lion (Felis concolor). Woodrats (Neotoma fuscipes), gray squirrels (Sciurus griseus), and other small forest mammals were hunted as well.

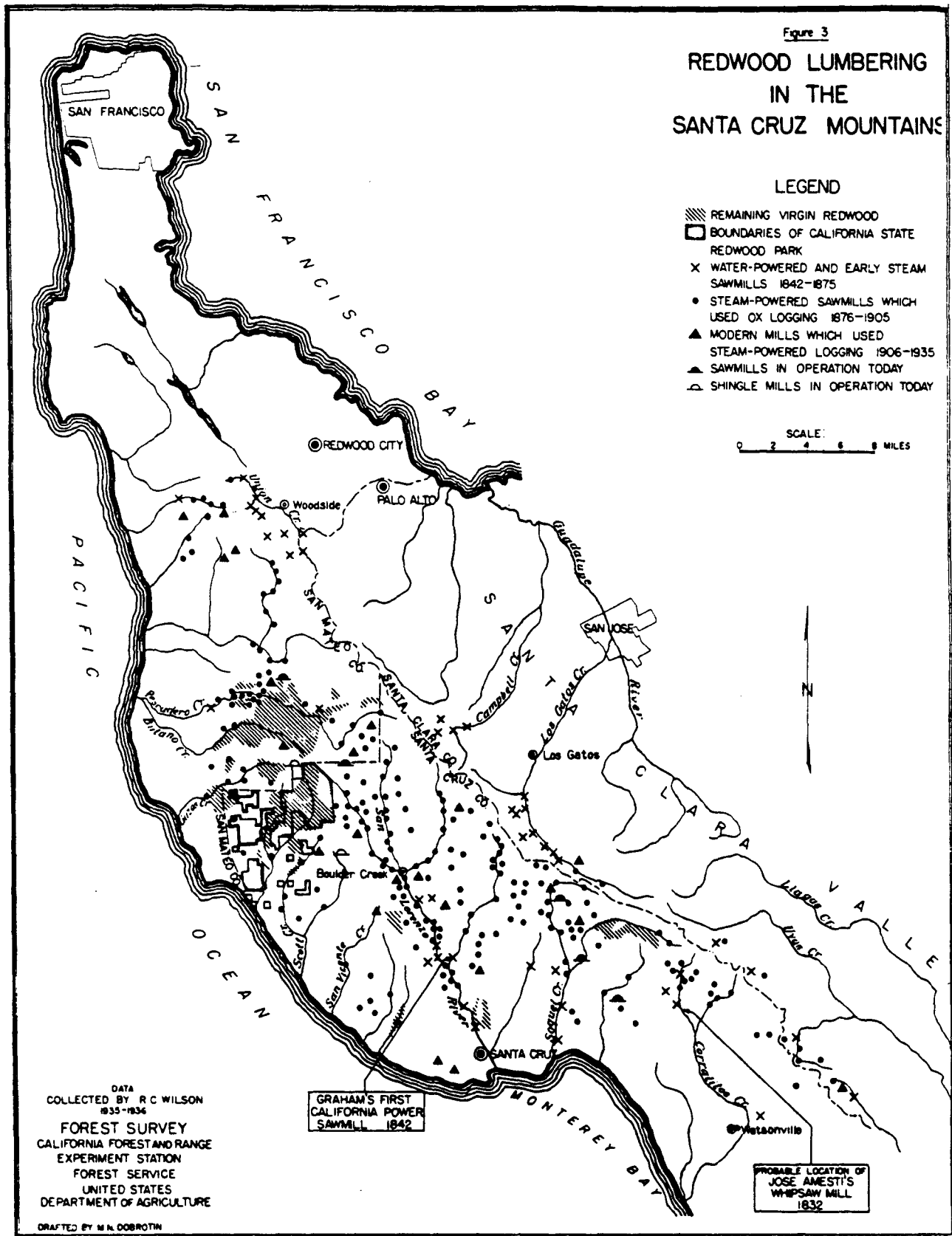
Overall, Indian inhabitants probably had less impact on the redwood forest than on the woodland, chaparral and grassland areas at lower elevations. Controlled burning was a common practice throughout native California but most such efforts focused on woodland and chaparral. Compared with woodland and grassland, even in the modern mixed-evergreen forest there are relatively few plant and animal species among those that were economically important in prehistoric times. Given that the modern forest is successional, probably derived from a redwood-Douglas fir climax by decades of intensive logging (Jensen 1939), then species diversity may have been even lower in the past than it is today. Trails to the Pacific Ocean, a source of shellfish, salt and other supplies, passed through the forest. But until the Spanish arrived the steep mountain slopes were largely unaffected by human activity.

The Spanish Period

As the Jasper Ridge area lies 18 km east of the coast, it is near the inland limits of the redwood forest zone. However, sawmill records demonstrate that a significant redwood forest once extended approximately seven km (4.5 mi) northwest-southeast along the base of the mountain slope just above Jasper Ridge (see Map 6, from Jensen 1939). Compared to the upper slopes, this forested region was easily accessible, leading to its early and continuing importance as a timber source.

The earliest written descriptions of the Santa Cruz Mountains forests are found in the diaries of Franciscan missionaries and soldiers who first explored the San Francisco Bay Area in 1769. Returning in 1774 and again in 1776, when the first Spanish settlements were established, explorers repeatedly noted the availability of water, pasture, firewood, and timber as well as estimating the size of local Indian populations. There is frequent mention of the quantity and quality of timber. Palóu and others noted in 1774 "especially the redwood, which bears a strong resemblance to cedar" (Palóu 1926:289).

...all the way from the vicinity of the Arroyo de las Llagas there runs clear to the Punta de Almejas a very high range, most of it thickly grown with cedars [redwoods] and other trees which continue as far as the valley of San Andrés... (Fray Font, March 1776, in Bolton 1930, Vol. IV, p. 344).



MAP 6. Location of sawmills, indicating extent of redwood forest. Jensen 1939.

The forests in the mountains made a major impression on explorers, but journals also noted isolated trees and groves of redwoods several km east along San Francisquito Creek (Clarke 1952). Whether these were located within the borders of the Biological Preserve is unknown.

In March 1776 the Anza expedition scouted the foothills north of Jasper Ridge near the present town of Woodside (see Map 1). They ascertained that the area held enough timber to supply the Presidio and Mission Dolores in San Francisco, founded that same year about 40 km to the north (Map 7, from Brown in Stanger 1963). Anza commented that the forests abounded in "all the timbers, both of pine and redwood as they call it here, as well as live oak, cottonwood, and willow, which may be needed for building" (Bolton 1930, Vol.III p. 131). In 1777, a second mission site was chosen at Santa Clara, 20 km southeast of Jasper Ridge. The nearby Pueblo of San José de Guadalupe became the seat of municipal government.

San Francisquito Creek was designated as the boundary between the lands of the two missions. Thus, both settlements were able to exploit the resources of the San Francisquito redwood forests. Because of the size and quality of the timber, logging was economically feasible despite the distances involved. The first buildings at the new mission settlements required little lumber; adobe bricks were used as wall material, limiting the need for timbers to heavy beams for framing. Nevertheless by 1788 the San Francisquito headwaters area had already acquired the name of El Corte de Madera -- meaning the "wood-choppings" or "timber-cuttings" (Brown 1966).

It is unknown when Mission Santa Clara and the town of San José began sending logging teams to the San Francisquito redwoods, but the first church at Mission Santa Clara was built with redwood logs, and was completed in 1778. Years later a San José official, Tomás Pacheco, noted that the San Francisquito forest had been the Pueblo's best source of lumber since the founding of San José in 1777 (Brown 1966:3). At San Francisco, logging began with the founding of the mission although the first buildings apparently used few timbers. By the 1790's increasing amounts of heavy timber were required; Brown (1966:2) provides a good summary of the methods and the conditions under which this early logging was done.

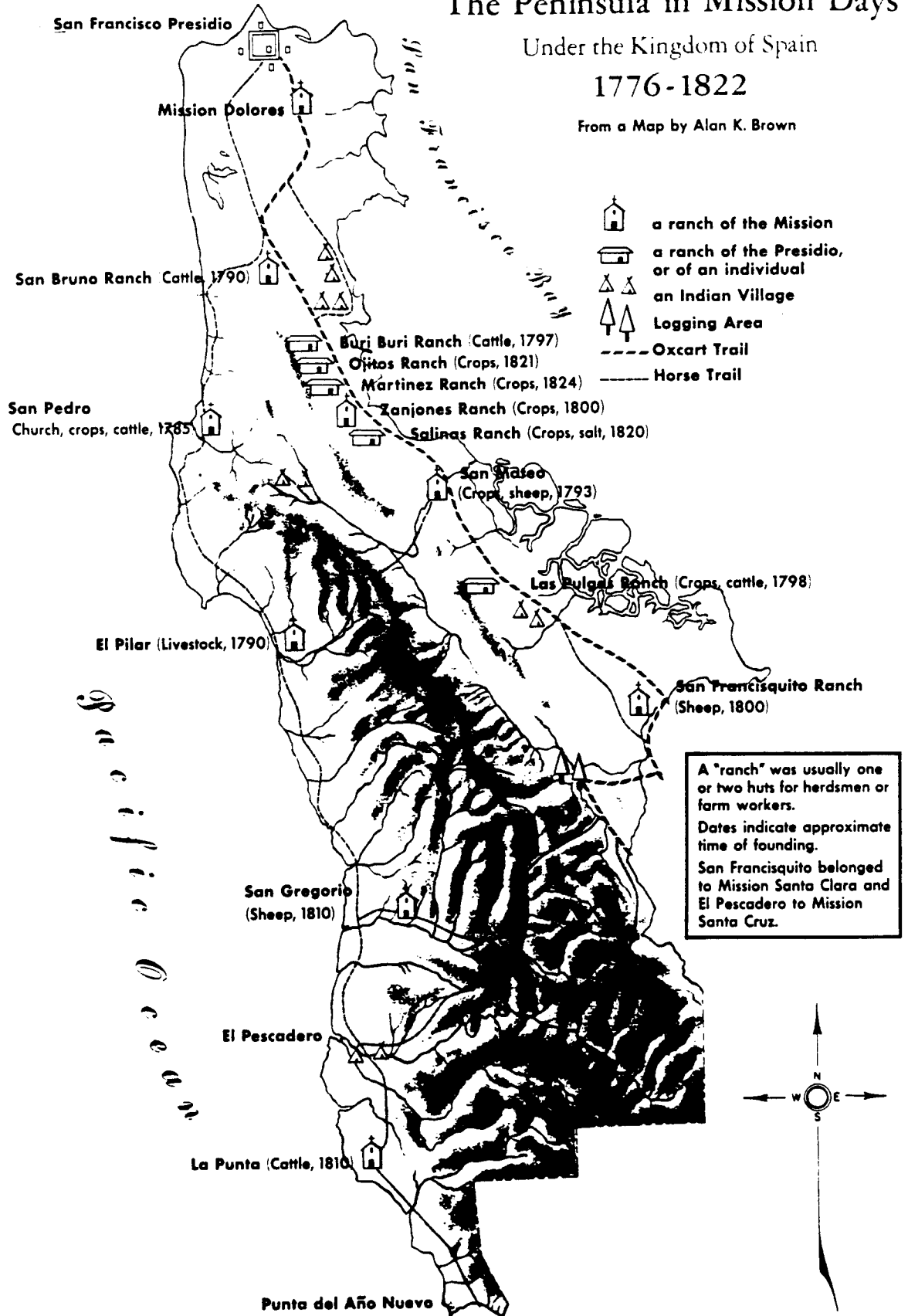
In 1792 the sergeant of the Presidio complained that 'the timber is at a distance of more than ten leagues [1 league is about 4.2 km]; with luck the journey can be made once each week, and this not at all seasons of the year'... When the Yerba Buena battery was built in 1797, fifty-one journeys for timber were made with as many yoke of oxen between April and December. The

The Peninsula in Mission Days

Under the Kingdom of Spain

1776-1822

From a Map by Alan K. Brown



MAP 7. The Peninsula in Mission Days.

Mission supplied both the ox-teams and Indian axmen to do the work; the Presidio sent along an officer to supervise and a small escort of soldiers...On the three-day return journey, each pair of oxen must have dragged one beam hewn and adzed out on the spot, for there was little call for boards, and sawing or splitting these was a very tedious process in Spanish times: at Santa Cruz Mission in 1818 it took six men six days to make twenty-five twelve-foot planks.

Although there are more references to logging in San Francisco's mission records, the Santa Clara Mission probably had a greater impact on Jasper Ridge during this period. The far northeastern edge of the forest -- near the modern town of Woodside -- supplied San Francisco. The draying road ran north through the hills and connected with the main road to San Francisco in present-day Redwood City. In contrast, Santa Clara's logging teams apparently focused on the area surrounding modern Searsville Lake.

The amount of logging inside the modern Preserve boundaries cannot be determined, but it is clear that Jasper Ridge would have been part of Mission Santa Clara's territory as it lies south of the official boundary along San Francisquito Creek. Also, there were two draying roads between the southern forest area and Santa Clara, leading to increased activity in the Jasper Ridge area. One, the route of modern Sand Hill Road, ran parallel to San Francisquito Creek on the north side of Jasper Ridge. This was still known in the late 1800's as the Santa Clara Mission's former lumber road although both missions may have used it. The second, opened in the 1830's, followed a cattle trail (now the route of Arastradero Road) along Matadero Creek on the south side of Jasper Ridge (Brown 1966; Hoover et al. 1966).

Logging activity near Jasper Ridge may have declined briefly after the height of the building boom at the missions, especially in the northern part of the forest. By the 1820's the forests of Marin County across the Golden Gate from the Presidio began to replace the Peninsula as a lumber supply for San Francisco. On the other hand, 1820 Santa Clara Mission documents mention the maintenance of axmen and the transportation of lumber from the "San Francisquito cuttings" (1966:3-4). In addition the growing town of San José continued to require lumber, regardless of activity at the mission. By 1820 the first "lumber yard" opened in San José, selling split and whipsawed redwood obtained from Americans logging in the Santa Cruz Mountains (Payne 1987:36).

Although the total area logged or the number of trees removed during the Spanish period are difficult to estimate, it is clear that forests near Jasper Ridge were an important source of redwood timber beginning in 1777. Relative to later years, mission-period impacts were limited because neither sawpits nor

mills were yet in use locally. Felling, cutting and hauling away even a small redwood must have been a major undertaking. As Brown (1966:2) suggests, logging was probably not done continuously during this period, but "only sporadically and as needed".

The Mexican Period

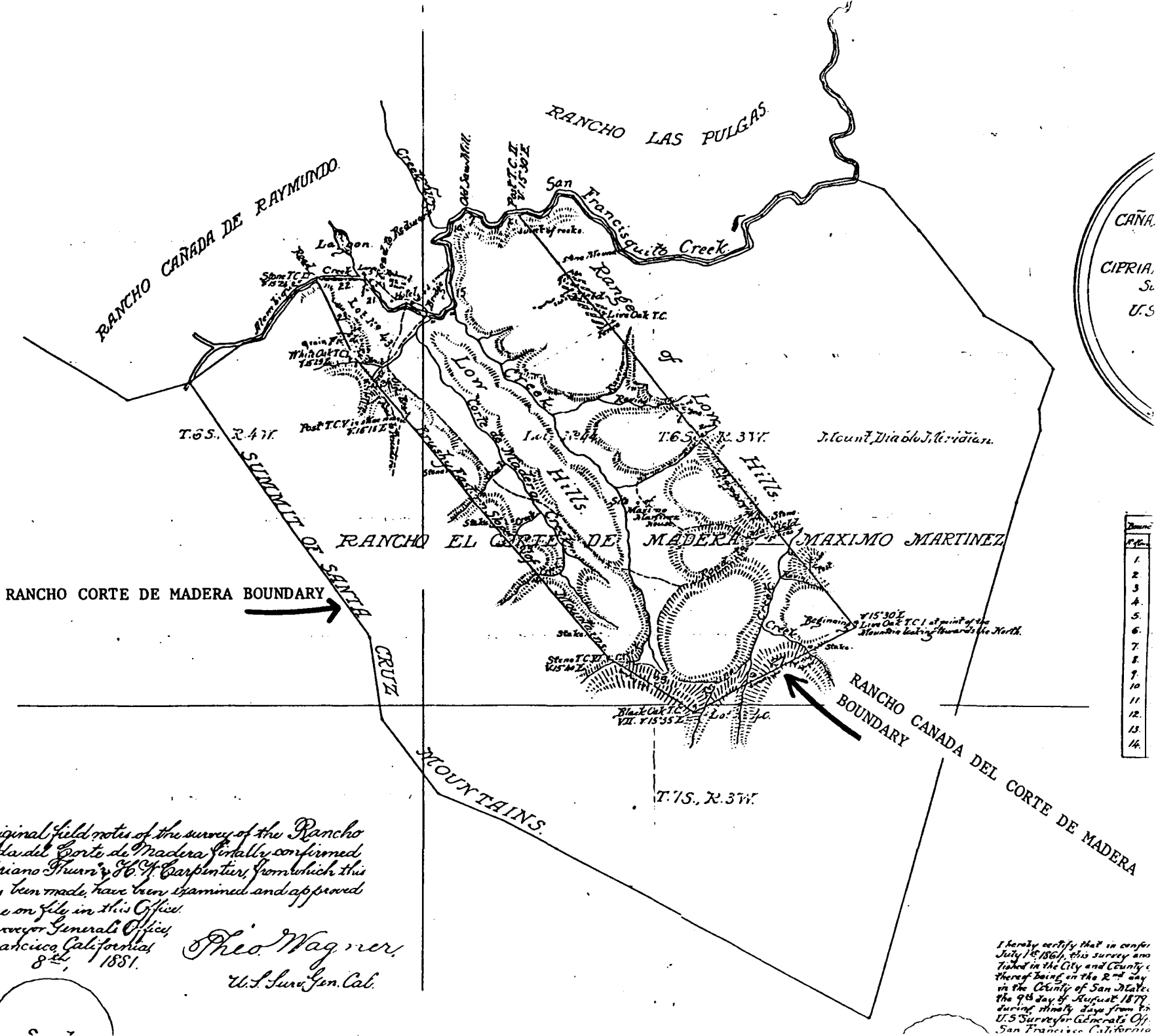
With the Revolution of 1821 Mexico became an independent nation and in 1824 its new constitution converted all property of the missions to public domain. Political turmoil and resistance by the Franciscans delayed secularization of the missions until 1833, but in that year the new government began granting former mission lands to prominent, loyal citizens. One of the first such grants, including the western half of Jasper Ridge, was a 1400-ha (3500 acre) parcel known as Cañada del Corte de Madera or "wood-cutting canyon" (see Map 7A). Máximo Martínez, a former soldier who was then alderman at San José, received this grant along with his partner Domingo Peralta in 1833 (Bancroft C-1 87:Reel 2, California Land Grant Documents). In 1834, Peralta sold out his portion to co-grantee Martínez and another settler, Cipriano Thurn. Thirty years later Thurn and partner Horace Carpentier sued for title to Peralta's original portion (SU Archives, SC-3, Box 1, Abstract of Title-Rancho El Corte de Madera). Thurn and Carpentier received a patent for the land in 1879 (Hoover et al. 1966:401), although Martínez or his descendants had occupied it since 1834.

Meanwhile, in 1844 Martínez was granted an additional 5200 ha (13,000 acres) known simply as Rancho Corte de Madera (see Map 7B). This parcel surrounded the original grant and included the remainder of what is now Jasper Ridge and lands as far west as the Santa Cruz Mountains summit. As the grant names indicate, the area was already a well known source of timber. The missions and the military had been exploiting its forests for at least fifty years.

Along with the private ranches came a significant increase in the local population. New settlements began to appear throughout the San Francisco Bay area, creating a stable market for lumber. This new demand resulted in the first permanent lumbering camps in the San Francisquito redwood forests. Many of the inhabitants were foreigners, including deserters from American, British or French ships. Occasional prisoners were also sent to the lumber camps "to find a master or labor on the public works" (Brown 1966:4).

The new foreign colony named the San Francisquito headwaters the "Pulgas Redwoods" because in the early 1830's, the area was considered part of the vast Rancho de las Pulgas. In 1840 the northern part of the Pulgas Redwoods was granted to John Copinger as part of the Cañada de Raymundo, and in 1844 the remainder went

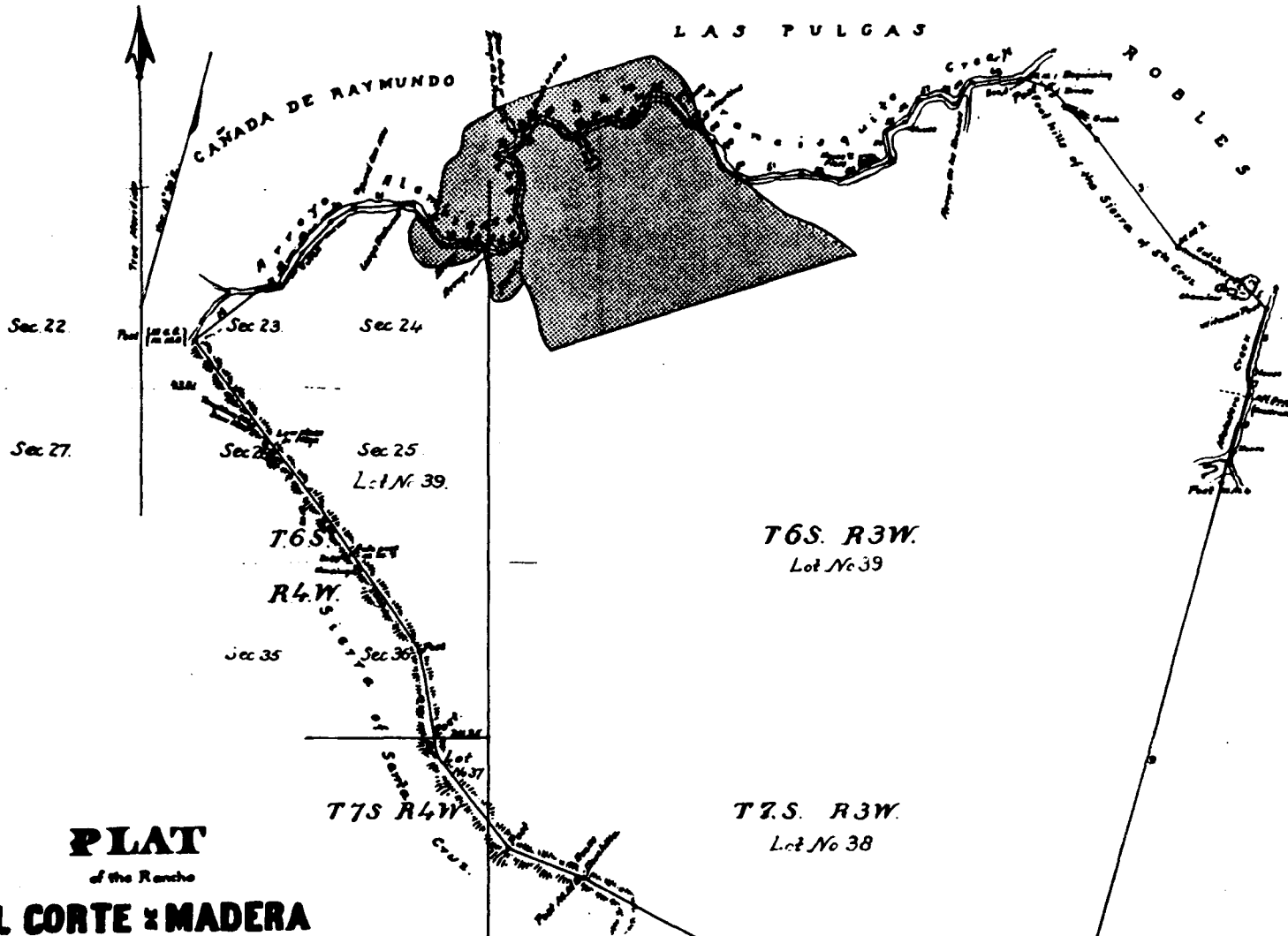
MAP 7A. Boundaries of Ranchos Corte de Madera and Canada del Corte de Madera.



The original field notes of the survey of the Rancho Cañada del Corte de Madera finally confirmed to Cipriano Truan & G. F. Carpenter, from which this plat has been made, have been examined and approved and are on file in this Office.
 U. S. Surveyor General's Office,
 San Francisco, California
 April 8th, 1881.
Theo. Wagner,
 U. S. Survey Gen. Cal.

I hereby certify that in confer July 1st 1861, this survey was taken in the City and County thereof being on the 2nd day in the County of San Mateo, the 9th day of August 1879, during the 3rd day from the U. S. Surveyor General's Office, San Francisco, California.

MAP 7B. Plat of the Rancho El Corte de Madera.



38P
2-1
3-1

Boundary Lines.

No	Course	Length	No	Course	Length
1	S 65° E.	14.	31	N 76° W	8
2	S 43° E.	32.40	32	S 57° E.	10.50
3	S 36° E.	52	33	S	5.50
4	S 61° E.	31	34	S 56° E.	5
5	S 42° E.	19.40	35	S 45° E.	5
6	S 15° W	28	36	S 68° W	11
7	South	10.	37	S 27° E.	3.20
8	S 17° W	42.50	38	S 27° E.	3
9	N 42° E.	303.05	39	N 67° E.	5.80
10	N 61° E.	235	40	S 36° E.	6
11	S 68° E.	37	41	S 77° E.	10
12	S 38° E.	54	42	S 77° E.	8
13	S 07° E.	40	43	N 48° W	9.50
14	S 34° E.	35	44	S 25° W	8
15	S 36° E.	121	45	S 80° E.	8
16	S 72° E.	37	46	S 41° E.	17
17	S 70° E.	11.20	47	S 77° E.	3
18	S 29° E.	13.	48	S 44° E.	10
19	S 41° E.	20.50	49	S 10° E.	8.80
20	S 30° E.	15.	50	S 30° E.	15
21	S 80° E.	26.50	51	N 63° W	25
22	S 30° E.	22.50	52	S 75° E.	16
23	N 79° E.	9.50	53	N 70° E.	25
24	S 62° E.	9.80	54	S 44° W	15
25	S 77° E.	10	55	S 65° E.	11
26	N 47° E.	5	56	S 37° E.	12
27	S 64° E.	6	57	S 79° E.	10
28	S 10° W	14.25	58	S 56° E.	7.50
29	S 72° E.	10	59	N 42° E.	13
30	S 47° W.	11.25	60	S 87° E.	21.80

PLAT
of the Rancho
EL CORTE DE MADERA

finally confirmed to
MAXIMO MARTINEZ
Surveyor under the orders of the
U.S. SURVEYOR GENERAL

by
T.S. Stephens Dep Sur.
July 1887
Containing 8288 Acres
Ready to be located

DEPARTMENT OF THE INTERIOR
GENERAL LAND OFFICE
Washington, D. C., Dec. 25, 1912.
I hereby certify that this is a true and correct copy of the plat of official survey of the lands to which it relates, as the same are on file in this office.

[Signature]
Assistant Surveyor General

The field notes of the Rancho "El Corte de Madera" and from which this plat has been made out, have been examined and approved and are on file in this office.
U. S. Surveyor General's Office
San Francisco, California
January 16th 1888



J. W. Manderhill
U. S. Surv Genl. Cal.

to Martínez in Rancho Corte de Madera. Copinger's petition for the grant, dated 1839, mentions the extent of logging underway at that time:

[Copinger] solicits grant of a small valley which lies in the sierra, in the same place where there is now a timber-cutting establishment, which place is 2 1/2 leagues in length and about three-quarters of a league in breadth... (translated from María de la Soledad Ortega de Arguello v. the United States, defendants. Transcripts of Land Cases, in Richards 1973).

Commercial logging of the redwood forests began in the mid-1830's. With the increasing need for lumber, aserrados (whipsaw frames and sawpits) appeared in the Pulgas forests in 1832, replacing the adze and axe used to cut planks and beams by hand. By 1836 several sawpits were established and work was proceeding "in a systematic manner, procuring the aid of Californians, Indians, and foreigners, whenever they could be found" (Brown 1966:7).

...eight or ten 'old runaway sailors'...worked in twos, each partnership owning a sawpit from sixteen to twenty-four feet in length. Two bearer-logs..were laid over the pit, and on top of these went the square-hewn timber for sawing. The two men plying the long-handled whipsaw, one on top of the log and the other in the pit, could turn out about a hundred feet of logs or square beams a day (Brown 1966:11-12).

Sawmills did not arrive in the Pulgas redwoods until after the Gold Rush although in 1841 one of the first power mills in California was built near Mt. Hermon in Santa Cruz County, 40 km south of Jasper Ridge (Andrews 1958:18). The productivity of the sawpits is suggested by the fact that as early as 1841, Copinger's Woodside mill produced sufficient lumber to export to the Sandwich Islands, now known as Hawaii (Richards 1973). As Thomas Larkin wrote from Honolulu to his local supplier:

In regard to the lumber - the square 'red cedar' logs you speak of will always sell here, at from \$5 to \$10 each...if it is the kind that has the clear straight grain. It is preferred by Carpenters here, on account of the ease with which it is worked, to any lumber excepting Am.[erican] soft pine boards... (Hammond 1951:176).

Larkin's papers include mention of a shipment, received at Lahaina from the schooner California on March 22, 1842, of 45 redwood logs that measured a total of 5,171 ft, or an average of 115 ft each.

Although it is difficult to estimate how much area was logged or how many trees were cut, it is clear that by the end of the Mexican period the Pulgas redwoods were producing a great deal more lumber annually than during Mission times. For example, in 1818 36 person-days were needed to produce 300 ft of lumber (25 12-ft planks). The 100 ft of logs or beams turned out daily by a two-man whipsaw operation represented an increase of 1800% in 1846.

In addition to logs, squared-off beams and boards, redwood shingles were an important product of the Pulgas forest. An 1842 document notes that two "medium-sized" redwoods yielded as many as 40,000 shingles (Brown 1966). Meanwhile, although oak trees supply relatively poor timber, numerous trees were cut for firewood and charcoal. The use of oak wood for fuel increased steadily throughout the Spanish, Mexican and American periods (McClaran 1986).

The importance of the Pulgas redwood industry is indicated by the construction in 1840 of a new port or embarcadero at the mouth of San Francisquito Creek. Linked to the forest by the old Santa Clara or Sand Hills Road, the port provided another option to the overland draying route to San Francisco. The draying road continued in use from 1830 until 1854. Also, as early as the 1830's the Arastradero road was opened to provide a southern route to the fast-growing San José market (Brown 1966).

As Larkin's correspondence and other records indicate, logging continued steadily throughout the 1840's despite unsettled internal politics and later, interruptions caused by the Mexican-American War. In 1846, for example, military officials visited the Pulgas area to recruit for the Mexican army and to confiscate firearms, horses and cattle. A greater interruption came two years later when gold was discovered at Captain Sutter's sawmill on the American River. Sutter's mill was 200 km away from Jasper Ridge; nevertheless "the beginning of the gold rush emptied the woods" (Brown 1966:15). Within a week of the first gold strike in 1848, Mexico and the United States negotiated and signed the Treaty of Guadalupe Hidalgo. California became an American territory and in 1850, the 30th state.

The American Period

The following discussion draws heavily on the work of Frank Stanger, whose 1967 Sawmills in the Redwoods is a valuable secondary source for this later period.

Despite seventy years of logging activity, in 1849 there were still extensive groves of virgin redwoods in the Pulgas Area -- north of Jasper Ridge along Alambique and Bear Gulch Creeks, as well as to the south near present-day Searsville Lake (Brown

1966). However, when the gold rush was little more than a year old logging was actively resumed in the San Francisquito headwaters. During that year, San Francisco had become a rapidly growing city with an insatiable market for lumber and shingles. Early in 1850 wharf construction required huge amounts of large timbers and decay-resistant redwood was in great demand (Stanger 1963). Only one of the former Pulgas sawpits (a Mr. Pacheco's) was still functioning, and small operations like his were soon displaced as much larger lumber camps began to appear.

...near what is now known as Searsville...was a noble forest of giant growth, only the time-worn stumps and second growth of which now remain. These noble trees were for the most part cut in 1849-50 by Edward A. T. Gallagher, who established two lumber camps, one in the bottom of the Cañada del Raymundo, the other on the flank of the mountain. About 115 men were employed in these camps ripping out lumber with whipsaw to be hauled...by water to San Francisco or by [wagon] trains to San Jose. Two men were constantly employed in packing deer down the mountain to supply the larder of the camps (Smith 1892:113).

The area's first water-powered sawmill was built in October 1849 at a site called Mountain Home on Alambique Creek, 2 km from the north side of Jasper Ridge. The owner, Charles Brown, had purchased 1120 ha (2800 acres) of land here and paid for it in sawpit lumber. Brown's mill was a small one with a single vertical saw; it had a simple frame with a straight saw blade mounted in it, raised and lowered by a crank shaft with power from a waterwheel. While these early mills were relatively crude machines they greatly increased productivity over the previous whipsaw method. In contrast to the sawpit yield of perhaps 100 ft of beams per day, 500 ft of lumber per day were produced by the first power sawmill in 1842 (Wilson 1937). Locations of water- and later steam-powered sawmills are shown in Map 6.

In 1850, after one year, Brown sold the mill and the new owner installed a steam-powered mill driven by a thirty-horse-power engine (Stanger 1967). Steam power had long been used in sawmills elsewhere in the country and was particularly advantageous given the markedly seasonal stream flow in California. The Mountain Home mill continued in operation until the Alambique watershed was logged out, possibly as early as 1859. This rapid deforestation was predicted several years earlier, in a letter from a census agent in 1852:

On the eastern slope of this range...is a forest of redwood, from which is obtained...a considerable quantity of excellent lumber. This timber however, is rapidly disappearing, and, probably within four or five years will be entirely cut off. There are now in the

immediate vicinity of this timber land, three saw mills in operation, and two others...in process of construction (O.P. Sutton to F.A. Nesbitt, December 24, 1852. Bancroft C-A115, Papers pertaining to the California Census-1852).

Immediately after Brown's mill went into operation, Irish immigrant Dennis Martin built another steam-powered sawmill on Dennis Martin Creek 2 km west of Jasper Ridge. This was a "gang" mill that had two vertical saws, thus twice the capacity of the Mountain Home mill. In 1853, a few hundred m upstream, Martin built a second and much larger gang mill with twenty-six upright saws, two edgers and a planer. This meant that one run of the mill could rip twenty-six planks off a redwood log simultaneously, completely finishing a small log with a single cut and producing boards of equal width and thickness.

Financial difficulties required Martin to sell his Upper Mill in 1859. The new owners moved it west over the mountains to La Honda and set up operations in the large virgin timber stands there. Meanwhile, another mill was built at Martin's former Upper Mill site. Logging along Dennis Martin Creek continued into the 1860's when, presumably, all marketable trees had been cut (Stanger 1966; also orig sources). A lumberyard opened in 1860 in the town of Searsville, and the Gazette reported that "every description of lumber can be obtained for cash, or for produce at cash prices" (September 8, 1860).

Five additional sawmills were operating in the hills within 2 km of the west side of Jasper Ridge during the period from 1852 to 1880. These were located on upper Dennis Martin and Bull Run Creeks. To the north, within 5 km of Jasper Ridge, another five mills were operating in the Woodside area along upper Bear Gulch and West Union Creeks. These latter date to the 1850's through the 1870's. However, none of these mills were in use for more than ten years -- some ran only three or four years.

At a slightly greater distance from Jasper Ridge, 5-8 km northwest along the West Union tributary of San Francisquito Creek, another seven lumber mills and two shingle mills were in operation in the 1850's. Little is known about these; at least one was an old-fashioned water-powered mill and another a more substantial, steam-driven operation. The two at highest elevations were in business for the greatest number of years, one of them as late as 1872.

There are few records about the operations of the smaller mills west of the Preserve. The mill owned by Morey Smith may have been the first on this side of the mountains to use a circular saw instead of a vertical, straight-bladed saw. Circular saws were introduced to the area by the end of the 1850's. More is known about the five mills farther north, in

particular one of the Bear Gulch mills that was in use from 1852 until 1855. This was the Baker and Burnham gang mill, another multiple-saw mill the size of Dennis Martin's Upper Mill, powered by three steam boilers and two engines. The site was surrounded by a large redwood grove which Baker and Burnham had leased, across the creek from the Mountain Home sawmill. During their three years of operation, Baker and Burnham apparently cut most of the timber within reach including some trees on the Mountain Home ranch. The Mountain Home's owners filed suit and obtained a court injunction ordering Baker and Burnham to cease work, but by that time (1855) the San Francisco financial crash had already shut down their operation. The gang mill was finally sold; its replacement burned in 1859 and was replaced by John Copinger's successor at Cañada de Raymundo with a much smaller mill using a single circular saw.

Logging in the Searsville-Woodside area had reached its peak in the 1850's:

The dry season was the harvest period for the mills, and ox-teams were then making an almost continuous procession between the lumber camps and the landing at Redwood City (M and DeP's 1878:16).

At the beginning of 1853 there were twelve mills in operation, producing an estimated 82,000 board-ft of lumber per day. [Note: lumber yields will be given in board-ft and usually will not be converted to metric.] By the end of that same year, fifteen mills were at work producing an estimated 100,000 board-ft per day (Brown 1966). According to Moore and De Pue (1878), these fifteen mills' annual yield was 20 to 25 million board-ft, and in the mid-1850's even the San Francisco lumber market was flooded by this overproduction (Melendy 1952:276). However, fires, financial difficulties (including multiple bank failures in San Francisco in 1855), and contested land claims caused some of the mills to go out of business by the end of the decade.

During the year 1859, a decrease was experienced of some 26-30 thousand feet per day by the cessation of the Caldwell [mill], Martin's and the gang mills, the latter being burned (San Mateo County Gazette December 8, 1860).

The previous level of activity was only slightly reduced throughout the 1860's. In many cases mills were sold and the new owners simply continued operations in the same locations. The easily accessible forests were slowly logged out, as mill owners were clearing the forests at higher and higher elevations. For example, the Morrison sawmill was built in 1860, considerably upstream on Bear Gulch Creek from the area where Baker and Burnham started logging in 1852. Morrison's was a large operation capable of producing 8,000 board-ft per day -- possibly

using a circular saw although records are not specific. The mill continued operating until 1865 when, according to Stanger (1967) the area Morrison leased was finally logged out. The mill was sold and the new owners moved it over the mountains to La Honda, where Martin's Upper Mill had been taken six years before.

The Huntington sawmill, built in 1875, was situated more than 2 km up Bear Gulch from the Morrison site that had been logged out ten years before. In 1878 a county history noted that Huntington still had two or three years' supply of timber to cut. But by that time, his was the only mill still in operation on the east side of the Santa Cruz Mountains (Stanger 1967:42).

There must have been a few redwood stands still visible in the late 1860's:

On the hills toward the south we can see the gigantic trunks of the superb redwood, Sequoia sempervirens, a most queenly tree, over 200 feet high (Brace, 1869 in Oberlander 1953).

But in general, by the 1870's the lower reaches of the Searsville-Woodside forest had been cleared.

Some idea of this timber in its virgin state may be gathered from tracts of it still uncut upon the west side of the mountains, but the gulches upon the bay side, where attention was first directed, have been almost wholly divested of the redwood giants... This is owing in most cases to the exhaustion of the timber supply, and in others to the present low price of lumber (Moore & De Pue 1878:16-17).

By 1880 logging was limited to the western side of the Santa Cruz Mountains almost exclusively. Jensen's (1939) survey, summarized in Map 6, clearly shows the westward movement of sawmills, progressing from just west of Jasper Ridge to the Santa Cruz Mountains between 1842 and 1935. Gang mills had largely been replaced by circular saw mills, and oxen trails by log-lined "skid roads"; the overall result was much greater timber yields. Before the end of the 19th century, in other words, "a new lumbering era was fully underway" (Wilson 1937:14).

Lumber was not the only product of the redwood forests. As noted above, the Pulgas loggers had also cut wood for shingles. The first shingle mill in the area was built in 1856 and was located 3.5 km northwest of Jasper Ridge above West Union Creek.

...they would come back to the Redwood and go to making shingles this winter...so we bought a lot of provisions and built a cabin...and have got almost enough timber cut down to last us all winter... I think

we can earn from 2 dollars to 2 dollars and 25 cents a day. (December 3, 1856; Bancroft #84/113 C, Orrin S. Payne, Letters to his Brothers).

At the going rate of \$10 per thousand, Payne clearly anticipated making 200-250 shingles per day.

Unless lumbermen burned the area, there was also a great deal of wood left after lumber or shingles had been cut. For example, in 1870 -- long after the good redwood timber had been logged -- 425 ha (1,059 acres) of the Cañada de Raymundo were completely cleared, and yielded 50,000 cords of wood (Stanger 1967:144). [Note: A cord is 128 cu ft or 3.8 cu m.] This clear-cutting was a common practice, one that opened land for agriculture and produced wood for fuel or other uses.

Some wood was used in split products like plant stakes or fence rails, needed in ever-greater amounts as the number of settlers in the area continued to increase. But it is likely that after trees were cut for timber, most wood was used for fuel, either as firewood or charcoal. San Franciscans in the 1890's paid \$7-11 per cord of firewood depending on the type: redwood, oak (black, white and tanbark), and pine or fir the most expensive (Wickson 1891:95). May (1956) suggests that charcoal production was particularly great during the Gold Rush and late 19th century, when the price ranged from "forty-five to sixty cents per sack holding about two bushels" (Wickson 1891:95). Charcoal burners were actively working on nearby Rancho San Francisquito, a few km downstream from Jasper Ridge (Hoover et al. 1966).

...we have plenty [of firewood] all around us both dry and green, red wood and oak; the oak burns almost as well as hickory, and the red wood is not quite equal to pitch pine but resembles it somewhat (Birney Burrell, March 4, 1854, in Stuart 1950).

In 1864, tax records for local property owners Simon Fleury and James Morrison listed 15 and 60 cords of wood respectively. The adjacent blue oak (Quercus douglasii) woodlands were a likely fuel source then as they were in 1888-1891, when Searsville Dam was built (see Water Resources, below). Grundmann (1990) suggests that the woodland on the northwest end of Jasper Ridge might have been cleared during dam construction.

Because both redwood and oak groves were rapidly disappearing, many varieties of eucalyptus trees were imported and planted throughout the general area as early as 1870 (Broek 1932); there is still one tree in the Biological Preserve and several others on the adjoining property of the Stanford Linear Accelerator. Eucalyptus wood was originally advertised as a source of fuel, furniture and timber, although in the end the

trees were most useful as windbreaks (Pyne 1982).

Tan oaks and Douglas firs are associated with redwood forest and as such were affected by the logging industry. Douglas fir timber was not as desirable as redwood; firs were only cut when found in a redwood stand (Jensen 1939). Tan oaks, on the other hand, were systematically exploited, at least toward the end of the period, in a secondary operation that accompanied redwood logging. Stanger (1967:145-146) describes the bark cutting process as follows:

The time to cut the bark was in the spring when the sap first began to circulate; then the bark came off easily. The tree was girdled in two places near the ground, four feet apart, then slit down one side, and the four-foot piece of bark pulled off the trunk...it was then cut down, the other sections removed, and all of them left out to dry. What remained of the tree could then be used for cordwood. After the drying season, probably in the fall, the bark sections were collected...At the tannery the bark slabs were pulverized and boiled in water to make liquid tannic acid.

As early as the 1850's there were already two tanneries in Redwood City; in 1878 there were three. A cord of tanbark sold for \$17-20 in San Francisco in the 1890's (Wickson 1891:95). The tanning industry and its heavy exploitation of tan oaks was a natural development given the growing population, the demand for leather, and the cowhides readily available from the ranches. Today there are stands of second-growth redwoods within the boundaries of the Preserve, but there is not a single tan oak. The nearest groves of tan oaks are found at much higher elevations several km to the west and it is unknown whether they originally grew in the Preserve.

The communities that developed around the Searsville and Woodside lumber camps grew rapidly, resulting in additional logging and burning as forest and woodlands were cleared for agriculture or to provide firewood.

Seeing among the redwoods a growing number of sawmill men, wood choppers, shingle makers, and 'bullwhackers', he [Dr. Tripp] ...built a shack and put out a sign, 'Woodside Store'. This was in 1851 (Stanger 1963:54).

The nearby town of Searsville was a convenient stopover point between the logging camps of the foothills and the port of Redwood City, which by 1850 had replaced the Embarcadero at the mouth of San Francisquito Creek. Searsville started as a blacksmith shop and eight bunkhouses, built by Martin near his Lower Mill in 1853. In 1854 a few homes, a school, and a hotel

were added and the lumber camp became a town. The 1867 Pacific Coast Directory describes Searsville as a lively place with a Crystal Palace saloon, a Wells, Fargo and Co. office, and a hotel, store, butcher shop and post office.

In 1875 Paulson's Directory listed Searsville as having 35 residents (taxpayers, not including wives and children) plus 30 other people living within a mile of town. In addition to nineteen teamsters, lumbermen and woodsmen, Searsville supported twenty farmers, eleven laborers, three miners, two clerks, and a carpenter, hatter, blacksmith, teacher, dairyman and so forth (Grundmann 1982). As of 1880 the town was abandoned, its land condemned for the eventual construction of Searsville Dam and reservoir (see Water, below). But Woodside continued to be a thriving community. What was once the Pulgas redwoods had become a farming and stock-raising community, and these activities ultimately outlived the lumber industry.

Cultivated fields had replaced redwood forest throughout the Santa Cruz Mountains, as suggested by the following agriculturist's soil study.

One sample of the coast loams was from redwood land taken about two hundred feet above sea level and two miles inland from Pescadero. As much fruit is now grown on land cleared from the redwoods, it is of interest to state that the analysis shows a high percentage of lime, a large one of potash... [but] it is pretty certain to need phosphates so soon as its first fertility is exhausted... It probably represents fairly the favorite soil of the redwood (Wickson 1891:46).

The same publication contained discussion of redwood forest clearing, noting that the first crop may be subject to "redwood poisoning" and recommending that field crops be planted for a year instead of fruits (Wickson 1891:97).

By the turn of the century, logging in the Santa Cruz Mountains was restricted to relatively inaccessible timber lands on the western side of the range. In the 1930's only three mills were still in operation, out of the three hundred total mill sites in the redwood region (Jensen 1939; Wilson 1937). On the other hand these three mills produced nearly 15 million board-ft in 1937; fifteen mills worked to produce 20-25 million board-ft in 1853. Some logging activity in the southern Santa Cruz Mountains continues to the present day.

In any case, since the late 1800's logging has had little impact on the area surrounding Jasper Ridge. An 1897 lease by Stanford University of the "Dennis Martin Tract", for farming and grazing, was made with the stipulation to "not cut down, uproot

or in any way destroy any of the trees or permanent growth on the said premises" (SU Archives, SC6, Leases, 1897, Box 23). This may have been standard lease language, although a 1915 report for the university's Trustees on the Palo Alto farm showed a \$1352 income from "wood sales" so some trees must have been cut (SC27, Box 11, Folder 5). On the other hand a 1916 letter from university President Wilbur argued against wood cutting in the "Dennis Martin Hills", saying that "The trees are one of our best assets" (Pres. Lyman Wilbur, March 17, 1916; SC27, Box 12, Folder 4).

A rough estimate of the area logged during the peak activities of the 1850's and 1860's can be derived by comparing board-ft/year produced with board-ft/acre available. The San Mateo County Gazette on May 28, 1859 summarized the capacities of eight sawmills, all those currently in operation in the county. The Morrison mill with its 8,000 board-ft/day capacity did not commence work until the following year, but the list did include five mills mentioned above: the Mountain Home mill at 3,000 board-ft per day; Martin's Lower Mill at 6,000 ft; Martin's Upper Mill at 18,000 ft; Morey Smith's circular-saw mill at 6,000 ft; and the Cañada de Raymundo mill at 5,000 ft. These figures add up to a total capacity of 38,000 board-ft/day for the mills within 5 km of Jasper Ridge. An additional 18,000 board-ft/day could have been produced by three mills on the western side of the mountains, according to the Gazette article. And according to the above-cited Gazette article of December 8, 1860, production had already fallen in 1859 from previous years' yields. In other words it is conceivable that the Searsville-Woodside mills produced 20 million board-ft annually, as cited by Wilson (1937).

The lumbering and forest management literature provides a range of estimated yields for redwood forest. According to one study, the range in thousands of board-ft/acre is as low as 50, 75 or 90 on "average" sites, and as great as 100-150 on the "best" sites (Melendy 1952:77, 95, 104, 110). Another study suggests a range of 38 to 88 thousands of board-ft/acre on "medium" sites, 88 to 163 on good sites and upwards of 163 on the best sites (Wieslander and Jensen 1946). A range of 75-125,000 board-ft/acre seems reasonable for virgin forest given that even second-growth trees at fifty years of age have yielded 76-116,000 board-ft/acre (Show 1932usda).

Using the range of 75-125,000 board-ft, if the Searsville-Woodside mills produced even 20 million board-ft per year, between 160 and 267 acres would have been logged annually. 12,500 acres (5,000 ha) is the size of the area bounded by Corte Madera Creek, Searsville Lake, West Union Creek, and Skyline Road at the Santa Cruz Mountains summit. Two decades of intensive activity, such as we know occurred in the 1850's and 1860's, would therefore have cleared between 25% and 43% of the forest

lands west of Jasper Ridge.

This estimate can be compared with figures for the entire Santa Cruz Mountains region. Before logging began in the late 1700's, there may have been approximately 1,700 sq km (416,000 acres) of virgin redwood or redwood-Douglas fir forest in the Santa Cruz mountains (Wilson 1937).

Redwood forests must have been abundant in the mountains between the southern arm of the Bay of San Francisco and the ocean, even within comparatively recent years. Much of what was once forested land is now tilled, but by the roadsides and along the fences one sees great blackened stumps which prove the recent presence of redwood forest (Peirce 1901:84).

A Forest Service survey estimated the original extent at only 1,000 sq km, or 254,000+ acres (Jensen 1939). Both authors agree, however, that by the 1930's the forest was much reduced. Using the more conservative estimate, only 11% (27,000 acres) of the original redwood forest remained untouched (Jensen 1939). 54% (137,000 acres) had been logged and re-established with second-growth forest and the remaining 35% (90,000) had been completely deforested, replaced by brush land or woodland.

Wherever virgin forest was not protected by park designation, it was "rapidly being absorbed by the mills" according to Wilson (1937). In 1948 there were three large corporations and 21 small timber operations at work in the forests of San Mateo and Santa Cruz Counties (Baker and Poli 1953, 1954). In 1972, there were five sawmills left in Santa Cruz County and none in San Mateo; in 1985 there were only two in Santa Cruz County (Howard 1974; Howard and Ward 1988). That year the mills used 6,000 bf worth of old growth trees (100+ years) and 36,000 bf of second-growth trees younger than 100 years (Howard 1974). Forest Service analysts noted that in California, only in the Santa Cruz Mountains did the logging of second-growth trees far exceed that of old growth, a reflection that most old growth trees had by that time been cut.

Summary

With the early methods of "lumbering by hand", loggers removed relatively few trees, one at a time, and sawed them up in place. At this pace logging did little to change the composition of the forest. With the introduction of water-powered mills, and the use of oxen teams to drag logs to the streamside, many more trees were cut, but little damage was done to the trees left standing. This pattern changed drastically once sawmills came into use. Although local records rarely mention the use of fire in forest clearing, Wilson (1939) makes it clear that once the first sawmills were built in the Santa Cruz Mountains, fire was

typically used to increase efficiency by burning bark and debris, facilitating movement of the logs.

Because the redwood is free from resin and contains much water, the freshly felled trees do not burn readily. For this reason, the lumbermen commonly clear away the rubbish around the trunk of a felled tree simply by setting fire to the brush. In this way the foliage and smaller branches are consumed and the main trunk becomes accessible... A fire hot enough to burn up so much green rubbish... would probably heat the ground enough and deep enough to injure or kill the underground parts [of the stump]... It seems to me, therefore, that the habit not of the redwood but of the lumberman is responsible for the failure of the northern redwood forest to renew itself (Peirce 1901:86).

Because many trees left standing were killed by fire, this practice encouraged permanent deforestation and replacement of the forest by brushland or woodland communities. One local resident described post-logging vegetation as "abundant stands of Wild Lilac", probably Ceanothus thrysiflora... a common member of the chaparral" (in Oberlander 1953:29). Alternately, former forests were readily converted to pasture or farm lands. "However the trees and underbrush may be wrenched from the soil, fire is the final clearer... Such stumps as do not burn with the brush must be gathered in piles and re-fired" (Wickson 1891:97).

Despite the greater potential for destruction during the later sawmill period, in the San Francisquito headwaters forest, Brown (1966:16-17) suggests that early loggers had a much greater impact overall. Before the Gold Rush, logging focused on the most accessible areas of the lower foothills -- areas that are now completely deforested. In contrast, at the higher elevations cleared by the post-Gold Rush sawmills, many groves of second-growth redwoods may still be seen today. The 1930's Forest Service survey tends to support Brown's hypothesis. The surveyors found that San Francisquito area lands were either deforested, or were supporting second-growth stands of a single age class. The latter is typical of regrowth where the original stands were removed in a short period of time, by logging and/or by fire (Jensen 1939).

In the Preserve today the redwoods, as well as most other trees, are second-growth individuals averaging less than one hundred to 125 years of age (see Franco 1976). The redwoods are now limited to riparian corridors; in fact, Porter (1962) described the redwood groves as a streambank association of the oak-madrone forest, although they may have been more broadly distributed before logging activity began.

On a larger scale, the once-extensive redwood forests of the Santa Cruz Mountains -- perhaps covering more than 1,000 sq km - - have been reduced to less than 100 sq km of forest in state and county parks, open space districts, and commercial "timberland preserve zones" (California Dept. of Forestry 1979). The reduced forest may have some implications for local climate, related to reduced humidity - a hypothesis still under investigation at this writing. Repass (1923:2) noted that logging seemed to have caused springs in the Corte Madera drainage to dry up, reducing the total amount of water entering the creek. To summarize, in addition to possible climatic effects, the loss of redwood forests has reduced the watershed capacity; reduced the habitat for forest wildlife; and expanded the area of oak-madrone forest and oak woodland.

RANCHING AND FARMING

Introduction

Nineteenth century land use in the Searsville-Woodside area paralleled the rest of central California in its transitions from cattle grazing, to grain farming, and finally to mixed agriculture. Ranching and farming, like logging, began during the late 1700's in the era of the missions. Until the 1840's, cattle and sheep raising was the predominant activity on the San Francisco Peninsula, with farming limited to minor crops of wheat and barley. In addition to the impacts caused by intensive grazing, a significant result of the Spanish occupation was the introduction of numerous European grasses and other species that forever changed the character of the native vegetation.

With the 1849 Gold Rush came rapid population growth and a constant need for food supplies in the nearby city of San Francisco. Settlers throughout the Peninsula, including landowners in what is now the Biological Preserve, began farming for the market, investing in dairying, orchards, vineyards, and a great variety of other crops. As forests on the eastern Peninsula disappeared, increasing numbers of residents abandoned the logging industry in favor of farming.

By the early twentieth century logging had ceased entirely in the Searsville-Woodside area. Small farms and orchards continued operating into the late 1960's; several are still in business, including the Webb Ranch adjoining Jasper Ridge. Within the Biological Preserve, cattle and sheep grazing continued uninterrupted on the upper grasslands (parcel 91) until 1960, when Stanford University stopped the practice to protect areas dedicated to research. Today there are still a few small orchards and vineyards, as well as seasonal cattle grazing in the hills surrounding Jasper Ridge.

The Mission Period

General Background. When the Franciscan missionaries arrived in California they brought with them a typical 18th-century Spanish agricultural assemblage: extensive stock ranging and grain farming, and small-scale orchards, vineyards and garden crops irrigated by ditches from lakes or dammed streams. At first, the missions were not self-supporting and had to request food supplies from Mexico. Towards the end of the period, the missions were producing sufficient food and in addition were exporting surplus hides and tallow from their large cattle herds.

Mission Santa Clara, at the north end of the Santa Clara Valley, was located among some of the finest agricultural lands in the state. The warm dry summers and wet winters were familiar to settlers from Spain and provided good growing seasons for

grain, fruit and vegetable crops. The Pueblo of San José, founded at the same time as the mission, was the first community in California intended specifically for farming. Settlers were to supply the mission with surplus products; in return the Spanish government supplied the seeds, livestock, and sufficient land for farming, as well as common pasture and timber areas. Timber was cut in the Santa Cruz Mountains forests; crops and grazing lands were located in the valley and along the lower foothills.

In contrast, Mission San Francisco had neither the appropriate soil nor climate for agriculture on site. To ensure its security, the mission was situated near the presidio, and the presidio was strategically located to guard the entrance to San Francisco's harbor. As a result of the coastal exposure there was frequent chilling fog. Crops to supply the mission and presidio had to be grown 20-25 km south on the Peninsula where the weather was warmer (see Map 7). Suitable grazing lands for cattle also lay well to the south of the mission.

Wheat was the staple crop for both of the missions although barley was also cultivated. Crops needing summer irrigation such as corn and beans were only planted to a limited extent. Between 1783 and 1831, when record-keeping at Mission San Francisco ceased, the total harvest amounted to 30529 bushels of wheat, barley, 15872; corn, 4517; beans, 5168; lentils, peas and pulse (other legumes), 5081. These figures are based on 0.4 bushels (14 liters) to the fanega, the volume measure in use at the time. During the same period, Mission Santa Clara's harvest totaled 42206 bushels of wheat; 5749 of barley, 11512 of corn, and 1330 of beans. (G. B. Griffin, Mission Stats Notes, Bancroft #C-C64, file 6).

These total crop yields indicate that only a very small proportion of the missions' lands were used for agriculture. The territory of Mission Santa Clara totaled approximately 240 sq mi or 600 sq km, comprising all the area bordered by San Francisquito Creek to the northwest, the Santa Cruz Mountains to the southwest, and the Guadalupe River on the east side. 30 bushels of wheat per acre is considered an average yield for mission times (Broek 1932:49). Using figures for annual yields at Mission Santa Clara, Broek estimates that the amount of land growing wheat in 1790 was less than 100 acres (40 ha). In 1826, when the mission population was at its peak, wheat was probably grown on 330 acres (132 ha) -- still less than 1% of the Mission's lands.

Farming technology in this period was simple. Ox-drawn plows cut shallow grooves into the soil just deep enough for planting; both sowing and harvesting were done by hand. Indian laborers, cutting ripe wheat high on the stalks, left enough seeds to resow the crop naturally and often gained a second and

even a third crop without having to re-plant (Broek 1932).

Livestock raising and the eventual export of hides and tallow supported California's economy under both the Spanish and Mexican governments. The abundant grasses and mild temperatures were favorable for raising cattle, so herds multiplied rapidly. Cattle were pastured in the valley lowlands around the shore of the bay during the winter and spring. In the summer, as in mediterranean Europe, herds were driven up into the foothills where water was still available and where greater winter rainfall maintained green grasses later into the dry season. Rangelands were not fenced; cattle were branded periodically, and the rest of the time one or two herders accompanied the livestock on horseback.

The missions also raised large herds of sheep, as well as goats, swine, horses and mules. In 1805, Mission San Francisco's herds reached their greatest numbers: 10620 head of cattle, 11000 sheep, 1015 horses, and 25 mules. The latest year that Mission Santa Clara data are available is 1821; 4500 head of cattle, 13000 sheep, 800 horses, 21 mules and 50 swine are listed. Since cattle and sheep would have needed several acres of pasture each (Broek 1932), it is clear that much more land was used for grazing than farming.

When the missions began to lose their lands to private ranches under the secularization process, stock were frequently included as part of the land grants. Some sources suggest that many animals were slaughtered to prevent the new settlers from acquiring them (Broek 1932).

Local Impacts. It is unlikely that agriculture was practiced in the Jasper Ridge area during the mission period, since abundant farm land was available much closer to each of the mission sites. Wheat and barley were probably grown on more accessible lands at lower elevations. Fruit and vegetable crops were generally grown within a few km of the missions themselves.

On the other hand, the grasslands and woodlands in any of the Jasper Ridge parcels (#90-91, 96-108) could have been grazed by sheep or cattle from Mission Santa Clara. Around 1800, Santa Clara Mission founded a sheep ranch on San Francisquito Creek, a few km east and downstream from Jasper Ridge (see Map 7; Brown, in Stanger 1963:21). When the Pulgas Ranch on the opposite side of the creek was granted to Captain Arguello in 1828, Mission Santa Clara lost what it considered "the best site for sheep", suggesting that Santa Clara animals had ranged on both sides of the creek prior to that time (1828 Mission Santa Clara-Position, Limits and Terrain; from Benicia/California Archives-Miscellany, Bancroft #C-A 62). Whether the sheep ranged uphill to the west, into the Preserve area, is unknown but there would have been nothing to stop them.

The Jasper Ridge area also faced grazing pressure from the north. Although Mission San Francisco was more distant it had similarly large herds of animals, and less open grassland, of which each animal required several acres. Between the presidio's and the Mission's herds, the peninsula had barely room for several thousand head of cattle in addition to sheep, goats, horses and swine. As early as 1790 the missionaries and the military had to divide the best pasture lands between them, such that sheep and cattle probably grazed wherever possible as far south as San Francisquito Creek (Stanger 1963:25-26). The San Francisco outpost nearest to Jasper Ridge was the Rancho Pulgas on the north side of the creek, but again, animals wandered freely as no areas were fenced.

The Mexican Period

Background. The new landowners, recipients of large land grants from the Mexican government, appropriated irrigated fields and livestock from the missions as well as fences, corrals, outbuildings and other improvements. Mexican independence brought new export opportunities and an increased market for hides and tallow. Ranchers began to expend more energy on cattle-raising than wheat-growing, and agricultural labor was frequently reduced to two weeks a season -- the planting and the harvest (Payne 1987). Meanwhile, cattle continued to range freely. Ranchers organized periodic rodeos (round-ups) after which bundles of hides and tallow were collected at boat landings and shipped to the East Coast or England (Stanger 1963).

Agricultural methods continued to rely on Indian laborers for the shallow plowing, sowing and harvesting of the crops (Broek 1932). One such laborer, working for the new Mexican owner of former Mission San Francisco's San Pedro ranch, described the unvarying routine of raising 5-6,000 head of cattle and planting wheat, beans and corn (Brown, n.d.). Overall there was little change in farming or in resource use by livestock after Mexican independence in 1821, or after mission secularization in 1834.

The greatest impact to the California's rangelands began during the early 1800's as an indirect result of the mission system and subsequent Mexican occupation. Like the rest of California, local vegetation on the Peninsula was irreversibly altered by the introduction and subsequent naturalization of Mediterranean grasses, composites, legumes and other species. The seeds arrived in the feed bags of Spanish livestock, in the animals' hair, and in the seed packets brought to start the mission gardens. For example, explorers in the 1790's and early 1800's do not mention seeing either European "wild" oats (Avena spp.) or mustard (Brassica spp). By the 1840's, however, visitors report extensive fields throughout the Peninsula and

adjacent Santa Clara Valley (Broek 1932:52-53).

We travelled fifteen miles over a flat plain ... covered with a great variety of grasses, wild oats, and mustard. So rank is the growth of mustard in many places, that it is with difficulty that a horse can penetrate through it (Bryant 1849:318; reporting a journey from Santa Clara to Palo Alto).

The European mustard, wild oats and other non-native annual species evolved in a mediterranean environment much like that of California. Once transplanted, European annuals rapidly established themselves throughout the California prairie at the expense of the indigenous species which were largely perennial bunchgrasses such as Stipa spp., Melica imperfecta, wild rye (Elymus triticoides) and others. The perennials were highly palatable and much preferred by livestock, so they were already partially exterminated by overgrazing when the annual species began to spread. After the wild oats and mustard, the annuals' succession proceeded to filaree (Erodium spp.), tarweeds (Hemizonia spp.), thistles (Cirsium) and goat grasses (Aegilops spp.), each stage less desirable as forage than the previous one. By the late 1800's most of California's native prairies had lost their desirability as rangelands (Burcham 1957; Heady 1977; Robbins 1940).

Local Impacts. The 1834 and 1844 Corte de Madera land grants to Máximo Martínez included present-day Jasper Ridge and the surrounding area, as noted in the previous section. There is little information about agriculture for this time period. Wheat, barley, corn and beans were probably grown by the Martínez family, at least in quantities sufficient for subsistence. Some of their fields may have been on Jasper Ridge, but it is more likely that they used the bottom lands to the east (parcels 93-95). Gardens may have been planted near their home, nearly 2 km south of the Jasper Ridge boundary (Minto 1879).

Other evidence of farming in the immediate vicinity includes Prudencio Espinosa, an associate of Máximo Martínez. Immediately west of Jasper Ridge in the valley between what is now Portola Valley and Woodside, Espinosa purchased part of Martínez' Rancho del Corte de Madera, and raised vegetables for the San Francisco and San Jose markets during 1849-1851. His partner was Omnes Guy, who operated a sawpit on this parcel at the base of the mountain (Regnery 1991). By the end of Mexican period, American immigrants had found an alternative use for some of the local corn crop -- they built a distillery in the Pulgas Redwoods near Jasper Ridge. An 1842 document written to the local justice of the peace noted that manufacturing alcohol was prohibited, and the practice was to be stopped (Document #38-2, City of San Jose Archives).

The Corte de Madera grants were not only valued for their timber but also for the numerous "wild" cattle ranging there that had formerly belonged to the missions. Martínez' 1836 survey describes the land as "el referido sitio de ganado mayor de que consta el Rancho de la Cañada del Corte de Madera", meaning that the "timber-cutting ranch" consists of the place of beef cattle (Martínez Land Grant Documents, February 22, 1836, Bancroft #C-I 87, Reel 2). Soon after receiving this first grant, Martínez registered a new cattle brand in an 1834 petition to the Pueblo of San José (Document #85-198, San Mateo Historical Archives).

It is clear that Martínez grazed cattle, sheep and horses on his Corte de Madera ranch lands; the original 1832 petition for the grant acknowledged that he had worked the lands and grazed his livestock there (Martínez Land Grant Documents, Bancroft #C-I 87, Reel 2). Tax records from 1857-1863 list livestock, and Martínez' will (1863) mentions both cattle and sheep. While the exact area used for grazing is uncertain, much of the Corte Madera grant was too steep or forested to provide good pasture. Most of the Preserve lands would have been likely grazing areas, especially the upper grassland (parcel 90, 91) and the west lake shore (parcels 97-108).

Many of the grassland plant species introduced by the Spanish are now well-established on Jasper Ridge. 92 species of introduced grasses, composites, and other forbs were found throughout the state by 1860 (Robbins 1940:6-7). According to Porter's (1962) list, 53 of the 92 are found within the Biological Preserve including the now abundant "wild" oats and mustard, ripgut grass (Bromus spp.), foxtail (Hordeum spp.), and Italian rye grass (Lolium spp). While most inhabit disturbed areas on Jasper Ridge (roadsides, lakeshores, etc), 10 are open woodland or streamside associations, and 17 are found in the grassland.

The American Period

North American settlers began to arrive on the Peninsula in the 1830's. At first, most made their living in the lumber camps, while those who farmed conformed to the local pattern of cattle raising, with grain harvesting and vegetable gardening for home use. "Usually a little wheat, beans and corn were grown for home consumption, but cultivation was kept at a minimum" (Stanger 1963:44). The discovery of gold in 1849, occurring just before California's independence from Mexico, led to soaring prices for tallow, hides, beef and all other food products, as well as for timber from the local redwood forests.

The demand for supplies coupled with a sudden influx of population placed great pressure on the large ranches and on the Mexican land grant system in general. Increasingly, American settlers could not accept that nearly all the Peninsula's lands

were already owned. The large land grants had no fences to mark their boundaries. Compared to the eastern United States or to Europe, California seemed empty and unoccupied.

San Francisco's mushrooming population was demanding foodstuffs as well as lumber...The net result was that, within a decade [the settlers] had transformed much of the vacant cattle range, as well as the redwood forest, into an American community of farms, lumber camps and incipient villages (Stanger 1963:61).

In general, the Peninsula mirrored the rest of California in passing through three agricultural phases after 1850 (Broek 1932). The first phase, the fifteen years following the frenzy of the gold rush, was characterized by continued cattle ranging, sheep raising, and extensive wheat cultivation. However, the new settlers began experimenting during this period with various orchard and vegetable crops. The "Appletree Gulch" stream bed, 5 km northwest of Jasper Ridge, is named after a few old apple trees that were the remnants of a late-1850's experiment in apple growing (Brown 1975). A cherry orchard in Woodside, planted in 1853, was still bearing fruit forty years later (Wickson 1891:272).

As the early settlers had already acquired the best valley wheat lands, later arrivals began to clear fields in the chaparral covering the upper alluvial fans at the base of the foothills. For pasture, redwood or oak forests were cleared in the following way.

...the stumps are untouched, the trees not taken by the lumberman are girdled and left a prey to decay and storms, and the brush slashed and burned every few years to prevent it from completely taking possession of the land (Wickson 1891:90).

Apparently, orchards were sometimes planted in only partially cleared woodland or chaparral, although complete clearing was recommended as "decaying stumps and roots...often kill the young trees; especially is this the case with old oak stumps" (Wickson 1891:90).

Clearing chaparral and grubbing out its roots was difficult work, although some costs could be recovered by selling the wood and chaparral roots or making them into charcoal (Wickson 1891:89). Once the fields were planted "there was yet a new struggle, to exterminate the 'ground squirrels' which overran the fields from adjacent chaparral lands" (Broek 1932:77). But the efforts were worth the results, according to the following correspondence describing a farmstead in the hills 25 km south of Jasper Ridge.

March 4, 1854: Mr. Burrell finished putting his wheat week before last, it is now up and looking finely, he also sowed some turnips that are up and growing... The land here looks mellow and rich as it is turned over by the plough and one would think it might produce abundantly, we have strong hopes that it will.

September 6, 1854: Our crops have done much better up here than our fears led us to expect we have a good supply of wheat, corn, beans, pumpkins, squashes melons, tomatoes, potatoes, beets, &c, &c, also grape vines, peach trees and apple trees, growing.

February 25, 1855: we have taken between 140 & 50 head of cattle and calves to ranch for a man living in San Jose...[we] make the butter and cheese for two thirds of the profit...the cows are coming in very fast and I suppose we shall soon commence cheese making (Stuart 1950:46-47, 52-53).

An enraptured visitor to the San Mateo hills, northwest of Jasper Ridge, in 1859 reported on the first orchards there: "such peaches, such pears, such apples and figs! What magic is there in this virgin soil" (Stanger 1963:71).

The second agricultural phase started in about 1865 when wheat and to a lesser extent, barley as major crops slowly replaced the large cattle ranches. An 1861 law required farm lands to be fenced, causing cattle and sheep to overgraze their newly restricted range areas. Hay production became a necessity for the first time; wheat and barley began to be raised for this purpose as well as for flour. In addition, ranching and grain crops had been affected by severe weather and repeated drought years during the years 1853-1865.

In the harsh winter of 1859-1860 when many cattle in Northern California died...it was said that the ranchos had been overrun by stray cattle seeking grass in the late fall, nibbling it down to the roots and leaving nothing for the ranch's own stock (Gates 1967:22).

Once the native grasses had been seriously depleted by drought and overgrazing, annual grasses -- with more viable seeds -- were able to spread quickly and soon out-competed the perennial species for water and space (Stoep 1973). But as noted above, the end result was less valuable forage for livestock.

Upland regions such as the hills surrounding Jasper Ridge were among the last to lose cattle lands to farmers. The Handbook and Directory for San Mateo County, 1875 noted that the chief resources of the county were still grain and lumber (Paulson 1875). The Searsville-Woodside area was described in

the directory as "one of the most important farming and stock-raising districts in the County". Of the 66 taxpayers listed in the Directory as living within a mile of Searsville, 20 were farmers, more than any other occupation (teamsters was the second most numerous, with 12).

During the third agricultural phase, beginning in 1875, mixed horticulture finally superseded both ranching and wheat farming. The cattle market fell sharply after the Civil War; the cattle population of San Mateo and Santa Clara Counties dropped to 31,950 head, compared with 60,812 head during the 1860's. Cattle populations then rose slowly until World War I, another period of increased demand when the population peaked again at 61,318 animals (Haygood and Zebroski 1983:16). Also, by the 1870's much of the former cattle range had been converted to annual grassland from the original bunchgrass prairie. Without good forage for cattle, and without irrigation, a ground-water survey concluded that most of the area would have continued in the production of oat and barley hay "and other crops as could be matured on the moisture from the winter rains" (Clark 1924:3). However farmers in the 1870's began investing heavily in irrigation systems to support intensive land uses such as dairying, and fruit, vegetable and flower seed raising.

In the 1870's commercial fruit orchards appeared in the hills south and west of Jasper Ridge. Against expectations the trees did well, once the chaparral was cleared from the gravelly foothill soil.

It soon became generally understood that the Santa Cruz Mountains were especially adapted to fruit-growing...In a short time orchards and vineyards were set out... Farming in the Santa Cruz Mountains consisted of dry farming as it would be impossible to irrigate on the hillsides and rolling terrain (Lyman Burrell, in Payne 1989:118).

Fortunately for local farmers, orchard irrigation was rarely necessary in either Santa Cruz or San Mateo Counties (McNulty 1889:220; Wickson 1891:210). Burrell's memoirs noted that fruit and wine growing increased after 1877 when the South Pacific Coast Railroad reached the foothills. In the late 1860's the State offered premiums to any farmer who would plant mulberry trees and cultivate silkworms. Although high grade worms were raised in California, the industry failed due to a lack of cheap labor and specialized knowledge of silk production.

By the late 1800's most of the chaparral had been cleared from the foothills. The original brushy vegetation was replaced by orchards and vineyards on all but the poorest soil. Chaparral roots, a by-product of the clearing, were in demand as fuel; for example, the San Francisco-San Jose Railway was paying \$6.00 per

load for roots in the early 1870's (Cooper 1922, 1926:13).

The logging industry had by this time cleared most of the marketable trees from the eastern slopes in the Searsville-Woodside area. Sawmills were moving higher, toward the west, to work the remaining forests on the seaward side of the mountains. Not only were the redwood groves disappearing, but oak groves were vanishing as well -- the wood used for fuel and the bark for tanning (Broek 1932:89). In reponse to public concern about deforestation, eucalyptus trees were imported from Australia and planted extensively throughout the area starting in 1890 (Pyne 1982). Groves of Monterey cypress were also planted on the Peninsula, beginning a few decades earlier, but in much smaller numbers than eucalyptus trees which numbered in the millions by the turn of the century. There were hopes that eucalyptus trees could furnish fuel and timber, including railroad ties, but another reason the trees were planted was to reduce property taxes, which were lower for wooded areas (Oberlander 1953).

Local Impacts.

The presence of man and 'civilization' has affected the original floristic and ecologic conditions of [Jasper] ridge in several ways: by the bringing in and naturalizing of plants, some of which dominate large areas of the ridge; by the clearing off of some of the land and the use of it for pasture lands, and by the cultivation of some of the land at the edges of the ridge (Springer 1935:40-41).

As already noted, Martinez and other local settlers were undoubtedly raising small fields of wheat, beans and corn in the area of the Preserve, like other ranchers in the 1830's and 1840's. Grain must have been grown near Jasper Ridge well before the Gold Rush because in 1846 Dennis Martin, one of the first American settlers in the area, bought land from early settler John Copinger and built a grist mill in what is now the Preserve. The land was an extensive parcel (#81-89), including the area between the creek and Sand Hill Road. He stocked the land with horses and cattle, building fences along Sand Hill Road, and cultivated a large area, including an orchard of about 1,000 trees (US Land Commission testimony, in Regnery 1991:13). He also built a home, church and schoolhouse near the eastern edge of Jasper Ridge (border of parcels 85 and 86).

Despite its intermittent water supply, and repeated damage by floods, Martin's mill continued in operation. It was leased to a Mr. Cameron in 1860 and converted to steam engine power in 1861. The San Mateo County Gazette (June 11, 1861) carried an advertisement about "Martin's Old Grist Mill...to respectfully inform the citizens of San Mateo and Santa Clara Counties, that the Mill has been improved and remodeled throughout".

Several years earlier (1854) Martin had purchased 1250 acres of Martínez' land on the south side of San Francisquito Creek, including the main, northwest and southwest parcels of Jasper Ridge. Martínez retained adjacent grant lands in the hilly Westridge area to the south which he continued to use for livestock. An 1856 letter from a local resident described the Woodside area as a "first rate place to raise wheat oats barley and beans", and continued on to say, "as for stock the country is full of it. Some of the old spaniards here own hundreds of horses and mules and thousands of cattle" (Bancroft #84/113 C, Orrin S. Payne, Letters to his Brothers).

The 1861 law requiring farmers to fence their lands created a market for hundreds of miles of split redwood posts, as barbed wire was not introduced into the area until the late 1870's. This increased the logging pressure on the Santa Cruz Mountains forests. As logging came to an end in the Woodside-Searsville area, local residents turned to farming, some in the mid-1860's and increasingly in the 1870's. Tax information from 1844 through 1863 indicates that the acreage owned by Martínez varied from 2-6,000 acres. During that time he had as many as 80 cattle, 200 sheep, 26 horses, as many as 100 milk cows and oxen.

Although there are discrepancies between the two, tax records and the Agricultural Census data (see Tables, below) give us additional details about life in the Jasper Ridge area during this period. The 1860 Census lists Dennis Martin as farming and grazing livestock on 500 "improved acres". During 1858-59 when Census data were collected, Martin was in the process of selling the main and western Jasper Ridge parcels, but he continued to farm on the main parcel at least. In fact, the 1868 Official Map of San Mateo County shows Martin as the owner of the 1250-acre main parcel (see Map 8). It's probable therefore that 1860 data pertain to activities within the Preserve's boundary. Among Martin's livestock (valued at \$2000) the Census lists horses, mules, milk cows, cattle, oxen, sheep and eighty hogs. It also lists 2500 bushels of wheat, in addition to rye and corn. Several years earlier, Martin had planted an orchard including apple trees on the northside of the creek (parcel 86).

Tax records for James Morrison, a Jasper Ridge neighbor, list a reaper and a threshing machine among his early 1860's assets. Morrison had owned the main parcel between 1858 and 1863. Simon Fleury, farther east on parcels 93-95, also had livestock and raised wheat, barley and hay on 160 acres, according to the Census. Tax records give additional detail about Fleury's holdings: a pair of oxen, a few hogs, up to 23 horses, and up to 60 cattle.

An 1879 Survey of Rancho Cañada del Corte de Madera recorded a small grain field centrally located in the Preserve's upper

OFFICIAL MAP
OF THE
COUNTY OF SAN MATEO
California.

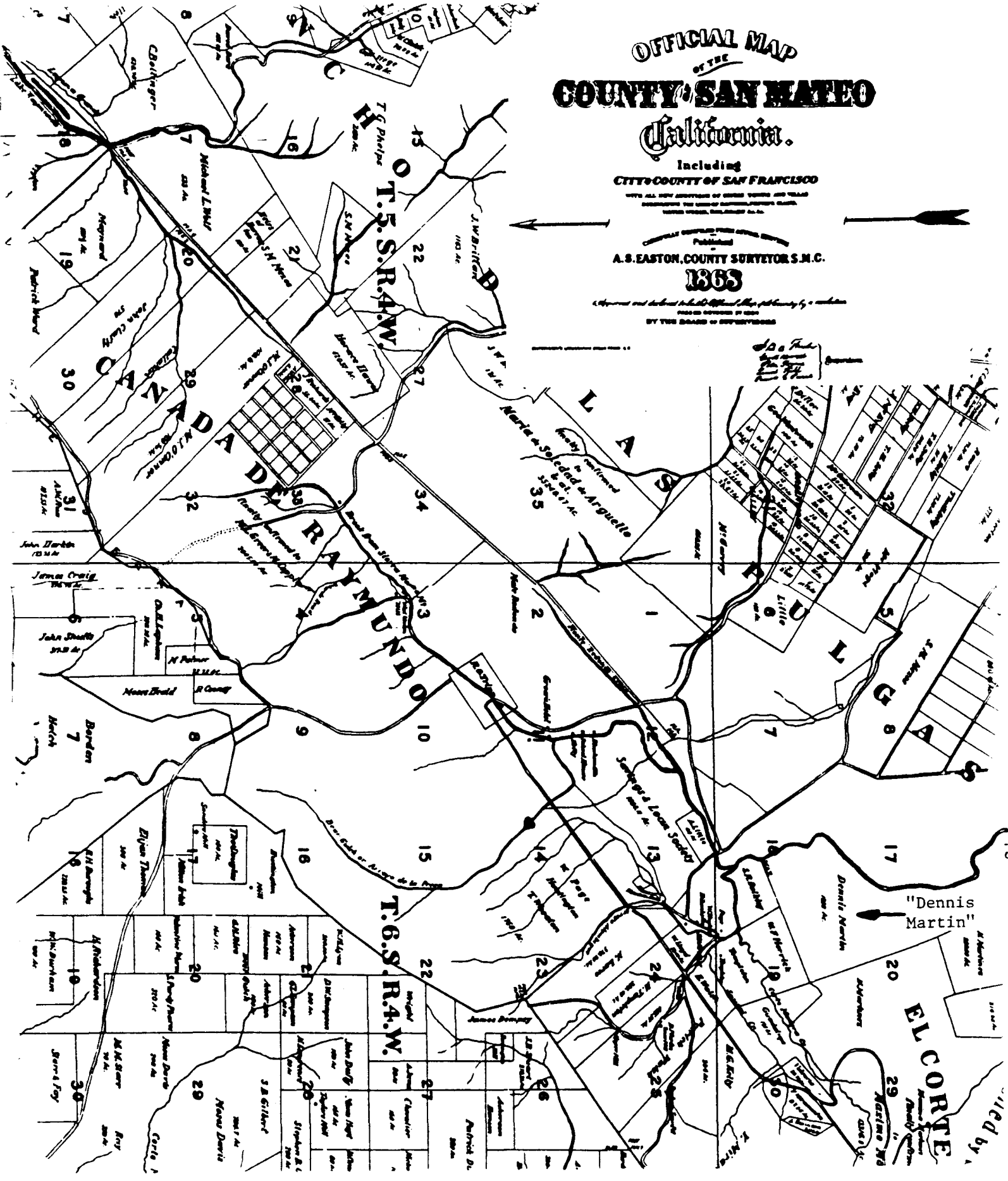
Including
CITY AND COUNTY OF SAN FRANCISCO

WITH ALL NEW ADJUSTMENTS OF BOUNDARIES, TOWNSHIP AND RANGE
CORRECTING THE ERRORS OF PREVIOUS EDITIONS
TOWNSHIP, RANGE AND RANGE

Published
A. S. EASTON, COUNTY SURVEYOR S.M.C.

1868

Approved and declared to be the Official Map of the County of San Mateo
under authority of Act
BY THE BOARD OF SUPERVISORS



Map 8. Section from Official Map of San Mateo County, 1968, showing parcel owned by Dennis Martin on Jasper Ridge.

Table 6. DENNIS MARTIN TAX RECORDS, 1857-1881

	1881	1878	1876	1874	1872	1870	1868	1866	1858	1857					
270 600	940	940	940	940	940	1040	1250	1160	650	650	650	300	300	1800	ACREAGE
M M												600	600	5750	\$LANDVALUE
O O												3000	3000	****	\$IMPROVE
R R						800	1000	1000	1000						\$PERS. PROP
T T	8	10	11	10	10	10	12	10		10					HORSES
G G		2	3		3	3	1	1							COLTS
A A		*	2		8	3				21					CATTLE
G G		2			3		9	14							CALVES
E E	2	5	6	9	8	10	25								COWS
D D	3	2	4	2	4	2	5	1		2					WAGONS
					*	1	*			1					MOWER
	*	*	*	*	*	*	*	*							FARM UTENS
		100					295								CROPS-AC.
		6	2	6	4	8	20	10							HOGS
	*	*	*	*	*	*	*	*							FURNITURE
	*	*	*		*	*	*	*							POULTRY
		*	*	*	*	*	*	*							GUNS
	*	*	*	*				*							MACHINERY
	*	*	*	*	*	*	*								HARNESS
					3										BEEHIVES
					\$50										HAY
	1		1												SEW. MACH
															/YEARLINGS
															/ HOUSE
															NOT / CORDS WOOD
															LISTED \ FENCE

Based on San Mateo County Tax Rolls; on microfilm at San Mateo County Historical Association, College of San Mateo.

Table 7.

SIMON FLEURY TAX RECORDS, 1857 - 1869

1869	1867		1865		1863		1861		1859		1857		
90	90	80	80	80	80	100	100	100	100	100	100	100	ACREAGE
											150	300	\$ IMPROVEMENTS
			400				635						\$PERS. PROP.
11		9	19		18	19	23		10	10	8	9	HORSES
					10	60	53		12	12		6	CATTLE
4		2			2	2				2	2	2	COWS
					1	1	1		1	1	1	1	OXEN
		*											WAGONS
					6		5		2				FARM IMPLEMENTS
									*		*		HOGS
													FURNITURE
					1								BUGGY
					15								CORDS WOOD

JOHN MURRAY - TAXES

JAMES MORRISON - TAXES

1878	1877	1876	1875	1874	1865	1864	1863	1862	1861	1860	
147	147	115	115	115	650	650	500	400	700	500	ACREAGE
					200				1337		\$PERS. PROP.
	2	3	2	1			4				HORSES
2							6				COLTS
										10	YEARLINGS
3	2	2		2							COWS
	3					15	14				HOGS
*	*										POULTRY
	1	1	1	1		1	2	2			WAGONS
		*									HARNES
*	*					*					FARM IMPLEMENTS
								*			THRESHING MACHINE
						*		*			REAPER
*	*	*					*				FURNITURE
						60					CORDS WOOD

Table 8.

AGRICULTURAL CENSUS OF 1860 (3RD TOWNSHIP)

JOHN MILLS	MAXIMO MARTINEZ	SIMON FLEURY	JOHN MURRAY	DENNIS MARTIN	
40	10	100		500	IMPROVED ACRES
800	3000	60	200	400	UNIMPROVED ACRES
2500	9000	3200	1000	4500	\$ VALUE OF FARM
200		150	80	1000	\$ FARM MACHINERY
4	3	4	1	18	HORSES
		*	*	*	MULES
13	100	12	10	25	MILK COWS
				6	OXEN
12	110	25		7	CATTLE
		2		1	SHEEP
10		11	9	80	HOGS
1000	2500	1000	1000	2000	\$ OF LIVESTOCK
750		300		2500	WHEAT BUSHEL* RYE "
				1	CORN "
				1	OATS "
		100			BARLEY "
					TOBACCO "
					COTTON "
					WOOL "
300	120	200	2000	500	BUTTER, LBS.
					CHEESE, "
	10	200		150	HAY, TONS
		200		300	\$ SLAUGHTERED ANI.

*bushels per acre

From U. S. Census Office, Partial Schedules; on file at California State Library, California Section. Sacramento, CA.

Table 9.

AGRICULTURAL CENSUS OF 1880

Dominick Grosso, overseer at Larco ranch

TILLED LAND--	400\	
MEADOW & ORCHARD	400	ACRES
OLD FIELDS	500/	
VALUE OF FARM	13000\	
EQUIPMENT	730 \	\$ VALUES
LIVESTOCK	1045 /	
FENCES-REPAIRS	100/	
MOWN	20\	
HAY	20 \	
BARLEY	120	ACRES
OATS	17 /	
WHEAT	18/	
HORSES	17	
MILK COWS	9	
OTHER CATTLE	7	
CALVES	3	
POULTRY	36	
EGGS	150	

From U. S. Census Office, Partial Schedules; on file at California State Library, California Section. Sacramento, CA.

grassland (Map 9). The grain was probably wheat, less likely barley although tax records are unclear, and the agricultural censuses of 1870 and 1880 excluded the 3rd Township of San Mateo County that includes Jasper Ridge. Discrepancies and missing data aside, though, available records suggest that by the 1860's, all arable land was under cultivation and livestock were grazing everywhere else. An 1878 lithograph described one farm near Woodside as 1500 acres, with only a small portion of the land cleared,

"planted with fruit trees of all kinds, which produce an abundance of superior fruit, and the grape, as well as all varieties of the citron family, grow to perfection as the climate on the side hills is very mild and free from frost" (Richards 1973:44-45).

Although hillside farming had begun two decades earlier, in the early 1870's farmers began to clear large tracts in the foothills to plant orchards and vineyards (Cooper 1926). An early resident describes well-established apricot orchards in the hills south or east of Jasper Ridge in 1901 (McDonald 1954:45). An 1893 lease document refers to "the young orchard set out and growing well" in the southeast corner of what now is parcel 95 (SU Archives, SC6, Box 22, 1893 file).

As early as 1872 the foothills along the east slope of the Santa Cruz Mountains became known as the "foothill wine district" (Broek 1932:83-84). Between 1870 and 1915, there were at least seven wineries and over 800 acres in vineyards in the hills around Jasper Ridge (Richards 1973). 158 acres on the Stanford property, including 30-40 acres in the hills near Felt Lake (McDonald 1954:35), were devoted to wine grapes. The Stanfords constructed a winery in 1888 near the present site of the Medical Center.

Unlike the grain field shown on the 1879 map, there is no documentation, as yet, of orchards or vineyards within the Preserve borders. Martin had long before planted his apple orchard on the north side of San Francisquito Creek. In the 1880-90's Grosso, the miner also known as "The Hermit", planted a few grapevines, olives, and other fruit trees near his cabin on a hillside in the chaparral west of the upper grassland (see Mining). Grosso acquired the mineral rights to Jasper Ridge as a result of a failed mulberry venture. Nicholas Larco, Grosso's employer, gave him the rights when he faced bankruptcy after investing in 50,000 mulberry trees on his lands south of Jasper Ridge along Corte Madera Creek. At least that year, Larco had raised thousands of silkworm cocoons successfully, but not in time to regain his investment (Mayfield [Palo Alto] Enterprise June 18, 1870).

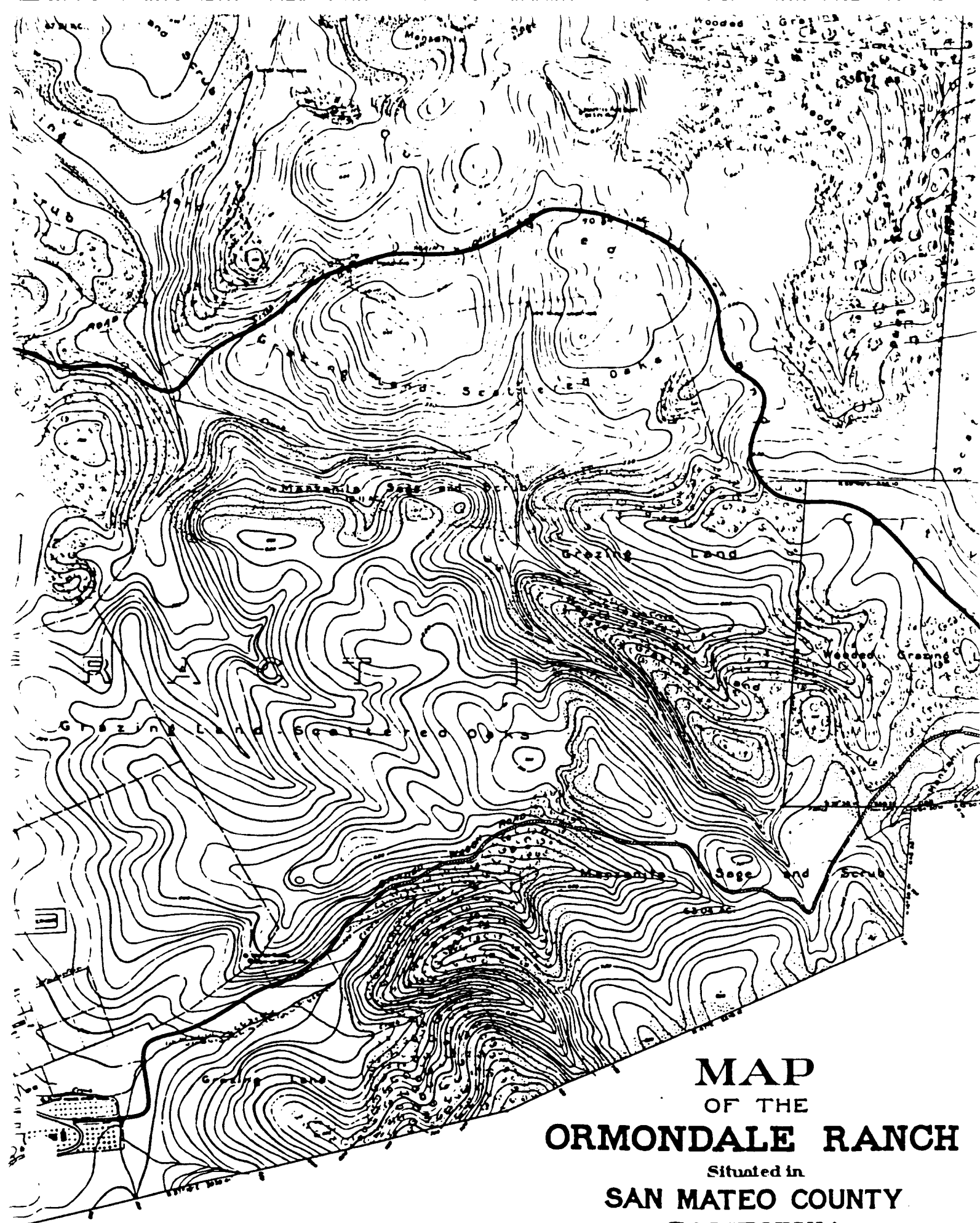
An interesting soil or vegetation feature, visible on air

photos, in the Jasper Ridge grassland may be evidence of a short-lived orchard or vineyard in that area. An oblong area that partly overlaps with the 1879 grain field is covered with roughly parallel lines, averaging 10 m apart, and trending northwest-southeast like the adjacent wagon road. The lines are similar to the traces of ridges and furrows from medieval cultivation still visible today in the English countryside (Rackham 1986:168). A review of 19th century agricultural practices in California (Wickson 1891:230-403) indicates that most of the locally grown fruits were planted in rows allowing trees to be 6-12 m apart (20-40 ft). Grapevines were typically more closely spaced, at 2-3 m. The row-and-column orchard pattern was used on hillsides as well as level ground except "on land too steep to plow both ways". Cherries, apricots, and apples -- all grown in the Woodside-Jasper Ridge area -- were usually spaced about 10 m apart as are the lines in the grassland.

As yet there is no archival or field evidence to confirm the former existence of an orchard on this site. Surface inspection has revealed only that the lines seem to reflect minor changes in topography, in the form of discontinuous low ridges; there may also be differences in vegetation, with taller grasses or different species on and between the apparent lines. Stanford geologists inspecting the area have ruled out soil types or geomorphology as explanations (Profs. Konrad Krauskopf, Ron Lyons, Ben Page, George Parks, personal communication, April 1991). Field investigations are currently planned to determine whether the lines are primarily caused by topography or vegetation, and to identify their origin if possible.

Grain crops continued to be grown in upland areas like Jasper Ridge after most of the richer Santa Clara Valley lands had been converted to orchards. For example, a nearby parcel on Page Mill Road, the Behm Ranch, "comprised about 300 acres, with probably 250 acres under cultivation of hay" in 1901 (McDonald 1954:56). Immediately south of the Preserve on the Ormondale Ranch, the hillsides were used for cultivation as late as the 1930's (Map 10). It is therefore likely that grain was grown on Jasper Ridge's 596-acre main parcel long after the fenced grain field was mapped in 1879. In 1880, James Dixon (son-in-law of Dennis Martin) assumed Martin's mortgage for the main parcel and adjoining eastern parcels. He agreed to make payments by turning over one-fourth the total harvest of hay and grain grown that season (SU Archives, SC30, Property Deeds, Box 3, File 14).

When Stanford acquired them in 1882-83, what we now know as parcels 90-95 were collectively known as Lot 35 or "the Dennis Martin Tract", a total of 982 acres. An 1883 survey of 982 acres in and around Jasper Ridge stated that 652 acres were "fit for cultivation", 160 acres were unfit, and 170 acres were "chaparral hills" (see Map 11; Coombe 1883). This survey excluded the northwest parcel, but included the main, southwest and parcels



MAP
OF THE
ORMONDALE RANCH
Sited in
SAN MATEO COUNTY
CALIFORNIA

SCALE OF FEET = 1" = 600'

Map 10. Section from Ormondale Ranch Map, 1937, showing land use designations.

93-95 east of the Preserve. About 236 of the acres fit for cultivation were included in the eastern parcels, leaving about 416 arable acres on the main and southwest parcels.

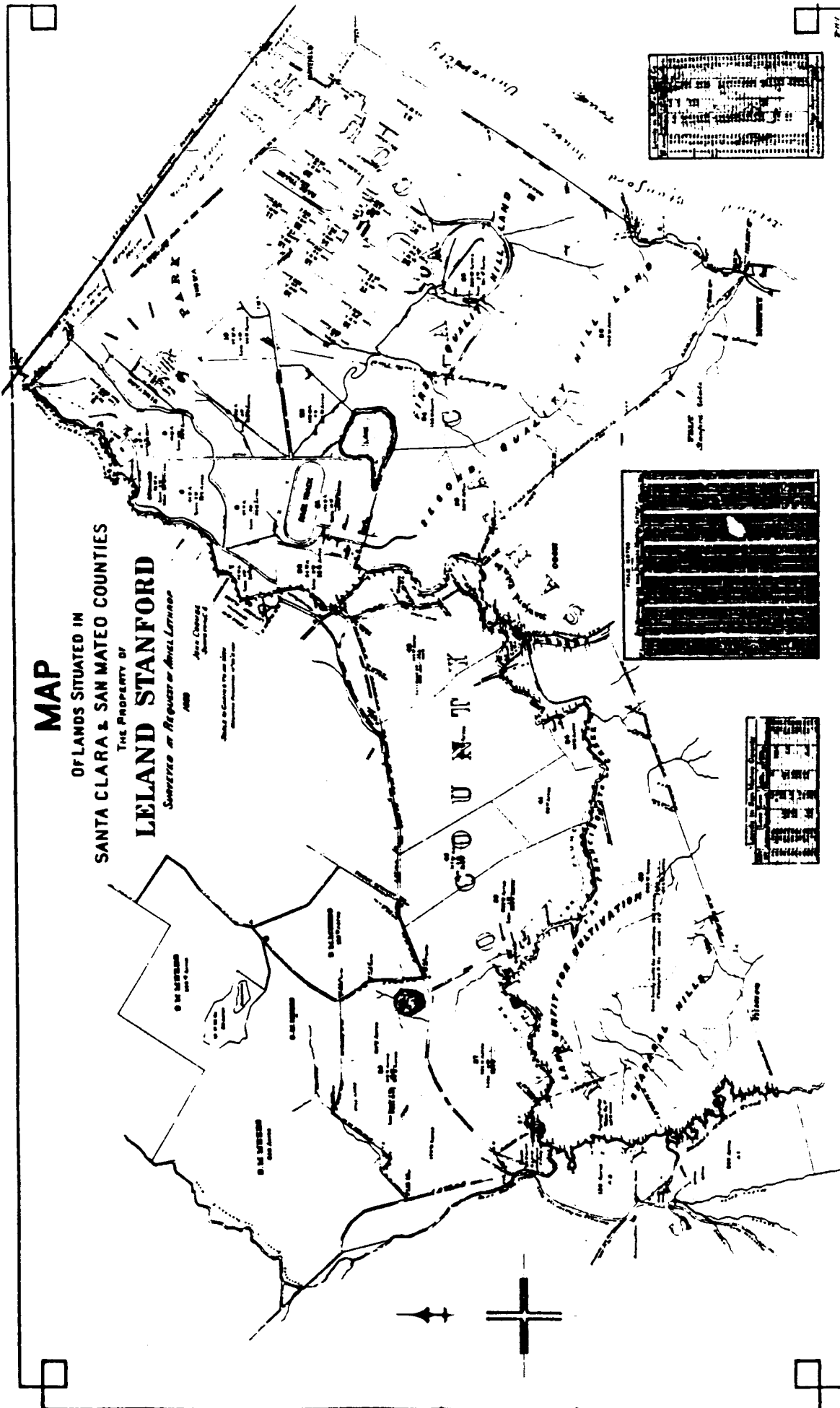
In any case, various parts of these lands were leased to local farmers. For example, Manuel Condray leased 330 acres of "hill land" for pasture use, and 150 acres of "bottom land" for farming in 1895-1899 (SU Archives, SC6, Box 23, File "Leases 1898"). 1899 records indicate that Condray harvested 765 bales of wheat, oat and barley hay, plus 609 sacks of wheat, oat and barley grain (SU Archives, SC6, Box 24). In 1899, payment for a year's lease amounted to one-third of the crop (SC6, Box 23, File "Leases 1899").

Because Jasper Ridge and east side parcels were both included in Lot 35, turn-of-the-century lease documents do not often specify whether grazing or farming occurred on Preserve lands. "Hill" lands were probably on the Preserve, and "bottom" lands in the eastern parcels, but both areas would have supported grazing or grain agriculture. There is strong evidence for this from the adjoining Ormondale Ranch (see Map 10) where four types of land use are shown for the hilly areas: manzanita sage and scrub; wooded grazing land; grazing land-scattered oaks; and cultivated land, on the hills with moderate slope. Land uses indicated for areas along Corte Madera and Los Trancos Creeks include cultivated land; flat bottom land; wooded creek bottom land; and one very small parcel of "irrigated land" on the creek bank (Punnett, Parez and Hutchison 1937).

Using wooded areas for pastures was a common practice; a 1901 description of the Abelee Ranch near Page Mill Road notes that "untillable, steep, hilly" lands "covered with greasewood and some large timber" were fenced for grazing (McDonald 1954:60). At times livestock were deliberately pastured in oak woodland. McDonald, raising hogs in the area in the early 1900's, noted that "feeding...wasn't expensive, as the hogs ran loose to secure much of their own sustenance such as acorns from the oak trees" (1954:83). The present age distribution of trees in the oak woodland very likely reflects changes in grazing pressure, following regional trends in cattle and sheep populations (Haygood and Zebroski 1983).

Overall, available records suggest that the Preserve's upper grassland was used for grain crops on and off from 1860 to at least 1880, if not 1900. Since that time the grassland appears to have been used for grazing continuously. But whether grazing or farming were primarily at fault, large expanses of "manzanita sage and scrub" or chaparral were steadily cleared from the local foothills, substantially modifying the original vegetation.

...at one time, [chaparral growth] dominated the ridge to a much greater extent than it does now; large areas



Map 11. Map of Leland Stanford Property, 1883, showing "land unfit for cultivation" on Jasper Ridge.

of the ridge now show the presence of what Dr. Cooper points out is characteristic secondary growth -- fields of Avena fatua and Avena barbata...now dominate a large part of the ridge (Springer 1935:24-25).

As agricultural and grazing pressure increased, non-native plants from Europe and increasingly, from other parts of North America became established in California. In addition to 53 of the species introduced prior to 1860, as mentioned above, 44 major species were introduced since 1860 and 9 of these are found in the Preserve (Robbins 1940; Porter 1962). Springer goes on to note that "naturalized weeds" were abundant in disturbed areas along roadsides and near buildings, but that there were comparatively few on the ridge where most research was conducted, at least in the 1930's when her study was completed.

In 1908 Stanford lands were resurveyed (Hermann 1908) and lease documents from this time forward refer to the parcel numbers such as 90 and 91 used in this paper. Earlier leases had been based on the Coombe 1883 map already discussed. During 1917 and 1918, the Army took over Jasper Ridge and all surrounding lands for training in artillery and maneuvers (see World Wars I and II, below). After the war, the Palo Alto Stock Farm leased approximately 2,460 acres including parcels 90-92 from Stanford for cattle grazing, as well as additional acreage for a dairy farm closer to campus.

The Stock Farm lease began in 1919. University zoologists and biologists responded to the presence of livestock by requesting a natural history reserve on parcels 90 and 91 of what was then called "Searsville Ridge" or "Dennis Martin Hills". A 1919 letter to University Trustees sought approval to "keep off all stock, as pasturing eventually kills out a great many of the native species and brings in common weeds to take their place" (SU Archives, SC27, Box 13, Folder 22).

This early recommendation must not have been approved since cattle and sheep grazing continued for several decades on Jasper Ridge's grasslands. A 1923 newspaper noted that the Palo Alto Stock Farm, in addition to their 325 dairy cows, had 1000 beef cattle "ranging the hills toward the west" (SU Archives, Encina Financial Records SC#100, Box 7). In 1922 the east side parcels 93-95 were removed from the Stock Farm and leased to the Webb family, for berries, flowers, row crops, and as of the 1950's, horse stables.

In 1927, Professor Arthur Vestal had the university fence off five small exclosures in parcel 91 to study the effects of grazing on local vegetation (see Research, below). Related correspondence relays instructions that Vestal's plots were fenced to be "absolutely protected against damage by sheep or other stock" (A.E. Roth, Comptroller, to Dr. Wilbur, University

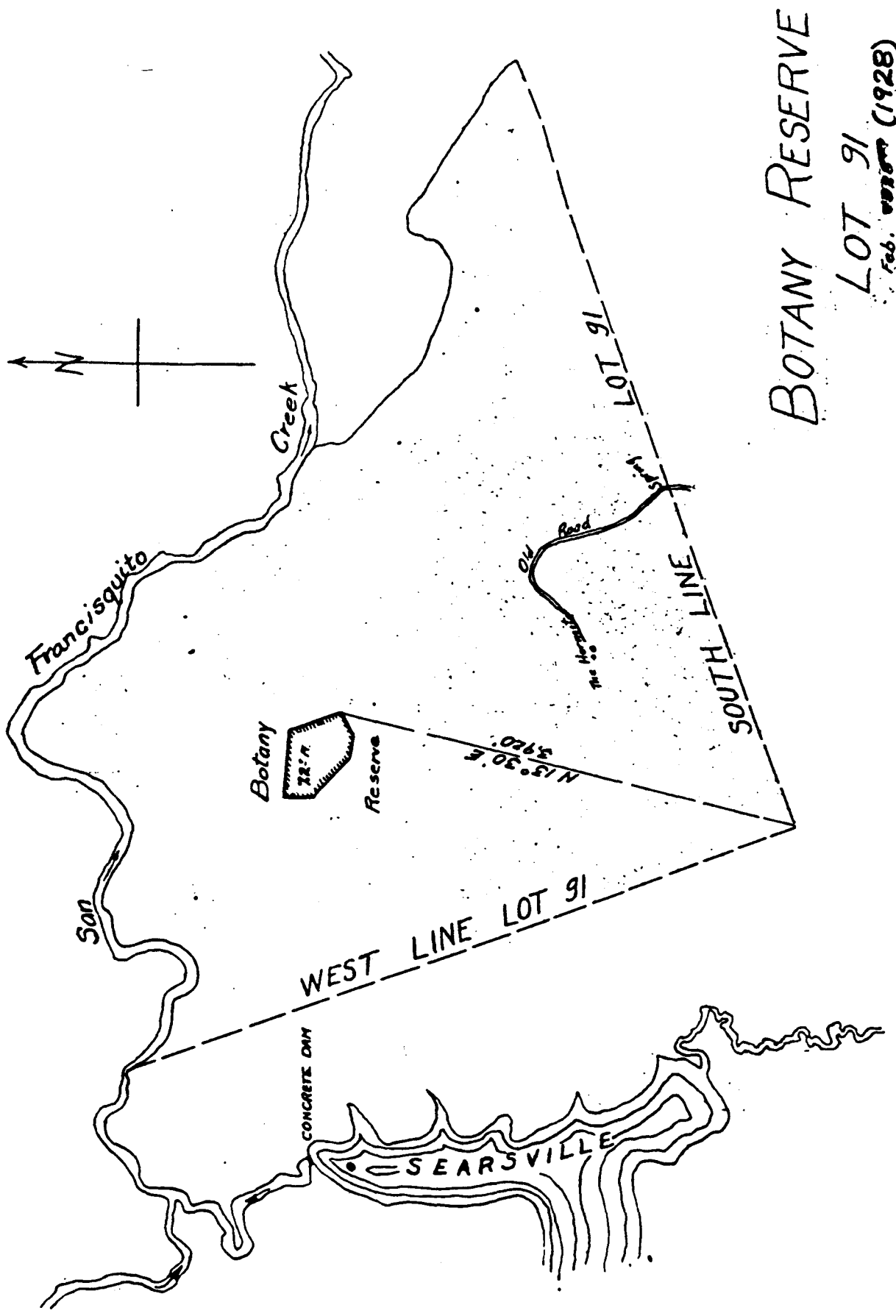
President, February 21, 1927). Vestal then reported that the fences were installed just in time:

...for within a week a large herd of sheep was turned in upon the 600-acre field [the main parcel] and already the close grazing and repeated trampling, forming numerous trails, has seriously damaged parts of the general area ...[causing] the irreparable loss to the university of the natural ground cover of perhaps 200 of the 600 acres (Prof. Vestal to Dr. Wilbur, 1927, Report on Preservation of Grassland Plots on Jasper Ridge).

The Stock Farm continued to lease parcels 90-92, and others not on Jasper Ridge, until 1933. In 1928, a 7.2 acre parcel was finally removed from parcel 91 of the Stock Farm lease and fenced as a Botany or Wild Flower Reserve (Map 12). This small fenced area also appears on later maps (1941 and 1950), so it continued to be protected from livestock. The Stock Farm lease was terminated in 1933; none of the Jasper Ridge parcels were leased that year (SU Archives, SC100 - Encina Financial Records, Box 7, File 28). But grazing must have resumed soon thereafter. A member of the Gambetta family, which had leased grazing rights since the 1940's, reported to student interviewers that 50-60 head of cattle ranged in the upper grassland year-round (Osborn and Gibson 1969). Finally, a 1950 map of parcels 90-92 shows a total of 321 acres as suitable for grazing, including all of the grassland area in the center of parcel 91.

Cattle grazing on the upper Preserve grassland was finally terminated by the University in June of 1960. A 1976 thesis used 1928-1970 aerial photographs to compare oak regeneration in that grassland and in the SLAC corridor, where grazing was still permitted (Franco 1976). No oak seedlings or saplings were found in the SLAC corridor, and Franco demonstrated conclusively that grazing was a major cause. Recent studies of oak regeneration in the foothills east of Jasper Ridge have reached similar conclusions.

After five seasons, the contrast between grazed and ungrazed land is dramatic. In grazed areas thistle and other thorny annuals indicative of desertification are proliferating and bare, cracked soil bakes in the sun. In the exclusion area, stands of native bunchgrasses are recovering vigor and soils are carpeted with moisture-conserving, nutrient-supplying organic detritus. Young oaks in the exclusion area, after a few years of very slow recovery, are now adding as much as a foot of new growth per year, while in grazed sections suppressed seedlings and juveniles still struggle, often unsuccessfully, for survival (Magic 1990).



BOTANY RESERVE

LOT 91
Feb. 1928 (1928)

Scale 18 chs to 1 inch

MAP 12. Location of Proposed Botany Reserve, Jasper Ridge, 1928.

In 1979 grazing was finally terminated in the SLAC corridor. Cattle were permitted to pass through the corridor twice a year, on their way between other grazing areas, but even that practice was stopped after 1981 (Grundmann 1990).

MINING

Introduction

During the 1870's, reports of mineral discoveries near the town of Searsville added short-lived local excitement to an economy otherwise based on logging and grain agriculture. Limited prospecting took place for several years in the hills and canyons east and south of Searsville Lake. One hopeful miner built a cabin on Preserve lands near the southern border and inhabited Jasper Ridge for at least twenty-five years. However, in comparison with either logging or grazing, mining activities had little direct effect on the environment of Jasper Ridge.

Early Discoveries

As early as 1852, a census agent had noted that small amounts of gold were occasionally found in San Francisquito Creek although not enough to warrant investigation (O.P. Sutton to F.A. Nesbitt, 12/24/52, Bancroft, #C-A115, Papers Pertaining to the California Census - 1852). The first record of mining activity on the San Francisco Peninsula occurred in the mid-1800's on Coal Mine Ridge, 3.5 km west of Jasper Ridge (Repass 1923). A seam of lignite was found on the mountain and worked intermittently from 1855 to the early 1860's (Brown 1965). Shortly thereafter, gold was reportedly found in nearby stream beds. However, prospectors met with little success and none of the properties were ever developed.

A decade or so later, other discoveries began to be reported in and around the town of Searsville.

There is really something in the new Quicksilver Mine discovered near the reservoir of the Spring Valley Water Works in Redwood City (San Mateo County Times and Gazette, November 1, 1882).

In 1868, the Gazette reported that a quicksilver, or mercury mine "of surpassing richness" had been found on the Searsville road. In May 1872, Searsville's hotel proprietor announced that silver assayed at \$64/ton had been discovered on his property south of town. Then in August 24 of that same year, the Sacramento Daily Union reported a gold discovery.

Parties interested in the gold mine not far from

[Searsville] had an assay made...and the rock turned \$20 to the ton. The company intends soon to take a ton of the rock out and have it worked in Frisco...several other locations have been made in the vicinity.

There were no further reports of either gold or silver production until three years later when the Daily Union announced another Searsville discovery. "Reports continue good of the assays of the N. Larco silver mines. The coin value being from \$150 to \$250 per ton" (Sacramento Daily Union June 12, 1875). The newspaper simultaneously reported that a "rich coal mine" had also been found in Searsville (Richards 1973:98).

The first record of ore discovery on Jasper Ridge dates from 1875. Silver assayed at \$64/ton was reported by John Murray, who owned the northwest parcel (#96) on the ridge above present-day Searsville Lake. The mineral rights were sold for \$3,000 to a group of men who excavated a tunnel into the hills east of the lake, just south of where Searsville Dam is now located. "Small stringers and pockets of ore were encountered, but as they were too erratic to pay the project was abandoned" (Repass 1923:4). There is no evidence that Murray's mine ever involved road or building construction or any activity outside the single tunnel opening, which is now under the waters of the lake.

The Hermit of Jasper Ridge

At about the same time as Murray's discovery, Larco's ranch foreman Domenico Grosso supposedly discovered traces of silver farther east on lands then owned by former lumberman Dennis Martin. Larco purchased the mineral rights in an agreement dated May 1, 1875. The agreement made Larco able to prospect throughout Martin's lands, "together with the use of sufficient ground around any and all such mines [for] the works and buildings necessary" (SU Archives, SC #1, "Mining Agreement" in Transcript of Title to D. Martin Tract).

After Larco purchased the mineral rights, Grosso supervised the excavation of two vertical shafts. One, just south of the present Preserve border, was abandoned without encountering ore at the depth of 23 m. The other, just above the southern border on Map 13, reached 61 m deep and was considered promising at the time. Although there is no record of their construction date or location, one or more bunkhouses must have been built in the immediate area for the miners during these projects. Grosso later dismantled these bunkhouses and used the lumber for a nearby cabin of his own.

Local residents grew hopeful that mining would strengthen the local economy as logging, grain farming, and cattle raising were beginning to die out. The redwood timbers lining Grosso's mine shafts were no doubt obtained from one of the few sawmills

still at work in the upper reaches of the Searsville-Woodside forests. Unfortunately, Grosso shipped only three or four tons of ore before a mining engineer visiting the site pronounced it "worthless" -- because "the ore body had been shot to pieces by volcanic activity" (Repass 1923:6). By 1877 the project had been temporarily abandoned. In 1878 Larco died, and the banking company which had purchased his ranch deeded all mineral rights to Grosso later that year (Repass 1923:7).

Sometime thereafter, Grosso set up housekeeping in a canyon near a spring a few hundred m north of the main shaft. He built a cabin -- using the miners' bunkhouses for lumber -- terraced the adjacent hillsides, and planted grape vines, olive and fig trees, oleanders, roses, and a vegetable garden (see Map 13; Repass 1923:8). The spring was diverted into a trout pond. After Stanford University opened in 1891, students began to explore the foothills and canyons of Jasper Ridge. They became enamored with Grosso and nicknamed him "The Hermit" although by all accounts he was a friendly host to students and other occasional visitors. Traffic by horse-drawn wagons, as well as cattle grazing, in this part of the Preserve are indicated by newspaper accounts of local visitors and of the fences Grosso built to keep cattle out of his settlement (Regnery 1991:83-85).

Despite previous failures Grosso was convinced that Jasper Ridge held valuable silver or gold ores. When his original shafts flooded, he began to dig shallow test pits instead and some twenty can still be found in the hills and grassland east of Searsville Lake. There is no record of ore shipments made during this period. However, Grosso periodically visited the assayer's office and let it be known locally that his mines were making significant progress. Grosso died in 1915. His cabin was thoroughly ransacked by people hoping to find a cache of valuable ore. Nothing was found, and his relatively worthless mineral claim reverted to the Stanfords who had purchased the land from Martin in 1882.

Student Miners

In the early 1920's Stanford's Department of Mining and Metallurgy decided to re-open the 60-m mine shaft to provide practical field experience for engineering students (Repass 1923). The top of the shaft had caved in, creating an immense logjam underground. In addition the entire 60-m shaft had filled with water. After re-excavating and timbering the upper part of the shaft, students brought in a 40-horsepower engine, built a hoist, and began pumping out the water, an operation that had to be repeated at least three times as the shaft refilled during the winter months. As the shaft is located about five m above the floor of a narrow canyon, pumped-out water probably ran over the tailings dump and downhill to temporarily irrigate the chaparral.

After clearing the shaft the students exposed a narrow vein of ore with minute traces of gold, silver, zinc, lead and copper. Students also explored the shallow test pits, or prospects, that Grosso had excavated all over Jasper Ridge. Assay values from twelve of the prospects were very low and the Department concluded that the ores had no commercial value (Repass 1923:64). The deep mine had dubious value as a teaching tool, since water continued to flood the main shaft. The project was abandoned and the shaft filled in, leaving a hole 7-8 m in depth today.

A 1927 letter mentions "the old road to the Hermit's mine", (Prof. Vestal to Pres. Wilbur, "Report on Preservation of Grassland Plots on J.R."). The fairly wide and level footpath now leading to the mine shaft was once a wagon road and is still visible today on aerial photos.

Summary

For years it has been known that gold and silver, and coal and lead and quicksilver abounded in the coast range of mountains. Many discoveries have been made. But so far as known mineral has not been taken out in paying quantities (San Mateo County Gazette, January 1, 1876).

Despite repeated assertions of mineral abundance, there is no record that commercially valuable ores were ever recovered from Searsville area mines. It is possible that the supposed mine sites were salted, but gold fever of the mid-1800's may be sufficient explanation for the exaggerated claims. In retrospect, nobody except a few local landowners profited from the purported mineral riches of the region.

Mining activities did little to alter the Jasper Ridge environment outside the immediate area of the Hermit's cabin and the mine shafts. On the other hand, visits to the Hermit first encouraged Stanford University students to explore the hills of Jasper Ridge and to become aware of their possibilities for biological as well as geological research.

WATER

Introduction

This section examines historical changes in the San Francisquito drainage area that have affected water resources within the Biological Preserve. The most obvious example is the construction of Searsville Dam in the 1890's, but in addition, logging and irrigation have affected both the amount and the seasonality of local stream flow.

Historical records beginning in the Mission Period indicate that water has never been abundant on the San Francisco Peninsula. Early explorers were always on the lookout for water; for example, an expedition to Pescadero Creek recorded "two very large arroyos containing a good volume of water... there were other smaller ones with running water and lagoons grown with good patches of tule" (Palou 1926, Vol. III, p. 288). Mission San Francisco's lands were said to be poor for agriculture because "its creeks do not give sufficient water for irrigation" (Bancroft, CA-62, Benicia/California Archives, 1828 Limits of the San Francisco mission and lands). Corresponding documents for Missions Santa Clara and San Jose echo this concern with lack of water for irrigation, and the scarcity of waterholes for livestock (see Ranching and Farming).

Searsville Dam

Because Corte Madera Creek drained an extensive area and carried a large volume of water during the rainy season, early settlers became interested in damming the creek and controlling its water supply. The first known plans for a dam on Corte Madera Creek date from 1864. When owner Stephen Bulkley sold the southwest Jasper Ridge parcel (#90), he reserved to himself the right to construct a dam on the creek. He also reserved a right-of-way for a flume to conduct water from the future dam north to Dennis Martin Creek, and from there to "a dam and flume already constructed" on lands that he owned downstream (Deed of Stephen Bulkley to Herrick and Miller, July 23, 1864; Book 5, p. 92, San Mateo County Office of Records). An 1883 map shows a dam site on Corte Madera Creek in parcel 90, as well as an existing "pipe or flume" line paralleling San Francisquito Creek downstream (see Map 11). This may have been Bulkley's dam; it would now be under the waters of Searsville Lake.

During the 1860's alternate periods of flooding and drought complicated plans for using and supplying creek water for the increasing numbers of new residents in the Searsville-Woodside area. Martin's grist mill, a few hundred m below the confluence of Bear and Corte Madera Creeks, had washed out repeatedly since its original construction in 1846. In 1860, after Martin leased it to Cameron, the newly refurbished mill washed out during

severe rainfalls the following winter. Meanwhile, during the summer months the mill could not operate at all. "This is a water-mill, and unfortunately, for want of water, runs only a part of the year" (San Mateo Times Gazette May 28, 1959). In both 1861 and 1862, Searsville experienced severe flooding. The town was evacuated in the winter of 1862; floods and landslides took the lives of three people and destroyed six sawmills plus several homes and bridges (San Mateo County Gazette January 18, 1862; Sacramento Daily Union January 24, 1862).

Beginning in the early 1860's, plans had circulated among San Francisco businessmen and city officials to tap the San Francisquito watershed as a major water source (San Mateo County Gazette April 28, 1860). Two decades of rumor were confirmed in 1878 when the Spring Valley Water Works, later Spring Valley Water Company, purchased the northwest Jasper Ridge parcel (#96) from owner John Murray. SVWC at that time planned to dam Corte Madera Creek and construct a reservoir there, the last in a chain of lakes supplying water to San Francisco. The upper and lower reservoirs at Crystal Springs, 15 and 25 km northwest, were already under construction.

Murray may or may not have foreseen the result of his sale, but in any case, most of the land he sold to SVWC for the east side of the dam consisted of steep, uninhabitable, chaparral-covered hills. The west side was acquired by SVWC several years later; this was relatively level land, where the woodland had been cleared for agriculture (Regnery 1991:107). Searsville residents became concerned when they learned that the proposed lake might inundate parts of the town, only half a mile upstream from the dam site (see Map 13).

"Will We Sell Out or Not? is the all-absorbing topic now agitating the residents of Searsville and vicinity. The survey of the SVWC shows that the lake...will entirely submerge the site of the town" (San Mateo Times and Gazette, July 23, 1878).

In 1879 United States District Court condemned the land for the lake. In 1888 SVWC began construction of the Dam on Murray's former property, in a narrow uninhabited ravine 800 m east of the center of town (Stanford Maps and Records, 50-D-023, "Corte Madera & West Union Creek Survey", ca.1885). According to newspaper reports, the project began with extensive tunneling, in search of a solid rock bedding for the dam as well as for gravel to mix concrete. Starting in 1891, 14,000 barrels of sand and cement were hauled by wagon-loads to Searsville from San Francisco (San Mateo Times and Gazette August 9, 1891). At its completion in 1982 the dam was 60 ft high, 300 ft across the canyon, and 50 ft thick at the base, made of interlocking blocks of concrete.

Photographs taken during construction of the dam show severe impacts in the immediate area of the dam site (Prints on file in the History Collection, Jasper Ridge Biological Preserve Office]. The hills surrounding the site were cleared and terraced, and an enormous trench, still visible in the hills just above the spillway, was excavated across the canyon and into the steep slopes on either side. Once the 60-ft high scaffolding was built, the individual concrete blocks were poured on site. Photographs indicate that all the excavation and concrete-mixing was done by hand, with supplies hauled into the canyon by wagon loads, and concrete moved on to the dam by a temporary bridge.

Access was apparently from the north and west sides, where sections of unimproved road surfaces are still visible in the hills between the dam, Sand Hill Road, and Portola Road. A reporter (San Mateo County Times-Gazette, July 25, 1891) mentioned many new buildings in this area, including horse barns, sleeping quarters, dining halls and store rooms.

In addition to the work in the canyon itself, SVWC would have needed nearby staging areas for the wagons and laborers; warehouses and other storage for lumber, supplies and machinery; and bunkhouses and cookhouses for workers. Employees made use of abandoned buildings in the town, but the main staging areas were probably located on the western side of the dam where the land is relatively level, and accessible from the town of Searsville and the roads north to Redwood City and San Francisco.

Work has commenced on the new Spring Valley dam near this place, Woodside... The Ashley house at the Cañada [de Raymundo] is being fitted up for the accommodation of the Spring Valley employees. Cypress Hall in Searsville is to be used for the same purpose. A tool house in the same town will be built in the near future, as the lumber has already been hauled... (San Mateo County Times and Gazette December 12, 1888).

At some point during the construction period, SVWC surveyed land for a 15 km, 3.5-m diameter tunnel to connect Searsville with distant Crystal Springs Lake. Some sources indicate that SVWC actually started excavations along the alignment, and built local factories in which Chinese laborers made bricks that would later line the tunnel walls.

The surveyors have been examining the ground between the proposed new lake in Portolá-Crespí Valley and Crystal Springs Lake. The exact location of the tunnel has not been definitely settled... The tunnel will be about 4 1/2 miles long, will be nearly circular... 11 feet in diameter. It will be walled with brick and have a cement floor (May 8, 1886 Times & Gazette; see Richards 1973:99-100).

However, the tunnel was soon abandoned. By 1883 Governor Leland Stanford had purchased the lands east of the Searsville project. In 1886, to supply the future university with water, Stanford established the Manzanita Water Company and obtained rights to build a dam on San Francisquito Creek downstream from Searsville. This meant that the Searsville dam could not legally interfere with Stanford's water supply. To resolve the situation Stanford and SVWC agreed, under contract, that by November 1, 1890, SVWC would build and operate a "substantial permanent dam" in the Searsville location. SVWC would maintain the dam in condition to contain 344 million gallons below the 60-foot height. The university would have total use of these first 60 feet, with water drawn at a specific rate determined by pipe diameters of 16 and 12 inches, depending on distance from the dam (SU Archives, SC-12, Contract between SVWC, Leland and Jane Stanford, and Manzanita Water Co., April 19, 1886).

For the venture to be worthwhile, SVWC would have needed to acquire additional land upstream and build a higher dam at the Searsville site. Later drawings indicate that SVWC contemplated a 100-ft dam instead of the 60-ft height needed to supply the university. Unfortunately for SVWC, landowners including the Stanfords farther upstream refused to sell property which would be inundated by a higher dam. Since SVWC was already under contract it was forced to build the dam to a 60-ft height for Stanford (Grundmann 1990).

Searsville Lake filled with water for the first time in the winter of 1891-92. The 12-inch Searsville pipeline followed Bulkley's original pipe or flume line documented in 1883 (Map 11). Today it continues to supply reserve water to the campus. Its only regular use is for Boething Treeland Nursery, which leases university lands on the northeast side of the Preserve, and one field at Webb Ranch (A. Grundmann, personal communication).

When Stanford began using Searsville Water in 1891, SVWC still owned the lake and the adjoining northwest parcel (see Map 14). However, because all impounded water went to the university, SVWC was unable to use Searsville for San Francisco's water supply as intended. Correspondence from 1913 suggests that Stanford and SVWC continued to negotiate for access to the lake, the dam, and the water (SU Archives, SC27, Box 9, Folder 8, Trustee Documents). Finally in 1919, the company sold the northwest parcel (#96), the dam, the lake and western shore (#97,101,102) to Stanford (amount \$ not noted; Deed #62236, Book 280, p. 143, San Mateo County Office of Records).

Although the lake submerged the eastern part of Searsville, there are no remnants of the town underwater because most houses and other buildings were dismantled and moved away before they

OFFICIAL MAP OF

SAN MATEO COUNTY

California.



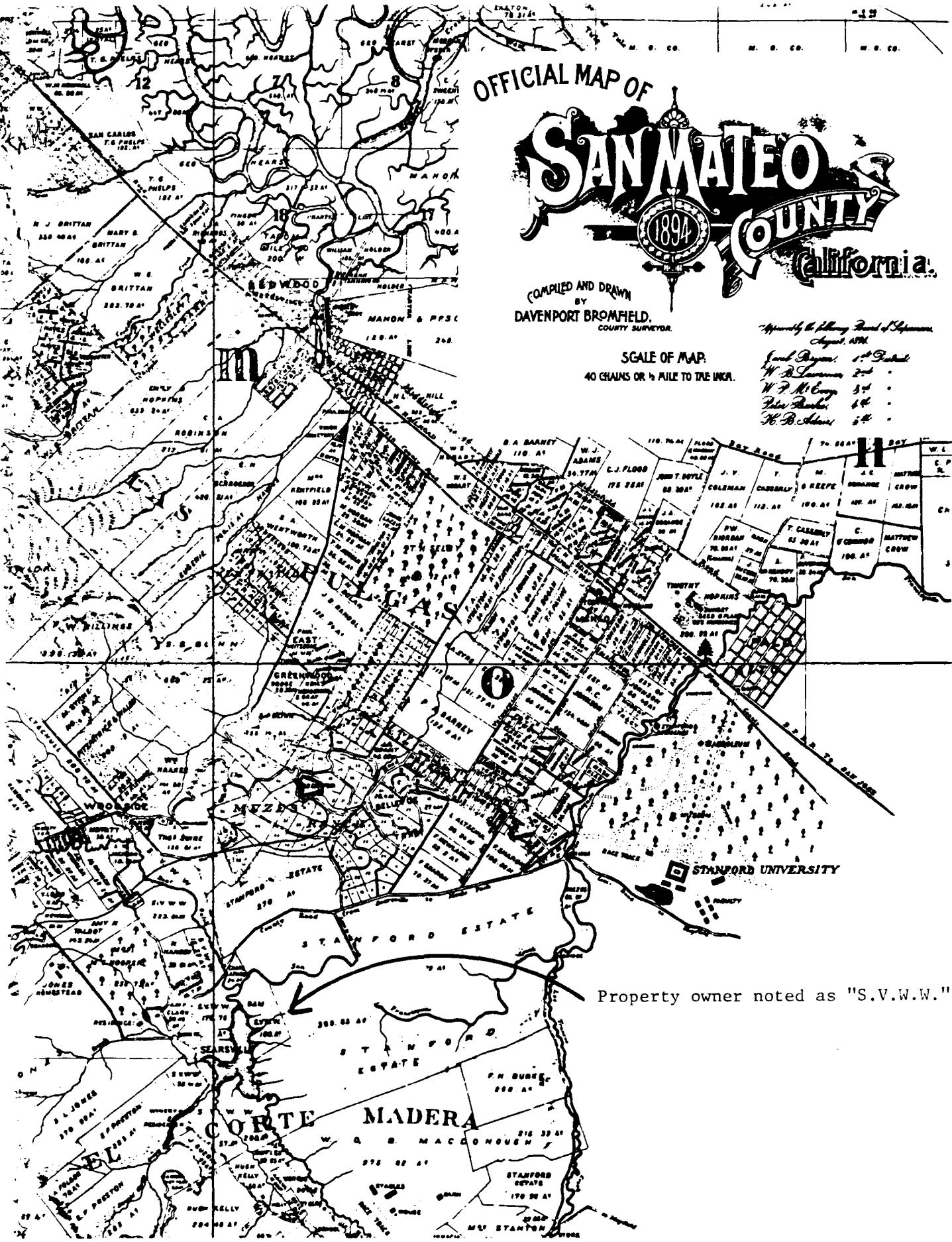
COMPILED AND DRAWN
BY
DAVENPORT BROMFIELD,
COUNTY SURVEYOR.

Approved by the following Board of Supervisors,
August, 1894.

SCALE OF MAP:

40 CHAINS OR 1/2 MILE TO THE INCH.

Land Owners: 1st District
W. B. Lawrence 2nd
W. F. M. Evans 3rd
John Rankin 4th
H. B. Adams 5th



Property owner noted as "S.V.W.W."

Map 14. Section from Official Map of San Mateo County, 1894, showing Spring Valley Water Works ownership of Searsville Dam Area.

were flooded. "...when the water began to rise the people razed most of the buildings and took out the lumber in less than a week" (B. Ralston, 1932, in Richards 1973:65). Searsville gradually lost its population to Woodside, the new community of Portola Valley, or other communities, until the town was finally abandoned (Stanger 1963).

In succeeding years several dams were proposed at other locations on San Francisquito Creek that would have resulted in flooding along the northern edge of Jasper Ridge. In 1917-18, Stanford examined three possible sites in the area of parcels 93-95 with hopes of increasing the stored water capacity for campus use (Hermann 1918). In the end a 7.5 ft crown was added to Searsville Dam instead, in 1894. Another proposal dates to 1935. Finally, in 1961 the Army Corps proposed to build a major flood control project at one of the lower elevation sites examined decades earlier by Stanford. Known as Ladera Dam, the project would have created a 8500 acre-foot capacity reservoir and inundated an enormous area, including much of the Webb Ranch and Jasper Ridge (March 1965 air photo; on file at Jasper Ridge Office). Stanford attorneys argued the University's case before Congress and the plan was finally rejected in 1968.

Evolution of Searsville Lake

When Searsville Lake was first filled it covered an area of 36 ha (90 acres) and had a high-water capacity of 1.2 million cubic m (315 million gallons) (Felin 1940). As soon as the lake formed, however, it began filling with silt from Corte Madera Creek. In 1915 the University sought estimates on the costs of dredging the lake and negotiated repeatedly with SVWC regarding the costs (SU Archives SC-27, Box 3; Box 10, Folder 10 Trustee documents-Spring Valley letters). Apparently, no dredging took place at that time because by the early 1920's, the southern end of the lake near the entrance of Corte Madera Creek had silted in completely, and an extensive willow (Salix) swamp had developed. The University was faced with gradual loss of the entire lake, so in 1929 100,000 yards of silt were dredged from the upper area of Searsville Lake and used to build a dike across the northern edge of the willow swamp.

While the work was primarily undertaken for the purpose of cleaning out the foul growth and opening up the new area, the dike formed a settling basin in the upper lake for the streams flowing into Searsville. This basin will have the effect of slowing up the silting process in the main lake during the heavy run-off season (Stanford University Annual Report of the President 1929-30, p. 42).

Originally Searsville water may have been intended for domestic use on campus. Scott (1927:6) notes that the lake "was

allowed to fall into disuse" as a source of household water. Because silt and detritus accumulated so rapidly, the water became unuseable even for irrigation.

Every year during late summer and early fall the characteristic smell of Searsville water pervades both lawn and garden in the irrigated district; a smell reminiscent of fish or pigpen, or perhaps of both... (Scott 1927:5).

During the drought season of 1923-24 the lake became "intensely green, and ... very evil-smelling" and had to be drained completely (Scott 1927:7). When the lake refilled it was stocked with 500 bass (Micropterus salmoides) and an unknown number of bluegills (Lepomis macrochirus) and black crappies (Pomoxis nigromaculatus); there had been a sizeable carp (Cyprinus carpio) as well, which disappeared when the lake was drained (Wohlschlag 1952:64-65).

Water quality continued to be an issue as in succeeding years, Searsville became the University's main irrigation source and supplied 7-8 million gallons per week during the summer (Felin 1940). One early attempt to upgrade water quality involved a new three-level outlet at the dam. The University hoped that by only drawing water from the surface, deeper layers would remain undisturbed (Scott 1927). It is unclear whether this outlet filtered water effectively. In 1929, the Searsville water line had to be cleaned of silt deposits which in the preceding 30 years had nearly blocked it (Stanford University Annual Report of the President 1929-30, p.42).

The continual difficulties with water quality combined with increasing public use encouraged further attempts to control flora and fauna in the lake. For example, Felin's (1940) study noted that during the May-September swimming season 75-100 lbs of chloride of lime were added to the water at the bathing beach every two weeks. Also, Felin stated that pond-weed growing in the bathing beach area was dragged with a chain periodically to keep the bathing area free of underground growth.

Additional information about herbicide use come from two 1950's studies of fish populations. One researcher, in 1952, observed that "prodigious growths of rooted aquatic vegetation [primarily Myriophyllum or water milfoil] choke the shallower waters of the entire lake" (Wohlschlag 1952). Six years later, Smith (1963) found that the milfoil was entirely absent although the same shoreline plants were present (Scirpus, Typha, and Polygonum). In fact, Polygonum appeared at that time to be replacing the water milfoil community.

According to Smith, the milfoil was eradicated with annual applications of a commercially available chlorinated hydrocarbon

("Benoclor"), used from 1952 to 1955 and again in 1957. It is possible that leaseholders of Searsville Park, rather than the university, initiated the water treatment. In any case, each year in mid-April, Benoclor was introduced to all areas where the water was less than 3 m (10 ft) in depth (Smith 1963:17). This compound killed milfoil by chemically destroying its chlorophyll, but in addition, the Benoclor destroyed all bottom fauna for periods of several months to two or three years (Smith 1963:18-22).

Benoclor is also directly toxic to fish. Since mid-April is the season when Searsville's fish move into the shoals for breeding, they encountered the herbicide and many were killed. The dead fish, added to rotting matter from excess weeds, may have produced ammonia that would have reduced the water's oxygen content, among other complications (Smith 1963:19).

At the time of Smith's study, fishing had been allowed in Searsville Lake for two years, having begun on a paid membership basis in 1955 (1963:14). The lake was not officially open when Wohlschlag's study was done; he indicated in 1952 that "In recent years there has been virtually no fishing in this lake" (1952:65). Wohlschlag felt Searsville had relatively large fish populations and that these reflected conditions of natural mortality (1952:72). His study therefore provides important comparative data for Smith's later work.

Between the times of Smith's and Wohlschlag's research, bullhead and bluegill populations declined 43 and 41% (Smith 1963). Meanwhile, the black crappie population had increased by 19%. Smith noted that black crappie feeding success might have been enhanced if removing the milfoil increased light penetration in shoal waters. Although the available data were inconclusive, Smith suggested that fishing (see Recreation, below) had only minimal effects on Searsville's fish population relative to the more serious effects of herbicides.

In addition to plant growth, silt deposition problems continued despite the construction of the southern levee in 1929. After the levee was built, the lake's expansion to the west occasionally flooded nearby roads. Finally in 1970 the university allowed neighbors to cut a new channel for Corte Madera Creek through the willow swamp and the levee, to allow the creek to reenter the main body of the lake. A growing delta supports willow thickets well into the lake area, and the original swamp area to the south has begun to dry out. Felin noted in 1940 that this area south of the levee simulated pond rather than lake conditions, being shallow enough to allow plant growth throughout. Zonation along the pond margin in 1940 consisted of submerged Chara, Potamogeton, and Sparganium communities, giving way to partially submerged Polygonum and above that, cattails (Typha) and finally a dense willow (Salix)

thicket (Felin 1940). Vegetation will continue to change here as the pond silts in, the delta expands, and the swamp builds up and dries out.

Searsville Lake continues to experience problems with plant growth and silt deposition. Sometime in the 1970's imported aquarium plants known as parrot feather (Myriophyllum brasiliensis) were introduced to the lake and took over 15 acres of marshland. Rather than use herbicide, as proposed by the San Mateo County Mosquito Abatement District, the University borrowed large barge-like mowing machines to cut and clear the foliage (SU News Service, May 24, 1976, SU Archives #3698). Parrot feather-mowing continues to this day.

By the early 1960's, silt deposition had reduced the original capacity by two-thirds, to 105 million gallons (Smith 1963). 1986 scuba divers' observations indicated that the bottom of the lake at the face of the dam has collected more than 12 m (40 ft) of silt in 94 years of the lake's existence (Grundmann 1990). The lake itself is now only 6.1 meters deep at its deepest point. Brown (1986) has observed that if present conditions are unaltered, the lake will silt in completely and eventually become a meadow.

Eventually, dredging will be necessary to maintain Searsville, but the costs are prohibitive (upward of \$4 million) to say nothing of the logistics of removing 900,000 cu yds of silt (Grundmann to Jasper Ridge Committee, Nov. 16, 1990). On the other hand, there is significant value in maintaining Searsville Lake -- the only freshwater lake in northern California preserved by a university for teaching and research. Of the 130 dissertations and theses using Jasper Ridge data since 1896, at least 16 have been based on its aquatic resources.

San Francisquito Water Supply

It is difficult to reconstruct the amount and seasonality of water flow in San Francisquito Creek prior to contact. The Spanish observed that San Francisquito Creek ceased flowing near the bayshore in the dry season; this was one reason Mission Santa Clara was established farther south, near the perennially flowing Guadalupe River. However, because of the differences in slope and substrate discussed earlier, at higher elevations it is possible that San Francisquito or its major tributaries (Bear and Corte Madera Creeks) flowed throughout the year. The creek at Jasper Ridge had insufficient water to run Martin's grist mill in summer, as already observed. There may have been enough water to supply local Indian communities during the dry season, but this is unknown.

Bear Creek drains the valley north of the preserve towards the town of Woodside. Since the construction of Searsville Dam

Bear Creek is probably the largest single source of water for San Francisquito Creek, although the amount and timing of runoff vary according to the location of winter storms. Corte Madera Creek now contributes water to San Francisquito only after Searsville Lake has filled and the dam overflows. Jasper Ridge records indicate that overflows begin after about 76 mm (3 in) of rain, and that water spills over the dam throughout most winter months. However, the dam has certainly reduced the amount of water and especially, the amount of time that water from the Corte Madera side of the watershed enters San Francisquito Creek.

Los Trancos Creek, the third major tributary, enters San Francisquito 2 km east of the edge of the Preserve. Los Trancos parallels Corte Madera and drains a large area to the south, but since construction of Felt Dam in 1929 a substantial amount of its water has been diverted to fill the Felt Lake reservoir. Felt Lake is used for irrigation on the Stanford campus. Because the latter requires about twice as much rainfall to fill as Searsville, water from Los Trancos only enters San Francisquito Creek much later in the season (Grundmann 1990).

Summary

A complex series of factors affects modern drainage conditions in and around Jasper Ridge. The dam, the former use of lake water for domestic supply, and its continuing use for irrigation have reduced the amount of water available at the source of San Francisquito Creek. On the other hand, logging certainly increased runoff, at least temporarily, because the areas surrounding the high mountain tributary streams to Corte Madera and Bear Creeks were almost completely deforested by the 1870's.

Meanwhile, at elevations below Jasper Ridge there is considerable winter runoff from Los Trancos Creek, storm drains in Stanford, Palo Alto and Menlo Park, and some from the Linear Accelerator cooler tower (see Crippen and Waanenen 1969). Modern conditions are indicated by these data from a hydrologic gauge located 1.1 km downstream the confluence of Los Trancos and San Francisquito Creeks (USGS 1985, 1990). Table 10 data represent total monthly outflow (cubic ft/second) for an exceptionally rainy year (1983) and a drought year (1989).

Table 10 Total Monthly Outflow, San Francisquito, 1983 & 1989

	J	F	M	A	M	J	J	A	S	O	N	D
'83	5751	7605	9758	2038	1223	247	102	50	37	52	936	2630
'89	1181	1381	905	161	54	8	5	6	8	11	43	198

USGS (1990) notes that stream flow is regulated by the now-952 acre-ft reservoir at Searsville, and by diversions totalling 800 acre-ft per year for irrigation at Stanford. In addition to modifying stream flow, reservoir systems have other effects. A study of Stevens Creek Dam, 19 km southeast of Searsville, suggests that the stabilized water flow caused by dams and reservoirs may increase bottom fauna production, and therefore benefit fish populations (Briggs 1947). The Stevens Creek study also documented notable changes in the size and distribution of bottom sediment and litter on stream banks; Searsville Dam has undoubtedly had similar effects on San Francisquito Creek.

Construction of Searsville Dam also had a substantial impact on the lands around the lake. Trees were cleared from the site and others were cut to provide fuel. Wagon roads provided access to the western and northern sides of the lake. Numerous warehouses, bunkhouses and other structures housed people and supplies.

Finally, it should be noted that Searsville's lake and marsh provide habitat for more than 70 bird species as well as fish and other wildlife. A third of the birds observed on Jasper Ridge are only seen at Searsville Lake, marsh or swamp. Freshwater mollusks and insects such as mayflies and dragonflies provide food for birds as well as bats (primarily Myotis spp.) and fish, of which Searsville has half a dozen species. Most fish in Searsville are introduced, as mentioned above. The only native fishes are the hitch (Lavinia exilicauda) and recently, a species of sucker as well. Among mammal inhabitants, woodrats (Neotoma fuscipes) and raccoons (Procyon lotor) are found on the lake shore or in the swamp area.

RECREATION

Early Uses

The new lake at Searsville created considerable public interest in access to the Jasper Ridge area. The Woodside Golf Club, in 1910, applied to the Spring Valley Water Company and to the University for swimming and boating privileges on Searsville Lake (SU Archives, #1011, 1908-1912 Trustee Minutes, file #28). Apparently, the Club intended to build a golf course on the south or western border of Searsville Lake (SU Archives, SC27, Box 5, Folder 4). The course was never built, although plans were drawn up, and a much-later document (1926) recommends a ten-year lease of approximately 30 acres for the Woodside Country Club, again for a golf course (SU Archives SC27, Box 17, file 4).

After the University purchased the dam, lake and adjoining parcels from the Spring Valley Water Company in 1919, more local residents took advantage of the area's recreational

possibilities. In 1922, the newly formed Woodside Trail Club gained access to Jasper Ridge for horseback riding.

Horsewomen of the summer colony at Woodside have organized a new club to be known as the Woodside Trail Club... Old trails in the hills have been opened. New trails will be constructed. The old trails were formed years ago by lumber camps for logging, and these are being put into condition for riding (Redwood City Tribune September 29, 1923).

Ten years later, the Menlo Circus Club [a second riding club] built a shed in the woodlands west of the lake and used the site to provision cross-country riders.

In the early 1930's Robert S. Odell...began to arrange brunches and barbecues for the riders on the Searsville property... Since it was difficult to bring in the necessary equipment on each occasion, he obtained permission from Ernst Brandsten [Searsville Park leaseholder]...to build a shack to store the equipment (Gerstley 1970).

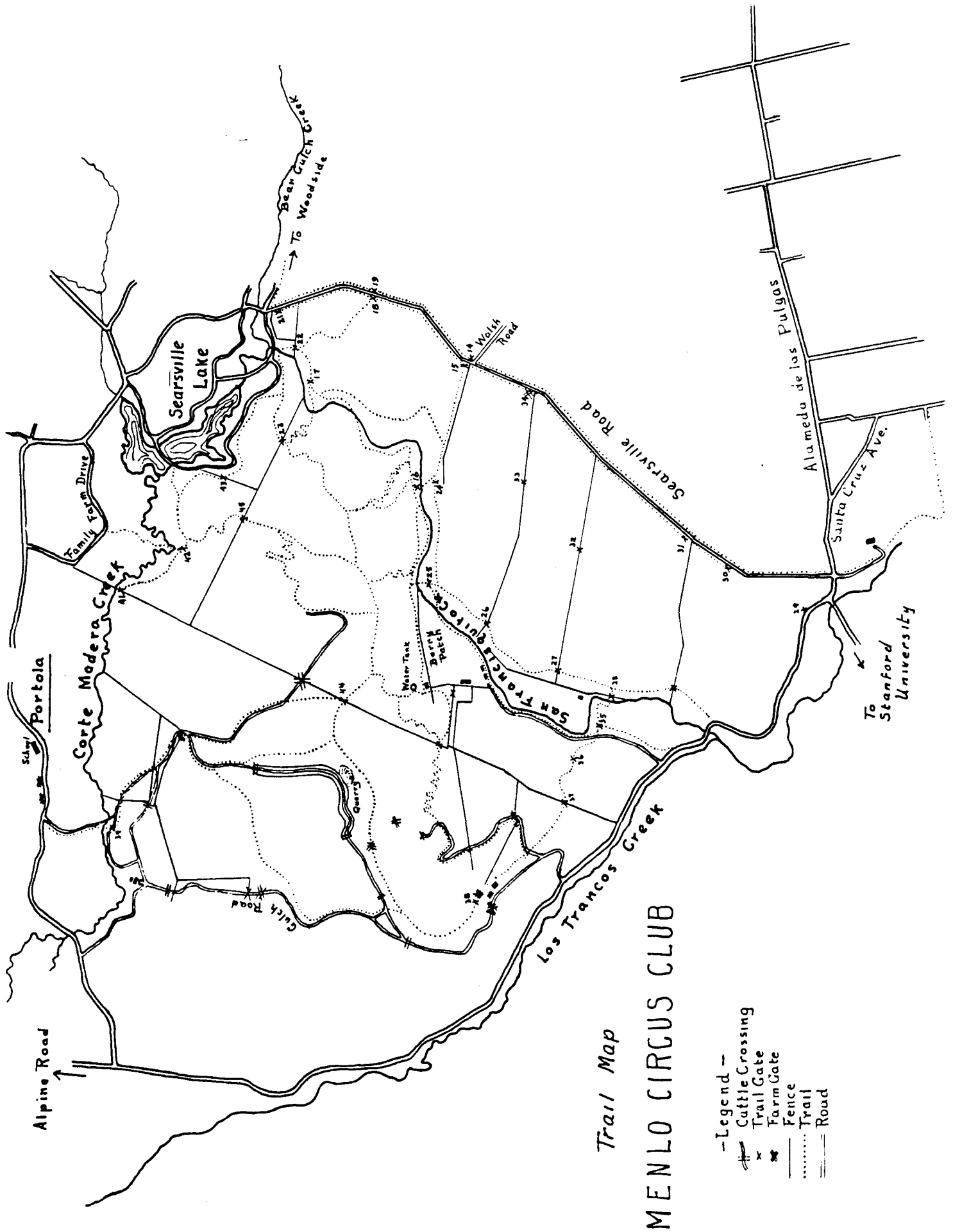
Trails used by the riding clubs ranged along the lake shore, the creek banks, and throughout the grassland and woodland areas east of the lake (see Map 15). Menlo Circus Club Trail Map, 1930's; Topography and Culture Map, 1941; on file at Jasper Ridge Office).

Boy Scout troops established campsites in southern parcel #91 near the Hermit's Cabin and in a redwood grove on San Francisquito Creek, apparently as early as the 1920's. The surrounding hills were used for hiking and other exercises; Herb Dengler reported to student interviewers that in the 1930's, Boy Scouts near the Zoology Cabin (see Research, below) cut trees and shrubs, and terraced the hillsides (Osborn and Gibson 1969). They also rebuilt the Zoology Cabin after the University tore it down in about 1927. Dengler himself built a log cabin in the same general area in 1931-32, using timber from fallen redwoods. The University finally removed both Dengler's and the Zoology Cabin later in the 1930's.

Resort at Searsville

"the Peninsula's favorite swimming hole" (Daily Palo Alto Times June 6, 1954).

In 1922, Stanford swim coach Ernst Brandsten (or Ernest Bransten) leased rights to the lake and "a narrow strip of land comprising the shore line on the northerly end". His intention was to operate a swimming and boating concession. The University Comptroller recommended the lease, noting that most of the landed



Map 15. Trail map from Menlo Circus Club showing horse trail network including Jasper Ridge area.

was flooded every year and was of no use to Stanford. Brandsten also purchased ten adjoining acres from the Spring Valley Water Company (SU Archives, SC27, Box 15, file 19). On the Stanford leasehold, Brandsten opened a dirt road from Sand Hill Road to San Francisquito Creek. He built a wooden bridge just below the present low-water crossing, a parking area and dance pavilion below the dam, and tent dressing rooms on the lake's east shore. Local newspapers note that Brandsten cut trails and bridle paths, suggesting that more of the area was opened to visitors than just the lakeshore. Reporters also noted that a 10-m diving tower on the dam would soon be used in the 1923 Olympic trials (Palo Alto Times August 25, 1923).

In 1925-26 the original lease for Searsville Lake Park was expanded to include the lake's west shore, an area of 125 acres in parcels 101 and 102 which Stanford had purchased that same year from the Spring Valley Water Company (Stanford University, Annual Report of the President, 1925-26, p. 59). Brandsten moved most of his operations to the west side from the northern end of the lake. He began importing sand from Santa Cruz County to create a beach, causing sand to wash into the lake for the next fifty years. He also built a snack bar (now rebuilt as Searsville Lab), a caretaker's house (still in use), and a three-tiered 10-meter high diving tower on top of the dam.

A few years later, after the University built the levee to divert silt deposition from Corte Madera Creek, Brandsten built a road across the levee and cleared a route through the chaparral-covered hills on the east shore to form a loop drive around the lake. This opened the east side of the preserve to more visitors, as well as the riders who already had established trails throughout the hills (Palo Alto Times October 14, 1929). Sometime during the 1920's Brandsten installed a piped water system supplying several picnic areas on the north and west sides of the lake. Swimming, boating and other activities continued for the next few decades. Postcards from the 1930's show dozens of cars parked on the west shore (History Files, Jasper Ridge Office).

Long-time Stanford employee Sam McDonald, who often prepared barbecues for groups at Searsville Lake, describes the dwelling of a possible squatter at Searsville Park in August of 1935.

...above an escarpment of manzanita and oaks...on a small patch of level ground beside a humble shack there were growing corn, pole beans, and a couple of cucumber bines...also perhaps two or three tomato plants and a bead of onion...The crest some few hundred feet above this placid spot was indeed a classic promontory overlooking the surroundings, including Searsville Lake (McDonald 1954:289).

The occupant was a John Bonini, whose card described him as a "Wood Chopper" and listed the Park's telephone number as his own. Bonini may have acted as caretaker, or performed odd jobs for Brandsten around the park.

Post-War Period

By the early 1950's, a local post-World War II housing boom was causing major public use of the attractions of the Ridge. The 1953 Master Plan for Stanford Lands shows a proposed residential area occupying most of the Jasper Ridge area, with a road running diagonally across the upper grassland (SU Archives #9150-953). This subdivision was never built, but housing developments at Ladera and Westridge were, and swimmers and boaters flocked to the nearby lake.

In 1955 Searsville Park was taken over by two former lifeguards, Austin and Steward Clapp (Daily Palo Alto Times February 2, 1955, p. 19). Under Brandsten the park had been expanded to nearly 400 acres (Real Estate Department #1300/9, 1950-1967, "The Stanford Lands 1950-1955"). The new managers added a bathhouse and planted a grove of Douglas firs on the west shore. Heavy equipment was used to construct a bicycle racing bowl near the main entrance. Newspaper photographs show rows of baled hay in the background, demonstrating that hay was grown during the Park's operation on the lands west of the lake in parcel 102 (Daily Palo Alto Times July 4, 1957).

Meanwhile, riders visited the hillsides in ever-increasing numbers. The Woodside Trail Club expanded its trail system, clearing some of the new paths with bulldozers. Also, a new group known as the "Shack Riders" began to ride Jasper Ridge trails. This group took its name from the former Circus Club shed, which the Shack Riders used as a drinking stop. Today the Shack is known as the Hillside Lab, used as a field site for research (see Map 13).

White sandy beach, picnicking in shady groves, miles of trails for hiking and equestrian paths. Very popular with the millions of people in the Bay Area and on the Peninsula (Searsville Park postcard caption, 1950's; files, Jasper Ridge Office).

Fishing started in Searsville Lake on a paid membership basis in 1955. The season ran from mid-September to mid-May when the lake opened for swimming. Membership records indicate that between 50 and 150 persons purchased fishing memberships, but there are no catch records to provide data on species or size selection (Smith 1963). The predominant fish in the reservoir at that time were bullheads (Ictalurus nebulosus), bluegills (Lepomis macrochirus) and black crappies (Poxomis nigromaculatus). Black bass (Micropterus salmoides), the native

hitch (Lavinia exilicauda) and sunfish (Lepomis cyanellus) were uncommon or rare (Smith 1963).

Some fluctuations in fish population sizes were observed during the 1950's; this may have been caused by fishing as well as herbicides, described in an earlier section (Smith 1963). Smith observed few anglers during this period and suggested that their impacts were minimal because productive fishing was only possible for brief periods in the autumn and the spring (1963:16). On the other hand, a Fish and Game Department report from this period noted that "A boat rental concession has been established on [Searsville] lake and angling pressure is heavy" (Skinner 1962:135). Searsville was the only lake available for fishing in the local area; Crystal Springs, San Andreas and Felt Lakes were all closed to the public.

In the mid-1960's, areas of the park most frequently visited by the public began to degenerate rapidly. At the same time, Stanford was under considerable pressure to allow greater public access. There were motorcycle races on roads around the lake. The riders' Shack was enlarged and provided with additional tables and hitching racks. Also, at about this time the Stanford Linear Accelerator Center (SLAC) was completed on the narrow strip of land between the Preserve's north border and Sand Hill Road. The massive excavation for this structure left large piles of boulders and fill dirt between the creek and SLAC, on lands which ten years later (1976) were acquired by the Preserve. The piles of fill were not removed until the mid-1980's.

Because of increasing research interest in Jasper Ridge by the university, in 1973 the Searsville Park lease was renegotiated. The new terms were much more restrictive and limited public access to the west lake shore. However, there continued to be problems with vandalism and with disruption to the Preserve as well as neighboring communities. A San Mateo Times article on November 10, 1976 noted that the number of persons using the lake had increased from 61,000 per year in 1970 to 103,000 in 1975. The Palo Alto Times (October 5, 1976, p. 1) pointed out that Searsville was at that time the only Bay Area freshwater lake where swimming, boating and fishing were all possible.

Nevertheless, in 1976 the University bought out the Searsville Park lease and closed the park to the public. An exception was made for the riding clubs that needed access to peripheral areas of Jasper Ridge in order to complete their local trail network. The Woodside Trail Club was given a license to use partially fenced trails along the Preserve perimeter on lands already disturbed by proximity to SLAC, and up the hill from Webb Ranch to Westridge.

Summary

The impacts of recreational activities at Jasper Ridge range from slight to severe. The Scout camps, horse riders' shack and Dengler cabin had limited effects on their immediate surroundings; in addition the riders maintained cleared trails throughout the Preserve's hills. Most activity has been focused on the lake, the western parcel between the lake and Portola Valley Road, and the northern area between the dam and the low-water crossing on San Francisquito Creek. The most obvious legacy is that of Searsville Park: the network of roads; concrete footings for bridges and tent structures; small leveled picnic areas; and several buildings, including the present caretaker's house, bathhouse and Searsville Lab. Sand washing into the creek from the imported "beach" has undoubtedly contributed to the rapid filling in of the lake bed. Chlorine and mechanical weed-clearing affected water quality and plant life in the bathing area on the southwest shore.

WORLD WAR I

'Fremont Troops Engage Imaginary Foe in Foothills'. This morning while the people of Palo Alto and vicinity are reposing quietly in their beds, a great battle is being waged up in the hills back of Stanford University (Trench and Camp August 10, 1918).

Between 1917 and 1919 more than 30,000 infantry and cavalry troops were based at the Camp Fremont cantonment in the town of Menlo Park. 62,000 acres in the nearby foothills were used for maneuvering grounds, with another 4800 acres for machine gun, mortar and other artillery ranges. Soldiers were also trained in trench, tunnel and bomb shelter excavation ("Camp Fremont"; Center for Military History, Dept. of the Army, Washington DC).

War Department correspondence indicates that Camp Fremont used most of Stanford lands except the central campus, including lot 35 which comprises Jasper Ridge west of Corte Madera Creek (SU Archives #SC27, Box 5). Only Searsville Lake and parcel 96, then owned by Spring Valley Water Company, were excepted from military use (Menlo Park Archives, Map 9: Army Corps 319th Engineers, March 1918).

The main rifle range lay to the south of Jasper Ridge, according to a map of Camp Fremont obtained from the Military Reference Branch of the National Archives (see Map 16). However, the map also indicates machine gun ranges just west of Searsville Dam (parcel 101), just south of the ridge in grassland/woodland areas of parcels 90-91, and east of the Preserve on Webb Ranch (parcels 93-95). Stanley Webb told an interviewer in November, 1990 that artillery emplacements were definitely present on the ranch, and were removed after the end of the war.

Wrecking of the rifle range near Los Altos is now going on rapidly... Lumber is being removed and bullets dug out of the ground. Already 6,000 pounds of bullets have been recovered for remelting (Palo Alto Times December 16, 1918).

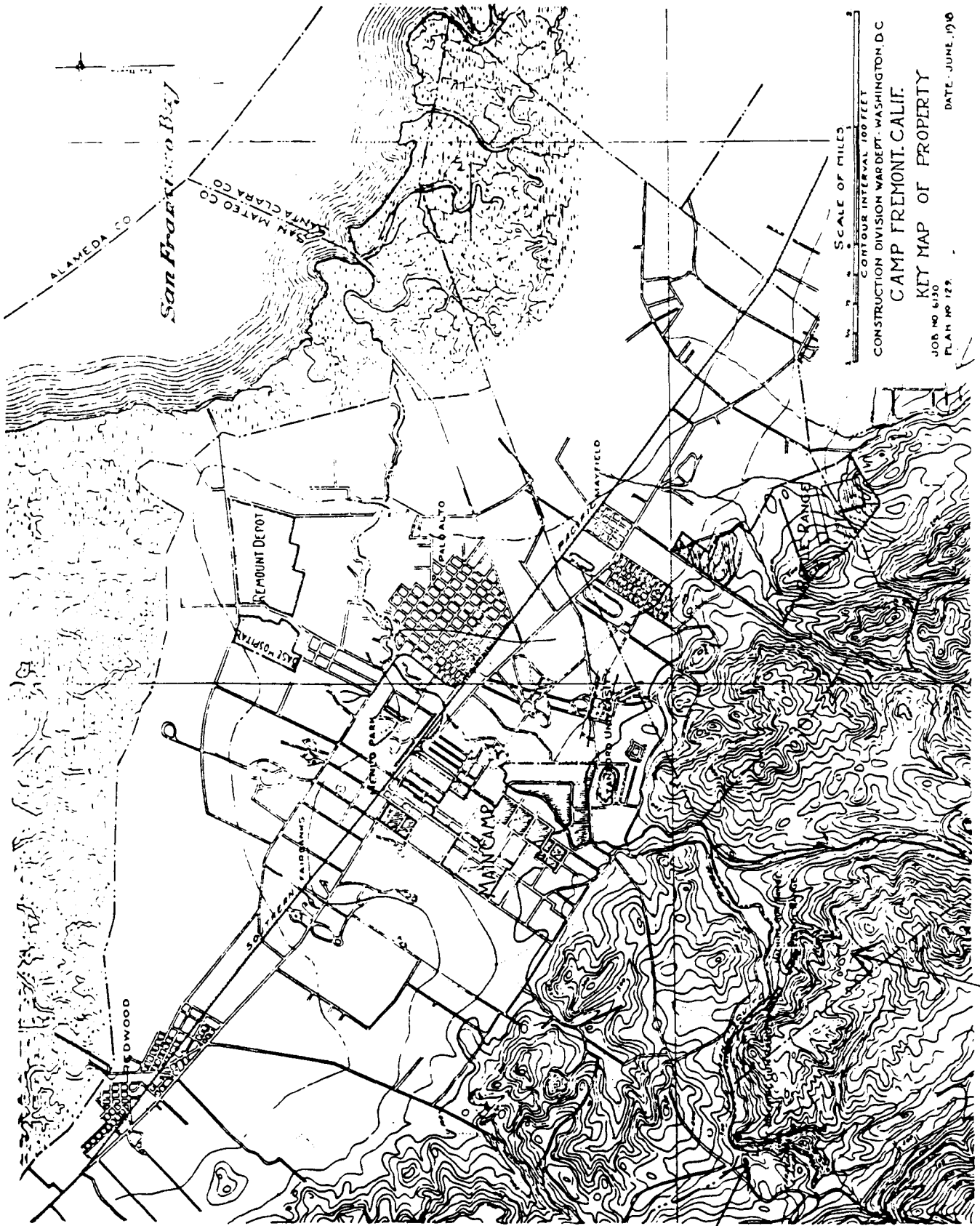
Several contemporary news releases mention that hillside rifle ranges were systematically mined for the reclamation of lead bullets after Camp Fremont was abandoned. This may have occurred on Jasper Ridge, although there is no sign of such extensive excavation, at least in the area indicated as a range in parcel 91-96. Lands west of the lake and on the Webb Ranch have been sufficiently disturbed since WWI that excavation traces might not be visible today. Some of the original trench locations could be seen on the Boething leasehold before it was graded (A. Grundmann, personal communication).

There may have been training in maneuvers anywhere in the Preserve since grazing and farming leases were suspended, and the entire area taken over by the War Department. Other than the machine gun ranges, however, there is no specific record of activities that would have substantially altered conditions within the Preserve. Northeast of Jasper Ridge there are mortar holes on some of the hillsides, and several abandoned tunnels and trenches have been found near the Linear Accelerator. Given the potential disturbance to the landscape, it is fortunate that during World War II Stanford's involvement was limited to intensive academic training in military science (SU Archives, SC19, Box 21, "War Training Office").

RESEARCH ACTIVITY

Jasper Ridge data have been used by researchers since the earliest days of Stanford University; the first M.S. and Ph.D. degrees based on Jasper Ridge research were issued in 1896 and 1897. Babcock (1896) undertook a systematic study of the genus Arctostaphylos (manzanita), and VanDenburgh (1897) reviewed the reptilian species of California and Oregon. By 1900, three more theses using Jasper Ridge were completed -- on mammals, winter-blooming plants, and climate conditions. Student Biology and Zoology Clubs made frequent use of the area, and in 1900 Club members helped to build the Zoology Cabin on San Francisquito Creek to accommodate field researchers (shown on Map 13; Begle 1978). The cabin facilitated research, since travel from campus took several hours each way by foot or horseback.

Overall, between 1900 and 1920 twenty advanced degrees were granted to students working on Jasper Ridge. Many of these were taxonomic or morphological studies, reflecting research interests of the times. Their subjects ranged from lichens, to trapdoor



Rifle Range

CAMP FREMONT, PALO ALTO, CALIFORNIA. KEY MAP OF PROPERTY

*Original map at National Archives.
Military Reference Branch*

Machine Gun Range

Machine Gun Range & Pistol Range

Map 16. Map of Camp Fremont, California, showing machine gun and pistol ranges near Jasper Ridge. Nat'l Archives, Military Ref. Branch, Textual Ref. Division.

spiders and tarantulas, to the chemical constituents of water in San Francisquito Creek.

As early as 1916 University President Wilbur recommended that "certain specified portions of the University estate be set aside as a native plant reserve." He mentioned specifically the natural growth along stream banks on campus, as well as the entire "Dennis Martin Hills", as Jasper Ridge was then known. Wilbur went on to say that the latter "should be left in their natural condition with the understanding that no cutting be done, but that they may be used for pasturage, except for sheep" (SU Archives, #27, Box 12, Folder 4; Trustee Supporting Documents March 17, 1916). Although Wilbur did not mention excluding livestock, soon thereafter the Zoology Department requested a one-acre field station "in connection with its work in birds, reptiles and mammals". The station was to be located on the south side of San Francisquito Creek in what is now Jasper Ridge, and Zoology's request specifically mentioned "wire fence to keep out the cattle" (same source, letter from C. Gilbert to President Wilbur, March 28, 1916).

The first formal recommendation for a larger Jasper Ridge preserve came in 1919, in a letter to the Board of Trustees from President Wilbur.

I wish to recommend to the Board of Trustees, upon the request of the Departments of Zoology and Botany, that the... "Searsville Ridge" or "Dennis Martin Hills" be set aside as a permanent reserve. This range is an almost ideal natural history park for this region, as it contains a large variety of plant and animal life... It will be necessary if this is set aside as a natural history reserve, to keep off all stock, as pasturing eventually kills out a great many of the native species and brings in common weeds to take their places" (SU Archives, SC27, Box 13, Folder 22).

This recommendation, like Wilbur's earlier one, must not have been implemented by the Board, as later researchers continued to be concerned with cattle and sheep grazing on Jasper Ridge.

Research efforts intensified in the 1920's. Twenty-one more advanced degrees were granted between 1921 and 1930, again on a wide range of topics from the Searsville limnology study (Scott 1927) to the ever-popular venomous spiders. It was during this period that Cooper (1922, 1926) developed his studies of the broad sclerophyll plant communities of California, including field research in the chaparral and forest communities of Jasper Ridge. Cooper concluded that the distribution of broad sclerophyll vegetation depended on water balance, related to differential evapotranspiration on north- and south-facing slopes.

Prof. Arthur Vestal came to Stanford in the early 1920's and initiated several studies at about the same time that Cooper began his work. Vestal was broadly interested in the relationship between topography and vegetation, and specifically in the effects of soil type, grazing and fire on grassland communities (Vestal 1925, 1926, 1928). Although no specific locations are mentioned, a study by one of his students concludes that "the effects of the fire, grazing and clearing" have been influential in the distribution of grassland and chaparral (Simon 1927:39). Vestal's notes also suggest that field burning and grazing were regular occurrences in local grasslands.

Invasions of the weedy grassland by Baccharis and Rhus diversiloba can be observed, and the frequent germination of acorns would result in establishment of many young trees if it were not for the intense competition of wild oats, and the repeated burning, cutting, grazing and trampling to which the fields are subject" (Vestal 1926:350).

Vestal is best known at Stanford for his interest in the effects of cattle and sheep grazing on the distribution and variety of forbs and grasses. His concern with grazing led to the installation of "Vestal's exclosures" in grassland parcel 91 -- three fenced plots measuring 40x40 ft and two smaller plots. One location is noted on Map 13. The exclosures may have been designed as part of a larger study of grassland associations (Clements and Vestal 1927). A. E. Roth, University Comptroller, directed the small plots to be set aside, but also noted in a letter to President Wilbur that it seemed "impractical to save this entire area [Jasper Ridge] when a few small detached plots will serve the purpose" (February 21, 1927). During this period Vestal also established a weather instrument station, the first on Jasper Ridge. Climate and soil moisture data for April-August 1927 are reproduced in Simon's (1927) thesis.

In 1928 the University removed a small plot (7.2 acre, 2.9 ha) from the Stock Farm Lease for a Native Wild Flower Reserve. This small reserve was located at the north end of the grassland on Jasper Ridge (see Map 12). The map shows a wagon road leading to the Hermit's cabin from the southern end of the preserve, a road Vestal mentions in his 1927 correspondence.

In the early 1920's the Mining Department became interested in using the Hermit's shafts and test pits to give students practical experience in field techniques (see Mining). Decades later, a thesis project analyzed copper, silver, zinc, and other trace elements found in Jasper Ridge soil samples to determine whether certain statistical measures would be useful for prospecting using geochemical data (Tripathi 1976). However, there is no further record of mining activity by students or

others on the Preserve lands.

A bubonic plague scare in the late 1920's or early 1930's led to massive eradication of the ground squirrel (Citellus beecheyi) population, according to a student interview with Emeritus Professor Ira Wiggins (Osborn and Gibson 1969). Bait containing strychnine in rolled barley was distributed throughout San Mateo County, including Jasper Ridge. Whether other animals consumed the poisoned bait is unknown. Today ground squirrels are abundant in much of the local area, but in the Preserve they have been found only in the SLAC corridor (A. Grundmann, personal communication). It is unknown whether ground squirrels were present in the upper grassland before the poisoning episode.

During the first two decades of Stanford's existence, there was little competition between research and recreational land use. But throughout the 1930's and 1940's, biologists and other scientists were increasingly drawn to research on Jasper Ridge while a growing local population focused on recreational activities. Academic use and recreational use continued together at Jasper Ridge until the 1950's, and during these three decades, another 42 advanced degrees were awarded to biology, geology, and engineering students using Jasper Ridge as a natural laboratory.

In 1956 the Stanford Board of Trustees designated Jasper Ridge, including the lake and swamp areas, as academic reserve instead of housing or open space. This was a reflection of faculty interest and was expressed through a new university committee on Land and Building Development. The academic reserve designation demonstrated a strong commitment by Stanford to continued research support in the Jasper Ridge area.

In 1959 Paul Ehrlich arrived at the university as Curator of Entomology. He soon identified the rare Euphydryas (checkerspot) butterflies on Jasper Ridge and began lobbying actively for preservation of the lands surrounding their serpentine grassland habitat. Long-term Euphydryas studies directed by Ehrlich and other researchers are still underway. Several E. chalcedona sites are shown on Map 13. Another major research project, still in progress, was initiated by Prof. Harold Mooney in 1978. With other investigators Mooney is studying various ecosystem processes in the serpentine grassland and chaparral.

By 1960, cattle grazing was no longer permitted in the upper grasslands. The effects of grazing have been an enduring subject of study, as shown by Franco's (1976) research and Stanford's continuing efforts in the 1980's and 1990's to reforest the foothill areas east of Jasper Ridge (Magic 1985, 1990). Public use during the 1960's was also increasingly restricted, by signs and by riding and hiking trail closures. Over much public objection, in 1970 the Biology Department arranged to build the Westridge fence which sealed the 1.5-mile (2.4 km) southern

border of Jasper Ridge.

In 1973 the University took several steps to further protect Jasper Ridge. The Board of Trustees designated 960 acres (384 ha) of "natural laboratory" as the Jasper Ridge Biological Preserve (SU News Service, January 16, 1973, SU Archives #3698). This original Preserve area included the ridge, grasslands, swamp and inner marsh (#90, 91, 92, 96, 97), but excluded the lake and the west shore. A 1975 study by independent consultants at SRI found that attendance at Searsville Park ranged from a low of 500 to a highs of 2500 on weekends with consequent damage to the environment.

Finally, in 1976 the University received an anonymous bequest that allowed the buy out of the Searsville Park lease. Later that year the Board of Trustees closed the park and added its several hundred acres to the Preserve, including the lake, the western lands and outer marsh areas. The SLAC corridor north of San Francisquito Creek was added to the Preserve at the same time, for a total of approximately 1190 acres. In 1979 a chain link fence along Sand Hill and Portola Roads effectively sealed the Biological Preserve from disruptive trespassers. That same year the docent program was expanded to provide the public with more opportunities for controlled access to Jasper Ridge.

APPENDIX: ARCHIVAL SOURCES

The following lists a set of materials used in the land use study and filed at the Jasper Ridge Biological Preserve Office, Stanford University. Many of the following are photocopies of notes made by Elena Reese; she has the originals as well as additional information not directly relevant to this paper. Most notes include reference to the library or archives maintaining the original documents. For published sources, see full citation in the Bibliography section.

- 1776-1 Summary of Mission San Francisco livestock data, 1776-1835. From Mission Stats Notes by G. B. Griffin, Bancroft Library #C-C64.
- 1793-1 Summary of Mission Santa Clara livestock data, 1793-1821. From Mission Stats Notes by G. B. Griffin, Bancroft Library #C-C64.
- 1804-1 Alcalde records, Pueblo of San José, notes on Máximo Martínez family agricultural records, 1804-1817.
- 1821-1 Presidio/Mission S.F. tax records and soldiers' provisions records, various notes 1821-1823.
- 1822-1 Notation of M. Martínez baptismal record, 1791.
- 1828-1 Missions San Francisco, Santa Clara and San Jose: "Position, Limits and Terrain."
- 1832-1 Notes on Land Grant of Cañada del Corte de Madera to Martínez and Peralta.
- 1834-1 M. Martínez last will; request to register cattle brand.
- 1836-1 M. Martínez land grant correspondence.
- 1841-1 M. Martínez noted in credits/debts to Pueblo de San José.
- 1844-1 Thomas Larkin correspondence 1844-1847 regarding Pulgas Redwoods.
- 1844-2 M. Martínez correspondence including cattle sales.
- 1852-1 Census agent letter describing Pulgas Redwoods area.
- 1854-1 Deed of M. Martínez to Bridget Martin, 1250 acres.
- 1856-1 Orrin Payne correspondence describing Woodside agriculture.
- 1856-2 Orrin Payne correspondence describing Pulgas lumbering.
- 1857-1 Summary of Dennis Martin tax records, 1857-1881. Based on

San Mateo County Tax Rolls; on microfilm at San Mateo County Historical Association, College of San Mateo.

- 1857-2 Summary of Simon Fleury tax records, 1857-1869. Based on San Mateo County Tax Rolls; on microfilm at San Mateo County Historical Association, College of San Mateo.
- 1857-3 Notes on Transcript of Title to Dennis Martin Tract.
- 1858-1 Orrin Payne correspondence on Pulgas sawmills.
- 1858-2 St. Denis Church records, notes on Martin and Fleury.
- 1858-3 Notes on Deeds of Welsh to Martin and Martin to Morrison.
- 1859-1 Summary of Mills and Franklin tax records, 1859-1862.
- 1859-2 Deed of Dennis Martin to Mills and Franklin, 300 acres.
- 1859-3 San Mateo Times Gazette news 1859-1868 on Martin logging, Redwoods area mining, agriculture etc.
- 1860-1 Summary of Agricultural Census, records for Martin, Murray, Fleury, Martínez, Mills. From U. S. Census Office, Partial Schedules; on file at California State Library, California Section. Sacramento.
- 1860-2 Summary of James Morrison tax records, 1860-1865.
- 1860-3 Notes from United States Census on Martin, Mills, Fleury.
- 1861-1 Notes on court case, Martínez v. Thurn and Carpentier over ownership of Rancho Corte de Madera.
- 1863-1 Notes on history of tax sales, etc of 500 acre parcel.
- 1863-2 Notes on deeds: Mills to Temple and Fox, Reynolds to Martin, Crook to Martin, Morrison to Martin, Martin to Felt, 1863-1870.
- 1863-3 Probate notice for M. Martínez in San Mateo County Gazette.
- 1864-1 Deed of Bulkley to Herrick and Miller, and Deed of Herrick to Miller, 1864-65.
- 1866-1 Cattle theft notice in San Mateo County Gazette.
- 1868-1 Official map, County of San Mateo, section including Jasper Ridge.
- 1869-1 Notes on deeds: Fleury to Martin, Bulkley to Herrick and Miller, etc.
- 1870-1 Notes from United States Census on Martin and Fleury.

- 1874-1 Summary of John Murray agricultural records, 1874-1878.
- 1875-1 Martin noted in Paulson's Handbook and Directory.
- 1875-2 Notes on Mining Agreement in Title Transfer from Martin to Larco.
- 1875-3 Deed of Bridget Martin to Dennis Martin.
- 1876-1 Notes regarding silver discovery on Murray ranch.
- 1877-1 Notes on 1877 Map of parcels in Jasper Ridge area.
- 1877-2 Notes on deeds: Martin to Martin, Martin to Dunne, Martin to Story, 1877-1878.
- 1877-3 Copy of map, County of San Mateo 1877, showing Jasper Ridge.
- 1878-1 Notes on court case, Martin v. Dixon over 1250-acre parcel.
- 1878-2 Deed of Murray to Spring Valley Water Works.
- 1879-1 Map and accompanying survey notes for Plat of Rancho Cañada del Corte de Madera.
- 1880-1 United States Census, notes on Martin household.
- 1880-2 Agricultural Census notes on Dominick Grosso.
- 1880-3 Deed of Martin to Castigan, 940 acres.
- 1880-4 Notes from pioneer reminiscences on Pulgas Redwoods area.
- 1880-5 Agreement between Coon and Dixon regarding Martin property.
- 1881-1 Notes of Sheriff's sale of Martin property to Austin and following sale by Austin to Dixon.
- 1881-2 Notes on Dixon to Leland Stanford deed of sale, 863 acres.
- 1882-1 Addition notes on deeds of sale to Stanford, 175 acres.
- 1883-1 Notes on Coombe's 1883 survey map of Stanford lands.
- 1886-1 Contract between Spring Valley Water Works and Stanfords.
- 1891-1 "Palo Alto in 1849", notes on Searsville Redwoods area.
- 1891-2 Advertisements in San Francisco for orchard fruit grading machines, from Wickson's The California Fruits.

- 1894-1 Cattle pasturing agreements, 1894-95 Palo Alto Stock Farm.
- 1894-2 Copy of map of San Mateo County, showing Jasper Ridge.
- 1897-1 Stanford Lease of Lot 35 (Martin tract) to Manuel Condray, notes on crops and livestock use, 1897-98.
- 1898-1 Lot 35 lease, notes on produce etc., 1998-99.
- 1901-1 Photocopy of Peirce article on the Coast Redwood.
- 1908-1 Board of Trustees minutes regarding Dennis Martin Ranch lease.
- 1908-2 San Mateo County lot parcel numbers for the Jasper Ridge area based on the Hermann 1908 survey of Stanford lands.
- 1910-1 Board of Trustees correspondence, proposed Woodside Golf Course bordering Searsville Lake.
- 1913-1 Board of Trustees documents on Searsville Lake: contract with Spring Valley Water Company, etc, 1913-1915.
- 1916-1 Notes on possible revival of Stanford Stock Farm.
- 1916-2 President Wilbur correspondence on Dennis Martin Hills as a native plant reserve.
- 1917-1 Notes on SU Archives Map 801, Insurance map showing Martin Ranch buildings.
- 1917-2 President Wilbur-War Department correspondence on Camp Fremont use of Stanford lands.
- 1917-3 Camp Fremont notes from Menlo Park Archives, etc: location of military activities in hills of Stanford property, 1917-1918.
- 1918-1 Camp Fremont, Key Map of Property.
- 1919-1 Recollections of Dennis Martin arrival in Pulgas area.
- 1919-2 President Wilbur recommendation that Dennis Martin Hills be set aside as a biological reserve area.
- 1920-1 Photo of Webb Ranch looking toward Alpine Road from Jasper Ridge - date probably early 1920's.
- 1922-1 Notes from Cooper's publication on chaparral ("broadleaf sclerophyll vegetation of California").
- 1922-2 Trustee documents on lease of Searsville lake by Ernst Bransten.

- 1923-1 Notes from Repass' thesis on The Hermit Mine.
- 1923-2 News clipping on Palo Alto Stock Farm cattle production.
- 1924-1 Photocopies of Vestal's grassland research notes, 1924-29.
- 1925-1 Forest Service timber tree volume table, from USDA publication.
- 1926-1 Searsville Lake lease notes in Stanford's Annual Report of the President, 1925-26.
- 1926-2 University Comptroller correspondence on Searsville Lake area lease and purchase.
- 1927-1 Pages from Scott's disseration on Searsville Lake Limnology.
- 1927-3 Notes, correspondence of Prof. Vestal and Pres. Wilbur regarding research and preservation of Jasper Ridge lands.
- 1928-1 Board of Trustees letter on raised water level at Searsville.
- 1928-2 Copy of map locating Botany Reserve at Jasper Ridge.
- 1929-1 Notes on Searsville Lake dredging, water pipe lines, etc, from Annual Reports, 1929-30 and 1930-31.
- 1930-1 Photocopy of 1930 aerial photo of Jasper Ridge area.
- 1930-2 Copy of Menlo Circus Club trail map, undated, ca. 1930's.
- 1932-1 Notes from Show's paper on Timber Growing and Logging in Coast Redwood Area.
- 1932-2 Notes from Palo Alto Stock Farm records, acres leased, etc.
- 1933-1 Notes on Dennis Martin from daughter Annie Wyatt.
- 1934-1 Comptroller to Trustees on Bransten lease of Searsville Lake.
- 1935-1 Pages and notes from Springer's disseration on Jasper Ridge.
- 1937-1 Photocopy of Wilson's Timberman article.
- 1937-2 Copy of Map of the Ormondale Ranch, adjoining Jasper Ridge.
- 1940-1 Pages from Felin's disseration on Searsville Lake.
- 1946-1 Figures from Wieslander and Jensen, Forest Areas and Timber

Volumes in California.

- 1947-1 Notes on background of William Herrick.
- 1947-2 Notes from Briggs' thesis on Stevens Creek Dam.
- 1950-1 Pages from Hasel's article on second-growth redwood volume.
- 1950-2 Pages from Stuart's "The Burrell Letters".
- 1950-3 Map copy, Grazing Lands of Stanford University Lots 90-92, showing grazing areas, trees, brush.
- 1952-1 Page from La Peninsula on 1859 sawmills of San Mateo County.
- 1953-1 Pages from Oberlander's disseration on San Francisquito watershed ecology.
- 1954-1 Notes from McDonald's Sam McDonald's Farm local history.
- 1954-2 San Francisco Chronicle story about founding of Searsville.
- 1955-1 Notes on transfer of Searsville Lease from Brandsten to the Clapps.
- 1955-2 Daily Palo Alto Times clipping and notes on Searsville recreation area.
- 1955-3 La Peninsula story on the Menlo Adobe and Dennis Martin.
- 1959-1 Notes from Brown's "It Happened in Portola Valley".
- 1960-1 University Memo about termination of cattle grazing at Jasper Ridge.
- 1961-1 Notes from Brown's "The Pulgas Redwoods".
- 1965-1 Aerial photo of proposed Ladera Dam reservoir.
- 1966-1 Photocopy of Brown's manuscript Sawpits in the Spanish RedWoods 1787-1849, 27 pp.
- 1966-2 Notes from Hoover, Rensch and Rensch, Historic Spots in California.
- 1967-1 Notes on Gates' California Ranches and Farms 1846-1862.
- 1968-1 Aerial photo of Jasper Ridge area.
- 1969-1 "History of Jasper Ridge" paper by Osborn and Gibson.
- 1970-1 Notes from Gerstley's "The Shack Riders".

- 1972-1 "A-Guide to Jasper Ridge", Biology 178 student papers.
- 1973-1 Notes from Richards' Crossroads monograph.
- 1973-2 Ann Van Der Stoep paper, "Takeover of California Rangelands by Annuals." (Bound with 1972-1)
- 1975-1 Chapters from Dodge's disseration on San Diego County fire history and land use.
- 1975-2 Pages from Brown's Place Names of San Mateo County.
- 1976-1 Pages from Tripathi's thesis on geochemical prospecting on Jasper Ridge.
- 1976-2 SU News Service, news about use of pesticide in Searsville Lake.
- 1976-3 Palo Alto Times article on proposed Searsville Lake closing.
- 1977-1 Mensing's thesis on blue oak regeneration in Kern County.
- 1978-1 Notes on Begle's paper "Eighty years of research on Jasper Ridge".
- 1978-2 Nishimoto's paper on social history of Jasper Ridge area.
- 1979-1 Peninsula Times Tribune notes on article about Searsville Lake park being closed.
- 1979-2 Summary of Woodside Fire Station records, 1928-1979, compiled by E. Wood.
- 1980-1 List of dates of human activity/events affecting Jasper Ridge history, compiled by Alan Grundmann.
- 1980-2 Information about "The Hermit" compiled by Alan Grundmann.
- 1981-1 Correspondence regarding Mexican land grant boundaries, A. Grundmann.
- 1983-1 Vegetation Management Plan-Phase 1, prepared for Stanford University.
- 1984-1 Notes from Northrop's Spanish-Mexican Families of Early California on Máximo Martínez family history.
- 1985-1 Direct Seeding of Oaks, Stanford University, 1984-1985, Magic Inc.
- 1986-1 Pages from Rackham's History of the Countryside on sources

of soil ridges.

- 1987-1 Oak Regeneration, Stanford University, 1985-1987, Magic Inc.
- 1987-2 Jasper Ridge History Summary on Dennis Martin, compiled by Alan Grundmann.
- 1987-3 Steven Hamburg, proposal to Andrew W. Mellon Foundation: Integration of an Historical Perspective into Ecological Research.
- 1988-1 Palo Alto Times, notes on article about Camo Fremont.
- 1988-2 Sarah Timby paper, "The Landscape of the Palo Alto area in the Early Spanish Period." (Bound with 1972-1)
- 1988-3 Jasper Ridge History Summary on Town of Searsville, compiled by Alan Grundmann.
- 1989-1 Elena Reese, notes on conversation with Nona Chiariello.
- 1989-2 Elena Reese correspondence with Steve Hamburg.
- 1989-3 Bocek and Hamburg, "Historical Perspectives in Ecological Research: Jasper Ridge Project Area."
- 1990-1 Steve Hamburg, preliminary GIS output mapping property lines, etc on Jasper Ridge.
- 1990-2 San Jose Mercury News clipping about the 1850's "Redwood Rush".
- 1990-3 Memo from Grundmann about costs and problems associated with proposed dredging of Searsville Lake.
- 1990-4 Elena Reese, notes on interviewing Stanley Webb about local history.
- 1990-5 Elena Reese, notes on various subjects: Jasper Ridge and Searsville citations in the Stanford Archives; Botany dissertations using Jasper Ridge; background on Murray, Mills, and other Dennis Martin neighbors; summary of tax information on Martínez; summary on Dennis Martin; crop acres vs. grazing acres; Jasper Ridge land use summary notes.
- 1990-6 Barbara Bocek, notes from meeting with Earth Science professors Ron Lyons and Ben Page to discuss Jasper Ridge soil ridges.
- 1990-7 Barbara Bocek to Nona Chiariello, memo proposing archeological field work on Jasper Ridge.
- 1991-1 Barbara Bocek, notes on redwood timber costs, volume, etc.

1991-2 Elena Reese, "Jasper Ridge Deeds: Summary and Context," and miscellaneous notes from research on deeds.

1991-3 Barb Bocek, notes from meeting with Alan Grundmann and Prof. Krauskopf (Applied Earth Sciences) to discuss soil ridges.

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