THE VEGETATION CALLED CHAPARRAL

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Much of California's uniqueness is a reflection of its natural diversity -- diversity of climate, geology, topography, and geography. The response of plant life to such diversity through past millenia has produced assemblages of plants found nowhere else in the world. Within the Mediterranean climatic region of California there are distinctive types of woody plant communities, which include evergreen forests and woodlands, evergreen scrubs (chaparral or hard chaparral), and drought-deciduous scrubs (coastal sage or soft chaparral). These types are referred to technically as "sclerophylls". The coniferous forests are narrow sclerophylls, whereas oak woodlands, chaparral, and coastal sage are examples of broad-sclerophyll communities; together they compose about 20 percent of the native vegetative cover of California.

Broad-sclerophyll vegetation is not confined to California, but occurs in the Mediterranean region, South Africa, Southern Australia, and Central Chile. This vegetative type is correlated in these five remote geographic regions with the Mediterranean-type climate, namely one with a long, dry summer and a cool, wet winter. Some broad sclerophylls are trees, but the scrubs are more wide-spread and important. The leaf form is the distinctive diagnostic feature of all sclerophylls, being small, thick, stiff and hard, and evergreen.

Chaparral covers about 8.5 percent of California; it is the most characteristic natural vegetative type in the state (Weislander and Gleason, 1954). It reaches its fullest development in southern California, where it ranges generally in elevation from 1,000 to 5,000 feet. In the wetter, more northerly portions of its range, chaparral occurs in a lower elevational belt ranging from 500 to 3,000 feet. Annual grasslands and coastal - sage scrub occur along its lower limits, although coastal - sage elements decline in importance in northern California. Various types of woodlands bisect chaparral brushfields in foothill areas and along canyon bottoms. The upper limits of chaparral are typically bordered by a mixed evergreen and coniferous forests.

Mature California chaparral is a dense, dwarf, one-layered vegetation. Its density is extreme, making entry nearly impossible. Often one has to "swim" over the tangled mass. From a distance it appears as a velvety mantle, even on steep, rocky slopes. It was this feature that reminded the early Spanish explorers of their "chaparro," the dense live-oak scrub of the Mediterranean region (The suffix "al" means "place of " in Spanish.). In present usage, chaparral describes the entire assemblage of shrubs, not a single species. It should be noted that the chaparral of California is distinct from that of the Rocky Mountain States. California chaparral is

evergreen, winter active, and summer dormant, whereas the Rocky Mountain (Petran) chaparral is winter deciduous and summer active.

The rose family (Rosaceae) is the most widely developed shrub family in California chaparral and is perhaps the most important browse group. Representative shrubs are chamise (Adenostoma), bitterbrush (Purshia), toyon (Heteromeles), mountain mahogany (Cercocarpus), and cherries and apricots (Prunus). Other families important to the chaparral are: buckthorn (Rhamnaceae), heather (Ericaceae), beech (Fagaceae), and sumac (Anacardiaceae).

Chaparral Environment

To the chaparral, the Mediterranean climatic type means favorable growing conditions during the winter and spring months, followed by temperature and water stresses during the hot, dry summer months. However, local conditions of soil and slope may greatly modify regional climate. Chaparral grows on coarse-textured soils which are limited in their water-holding capacities. If the slope is steep and the rainfall intense, or if the soil contains non-wetting agents, the usable or effective rainfall is less than that recorded by a rain gauge. The position of a slope in relation to north (slope aspect) creates local climatic conditions that are far more "real" to the plants than the regional climate. In fact, slope aspect is the most important selective factor in the chaparral environment (Hanes 1971). It strongly influences which species make up the local chaparral community and the changes and rates of change in the community following fire or other disturbance. Finally, the geographic setting -- proximity to the Pacific Ocean, desert exposure, and elevation -- may override regional climate.

Fire is as much a part of the chaparral environment as the amount of rainfall or temperature patterns, though not as regular. It is generally agreed that fire has been a significant factor in the California environment for the past 2 million years. The density of chaparral, the presence of volatile substances in the leaves, and its low moisture content during the annual drought predestine it to support fire. These three characteristics of the California chaparral, therefore, make it a "fire-type" vegetation and one of the most fire susceptible in the world.

The relationship between fire and chaparral is, however, a dynamic one, not passive. The shrubs have responded to recurrent fire by employing several strategies. About half of the species of plants composing California chaparral possess a root crown burl which contains countless dormant buds. Within a few weeks or months after fire has killed or incinerated the above-ground portions of the shrub, numerous shoots emerge from the burl. This vegetative response is independent of the rainy season; the new shoots apparently draw on water reserves of the root system. This type of vegetative reproduction gives the sprouting species a decided competitive advantage over nonsprouting species. Since nonsprouting species lack a rootcrown burl and resistance to fire, they must rely on seeds for reestablishment. Certain species of seed are not resistant to fire, yet their large numbers ensure that

some will escape the killing temperatures and live to perpetuate the species. Chamise (*Adenostoma fasciculatum*), the dominant species of chaparral, is this type of seed producer. It is also a vigorous sprouter, and, hence, it has a double insurance strategy against extinction due to fire. Chamise and the other sprouting species are able to hold their ground with intact root systems. These venerable sprouters periodically get a new lease on life after being visited by fire. The sprouting species are also the longest lived and are found in the greatest range of habitats.

Many nonsprouters produce seeds that have tough seed coats that insulate the embryos against killing temperatures. It is within this group that we find the most extreme interaction between fire and plant. Some herbaceous annual and perrenial plants, as well as woody perennial shrubs of the chaparral, produce fire-resistant seeds that fail to germinate year after year until a fire conditions them to germinate. These are the "Rip Van Winkles" of the chaparral world. Many of these species are known to exist as dormant seeds for decades, long after the parent plants have died off. The seed coats are impervious to water even after yearly wettings. It is only after fire has weakened these seed coats that water can infiltrate the seed and enable the embryo to break its bonds of dehydration. The fire has not caused germination, but has altered the seed coat to allow hydration of the embryo. In all these strategies of shrub establishment from seed, adequate soil moisture is necessary. As mentioned previously, chamise is the dominant species of the chaparral, found in about 70 percent of all the stands in the State. It is adapted to the drier and sunny exposures and locally may form pure stands. Generally its associates are shorter-lived nonsprouters. Scrub Oak (*Quercus dumosa*) is the dominant species on north-facing and other cool, moist sites. It and many of its associates are long-lived sprouters, such as hollyleaf cherry (*Prunus ilicifolia*), hollyleaf redberry (*Rhamnus crocea* var. *ilicifolia*), mountain mahogany (*Cercocarpus betuloides*), and toyon (*Heteromeles arbutiflolia*).

The rooting pattern of chaparral shrubs shows a vital response to chaparral soils. The soil is usually rocky and shallow over a highly fractured bedrock. The root system is usually extensive with some roots exploiting water that has penetrated many feet into the rock fissures, thus eliminating competition from nonchaparral species. There is comparatively more root volume than shoot volume, Hence, there is less above-ground demand for nutrients. There are three rooting types found among the shrubs of chaparral: 1) shallow, short lived, 2) deep, short lived, and 3) deep, long lived.

The juvenile soils of chaparral lands have low fertility, yet chaparral plants are able to carry out their life processes in a regime of low mineral supplies. Current research indicates that in older stands of chaparral there is a poor conversion of organic nitrogen compounds to mineral nitrates. Fall rains tend to leach away accumulated soil nitrates leaving them at chronically low levels. On the other hand, soils in recently burned chaparral show increased levels of mineral nitrates. It is interesting to note that nonleguminous shrub species, such as mountain mahogany (*Cercocarpus*) and mountain lilac (*Ceanothus*), are a primary source of

soil nitrogen. It has been determined that nitrogen-fixing bacteria dwell in root nodules of these chaparral shrubs.

Adaptation to Drought

The moisture regime in chaparral lands is the single most important environmental factor. Annual rainfall averages 15 to 30 inches, occurring between October and May in a few moderate to intense storms. However, averages are misleading. Rapid runoff, low moisture retention by soils, high rates of evaporation, and the protracted rainless period each year drastically reduce the effective moisture. During an extremely dry year chaparral plants must be adapted to only 5 or 6 inches of rain and a drought from 5 to 6 months in duration.

Paradoxically chaparral plants are both spendthrift and miserly with water resources. They use up all of the soil moisture by the end of summer regardless of how wet the previous rainy season. On the other hand the small, stiff leaves reduce the amount of water lost from the leaf surface, and their heavily waxed surfaces further reduce water loss. However, it is their physiological capacity that makes chaparral shrubs uniquely adapted to the scarce-moisture regime (Hanes, 1965). As soil-moisture supplies become limited in late June, most chaparral plants enter a summer "sleep". This drought-induced dormancy deepens as the heat of summer intensifies. By August the plants may be sustaining life at only 4 or 5 percent of their wet-season maximums. It is at this time that they are the most fire susceptible.

If California chaparral plants lost their leaves during the summer drought, they would be far less flammable. Much of the fuel volume would be on the ground instead of making a continuous fuel element above ground. However, the evergreen nature of chaparral shrubs is an important physiological strategy. An uncommon summer thunder shower or an early autumn rainstorm will "awaken" the chaparral shrubs from their deep slumber, and, within minutes after the moisture has been absorbed by the roots, the shrubs can be photosynthesizing. Evergreenness, therefore, makes chaparral plants opportunists; they can use soil moisture as soon as it becomes available. If they were drought deciduous, an entire crop of new leaves would have to be developed before the new moisture supply could be utilized. Such a delay would greatly reduce the value of the rainfall. Still, the leaf of the sclerophyll is relatively small, and, even though it has gained a time advantage on a new supply of water, it is restricted in its photosynthetic capacity by its reduced leaf surface. Another advantage to the evergreen sclerophyll is that it does not wilt, even in the severest drought condition. Subsequently, it does not have to commit part of a new water supply to hydrating its leaves to maximize light absorption.

Succession and Aging

Nature is no nudist, and chaparral lands are no exception. Following disturbance by fire, erosion, or man, chaparral has remarkable recovery potentials.

Recently disturbed sites are characterized by seedlings and rootcrown sprouts. The seedlings are of three types: 1) annual and short-lived perennial forbs and grasses such as penstemons and four-o-clocks; 2) intermediate-lived perennial shrubs, such as some *Ceanothus* species; and 3) long-lived perennial shrubs, such as chamise, scrub oak, and manzanita. Disturbance means diversity in chaparral. All types are present in the first wet season following a major disturbance. This feature makes chaparral succession unique and has led me to refer to it as "autosuccession", i.e., chaparral succeeds itself rather than being proceeded by other vegetative types (Hanes 1971).

The herbs and forbs dominate the site for a few years by virtue of their showy flowers and sheer numbers. Yet the seedlings of the woody species and resprouters begin to dominate the scene within 2 to 5 years. Their more aggressive root systems exploit deeper water reserves, and their more robust tops shade out the forbes and grasses. Woody chaparral creates both a water and light monopoly.

My studies indicate that there is a dying off of some seedlings of woody species each year. These "die easies" are mainly shallow rooted, nonsprouters like some *Ceanothus*. Depending on the species involved and site conditions, all of the individual shrubs of such nonsprouting species may have died within 3 or 4 decades after the initial disturbance. The longer-lived species increase in size, but not numbers, to fill in the gaps left by the nonsprouter dieoff. On south-facing slopes, mixed stands of chaparral gradually become less diverse and tend to become dominated by long-lived chamise. On north-facing slopes, even though the die-off process is evident, chaparral stands are rich in species, since most are long-lived sprouters, and occasional seedlings of other species become established years after the disturbance. If fire sweeps through chaparral every few years, seed reserves can be exhausted, nonsprouters can be eliminated, and only sprouting species remain.

There is another trend that becomes noticeable in mature unburned stands of chaparral, especially in chamise chaparral. It is best described as senility or decadence. The amount of annual growth decreases so that, in stands that have reached the mid-century mark, there is little, if any, productivity. The number of dead branches may exceed the number alive. There is no understory -- neither forbs nor grasses -- and seedlings of woody shrub species are lacking. Chaparral plants are, in a sense, victims of their own success. Monopoly is a game nature does not play for long. Some plant ecologists have speculated that, given enough time without disturbance, chaparral would be replaced by an oak woodland. I see no evidence for such a speculation, particularly when considering chamise chaparral.

The question may be asked, "What will happen to a chamise chaparral stand if left undisturbed for centuries?" First, the situation is an artificial one, since fire is a natural part of the chaparral environment. Secondly, the chaparral would not become anything new, only a progressively more degraded stand. More and more we suspect that old age in chaparral is related to the production of toxic substances by various chaparral shrubs. As the stand ages, these phytotoxins accumulate in the

ground, affecting plants directly or upsetting microbial activity and nutrient cycles to the detriment of normal plant processes.

Chaparral needs periodic fire to ensure its vitality. Also fire in the chaparral is inevitable. Fire exclusion from the chaparral does not prevent fire, it only forestalls it. A better understanding of the force of fire in the ecology of chaparral is imperative if man is to live with the chaparral.

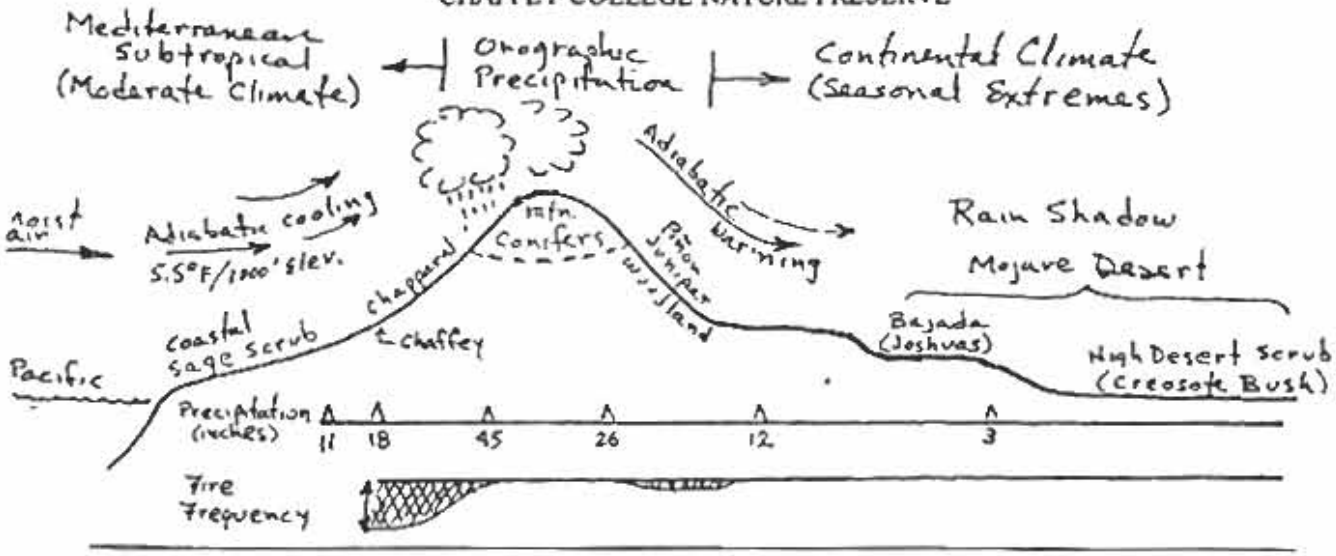
References

Hanes, T.L. 1965. Ecological studies on two closely related chaparral shrubs in Southern California. Ecol. Monog. 35: 213-235.

Hanes, T.L. 1971. Succession after fire in the chaparral of Southern California. Ecol. Monog. 41: 27-52.

Weilander, A.E., and C.H. Gleason. 1954. Major brushland areas of the Coast Ranges and Sierra-Cascade Foothills in California. U.S. Forest Service, Pacific Southwestern Forest and Range Experiment State, Miscellaneous Paper No. 15.

CHAFFEY COLLEGE NATURE PRESERVE



A LIST OF THE CONSPICUOUS CHAPARRAL PLANTS

Adenostema fasciculatum (chamise)
Artemisia californica (calif. sagebrush)
Astragalus pomonensis (locoweed)
Croton californicus (croton)
Eriodyction trichocalyx (Yerba santa)
Eriogonum fasciculatum (calif. buckwheat)
Lotus scoparius (deer weed)
Peonia californica (peony)
Prunus ilicifolia (Holly-leaf cherry)
Ramnus crocea (buckthorn)
Rhus trilobata (squawbush)
Salvia apiana (white sage)
Salvia mellifera (black sage)

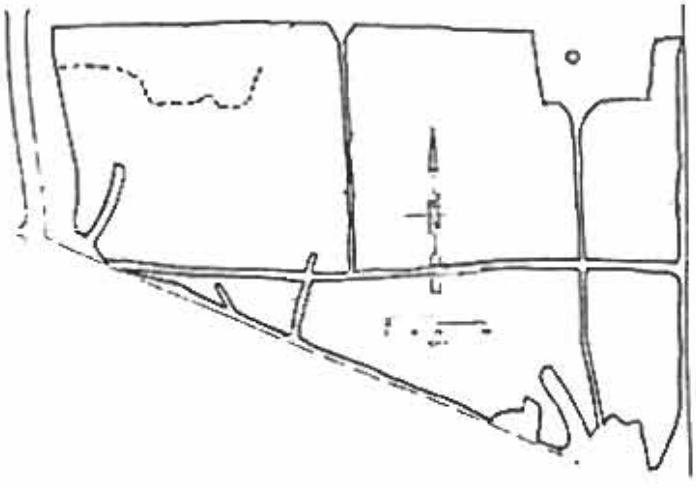
DISTURBANCE HISTORY OF THE PRESERVE

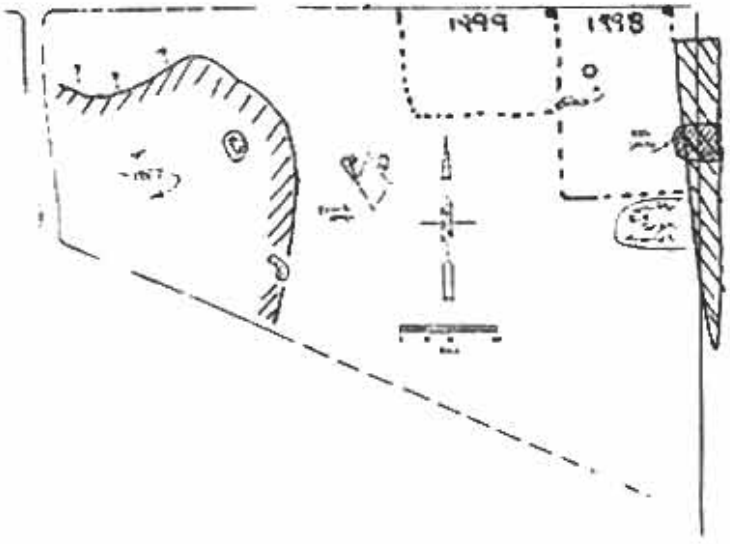
Mechanical disturbances

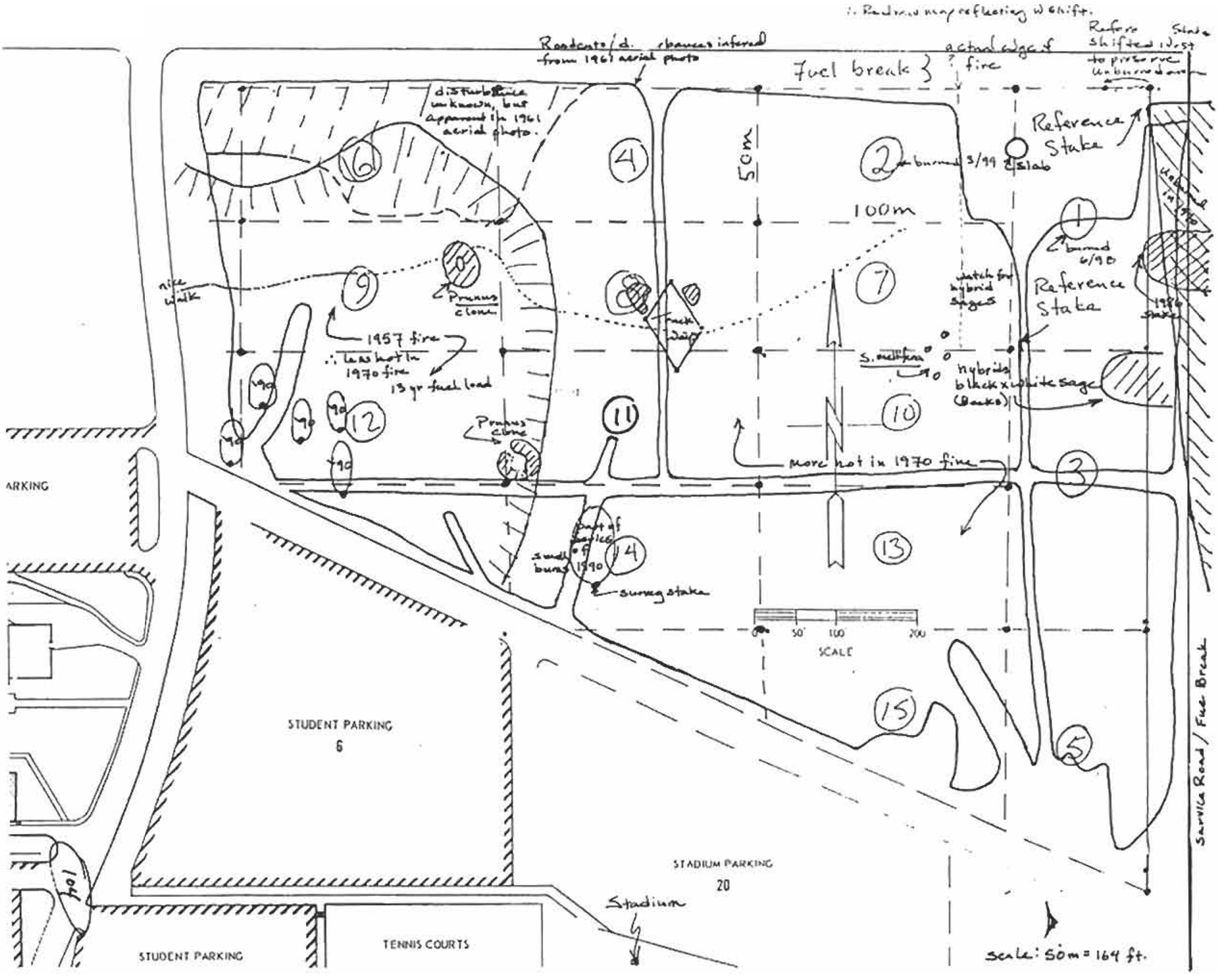
Scars left by mechanical disturbance in 1959, still visible today. Colonist species occupy these areas today and resemble Coastal Sage Scrub.

Fire History

The entire area has been burned repeatedly during this century. All but a sliver was burned in 1970. Every 20-30 years fire revitalizes the habitat. The Current controlled fire program is intended to simulate the historical fire pattern.






Fuel break
100m
50m
Reference Stake
burned 3/99 & slab
burned 6/90
watch for hybrid sages
hybrids black x white sage (Banks)
more hot in 1970 fire
1957 fire
∴ less hot in 1970 fire
13 yr fuel load
Prunus clone
Truck Way
nike walk
survey stake
SCALE
0 50 100 200
STUDENT PARKING
6
STADIUM PARKING
20
TENNIS COURTS
STUDENT PARKING
ARKING
Stadium
scale: 50m = 164 ft.
Service Road / Fire Break
104

PLANT KEY

1. Leaves opposite on the stem..... 2
1'. Leaves alternate on the stem or projecting from a basal clump.....5

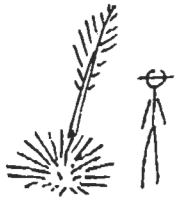
2. Leaves strongly aromatic (mint like).....3
2'. Leaves not strongly aromatic 4

3. Inflorescence (flower group) narrow, oppositely branched, 15 dm. tall; leaves soft, light gray-green, aromatic as in cooking sage. ..... *Salvia apiana*
(White sage)

3'. Inflorescence 10 dm. tall; not branched but a series of head-like whorls,leaves with upper surface cobblestone texture, veined beneath, green, aromatic. ..... *Salvia mellifera*
(Black sage)

4. Plant a well developed shrub or small tree with woody stems; underside of leathery leaves matted with white, short hairs; stipules cork-like.....*Ceanothus crassifolius*
(Leather-leaf mtn. lilac)

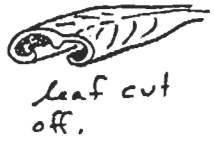
4'. Plant a small shrub, less than 1 m. tall; leaves with a cobblestone texture, gray-green; stems gray and wooly; inflorescence in a series of head-like whorls; fruit a dry burr that readily adheres to hair, clothes, etc.....*Marrubium vulgare*
(Horehound)



5. Leaves 30-80 cm. long, linear, stiff, spine-tipped and radiating from a reduced stem near ground.....*Yucca whipplei*
(California Yucca)

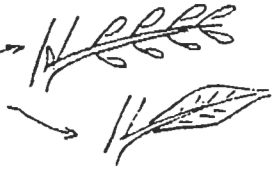
5'. Leaves not as above.....6

6. Leaves grouped in fascicles (bunches) along the stem.....7
6'. Leaves not grouped in fascicles 8



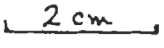
7. Leaves 4-8 mm. long, needle-like; plant a well developed, woody shrub, mostly more than 1 m. tall.....*Adenostema fasciculatum*
(Chamise)

7'. Leaves 6-15 mm. long, strongly turned under on edges, white wooly beneath; plant usually less than 1 m. tall.....*Eriogonum fasciculatum*
(Calif. buckwheat)



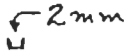
8. Leaves compound.....9
8'. Leaves simple 11

9. Leaflets 3-5 in number.....10
9'. Leaflets many, from a midrib; leaf feather-like; dry fruit an inflated pod with loose seeds within.....*Astragalus pomonensis*
(Pomona Loco weed)



10. Mature leaflets greater than 2 cm. long, edges variously lobed; diffusely branched shrub, about 1 m. tall.....*Rhus trilobata*
(Squaw bush)

10'. Mature leaflets mostly less than 1 cm long; plant low, rounded, bushy with numeroussmall green branches from basal clump; flowers yellow, tinged with red.....*Lotus scoparius*
(Deer weed)



11. Leaves or leaf segments less than 2 mm wide.....12
11'. Leaves greater than 2 mm wide.....13

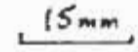
12. Leaves scale-like and closely appressed to a green stem; leaves less than 2 mm long; flowers yellow.....*Lepidospartum squamatum* (Chaparral broom)

12'. Leaves deeply dissected, 3-5 needle-like segments forming a pattern not too unlike birds' feet.....*Artemisia californica* (Calif. sagebrush)

13. Plant a shrub or small tree with well developed branching woody stems.....14

13'. Plant not a well developed shrub or small tree, but may be partly woody near the base.....17

14. Leaves less than 15mm long, margins finely serrated; branchlets somewhat spine tipped; fruit a small green or red bead.....*Rhamnus crocea* (Buckthorn)



14'. Leaves mostly longer than 15 mm.....15

15. Petioles (leaf stems) of largest leaves 10-12 mm. long; leaves holly-like, glossy dark green.....*Prunus ilicifolia* (Holly-leaf Cherry)

15'. Petioles 2-6 mm. long.....16

16. Leaves with spiny serrations on margin; fruit an acorn. .....*Quercus dumosa* (Scrub oak)

16'. Leaves with non-spiny serrations near the apex, feather veined on lower surface of leaf; fruit dry with feathery tails.....*Cercocarpus betuloides* (Mountain Mahogany)

17. Leaf blades entire (smooth margins), about 4 times longer than wide. ..... *Croton californica* (Croton)

17'. Leaf blades serrate or variously lobed.....18

18. Plant soft, herbaceous, and red flowered .....*Peonia californica* (Peony)

18'. Plant perennial, woody near the base; leaves with netted venation on the under surface; young leaves shiny, rather sticky when crushed.....*Eriodictyon trichocalyx* (Yerba santa)

THE VERTEBRATES OF THE CHAFFEY PRESERVE

The Familiar Birds

More than 150 species of birds have been ;erved on the Chaffey campus. This list ıncludes only those species that you are most likely to notice.

	Spr	Fall
Scrub Jay	C	C
Mockingbird	C	C
Common Crow	C	C
Common Flicker	C	O
California Towhee	C	C
California Quail	O	O
Greater Roadrunner	U	U
Mourning Dove	O	O
Anna's Hummingbird	C	O
Costa's Hummingbird	U	
Common Bushtit	U	U
Red-tailed Hawk	C	C
House Finch	C	C
White-crowned Sparrow		O
Dark-eyed Junco		O
California Thrasher	U	U

C = Common. Seen on nearly every visit
O = Occasional. Seen on most visits
Uncommon. Lucky to see.

Reptiles and Amphibians

Blue-tailed Skink	*Eumeces skiltonianus*	R
Side-blotched Lizard	*Uta stansburiana*	C
Western Fence Lizard	*Sceloporus occidentalis*	C
Alligator Lizard	*Gerrhonotus multicarinatus*	U
Legless Lizard	*Anniella pulchra*	R
Calif. Kingsnake	*Lampropeltis getulus*	U
Gopher Snake	*Pituophis melanoleuchus*	U
Pacific Rattlesnake	*Crotalus helleri*	U
Ringnecked Snake	*Diadophis amabilis*	R
Western Toad	*Bufo boreas*	U

C = Common, O = Occasional, U = Uncommon,
R = Rare or very inconspicuous.

The Familiar Mammals

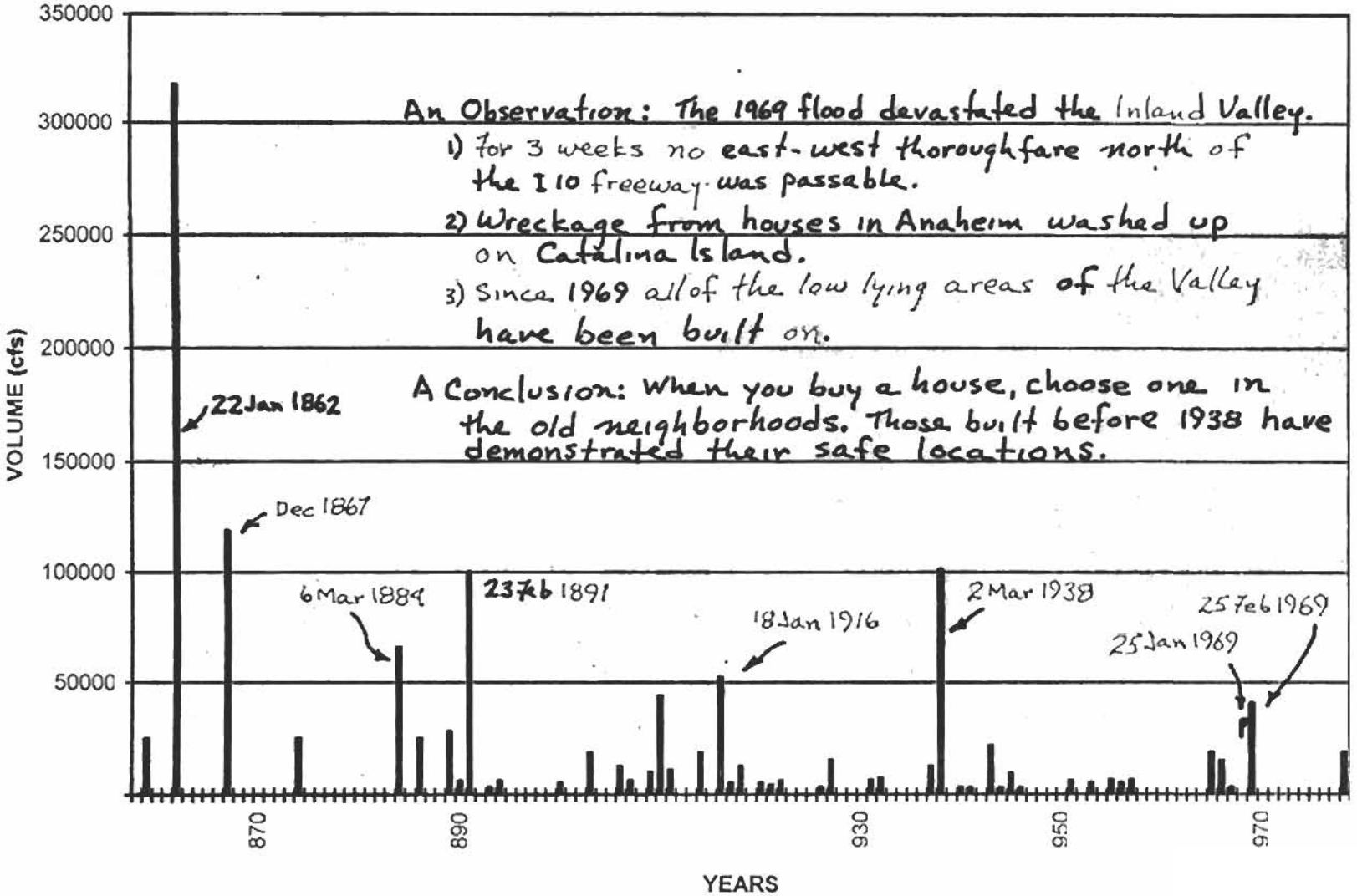
San Bernardino Kangaroo Rat	*Dipodomys agilis*	C
Desert Woodrat	*Neotoma lepida*	C
Dusky-footed Woodrat	*N. fuscipes*	O
Brush Mouse	*Peromyscus eremicus*	C
California Mouse	*P. californicus*	U
Valley Pocket Gopher	*Thomomys bottae*	C
Coyote	*Canis latrans*	C
Gray Fox	*Urocyon cinereoargenteus*	U
Raccoon	*Procyon lotor*	U
Striped Skunk	*Mephitis mephitis*	U
Spotted Skunk	*Spilogale putorius*	U
Cottontail Rabbit	*Sylvilagus auduboni*	C
Long-tailed Weasle	*Mustela frenata*	U
Southern Grasshopper Mouse	*Onychomys torridus*	U

C = Common, O = Occasional, U = Uncommon.

In addition to these species perhaps 10 species of bats occur on the campus. A number of very inconspicuous species have not been listed. There are records of species on the campus that are now extinct here due to the loss of the chaparral habitat between the campus and the foothills. They include; Bobcat, Mountain Lion, Badger, Black Bear, Mule-tailed Deer, California Meadow Mouse, and the Gray Squirrel.

Prepared by Jim des Lauriers,
Aug 1999.

RECENT FLOODS, SANTA ANA RIVER



LYME DISEASE IN CALIFORNIA

Ticks are an unpleasant but inevitable pest for every field biologist. They hang on bushes or grass waiting for a host to walk by. When they get on you they walk around until they get under your clothes where they bury their head in your skin and fill up with blood. Remove them when you see them. Be aware of your comrades' body surfaces and do some mutual grooming. Check your own body with some care soon after returning from the field.

One tick in California carries a spirochete bacterial disease called Lyme Disease.

THE CARRIER: The Western Black-legged Tick is the only tick out of the 49 species in California that is known to transmit Lyme disease to humans, primarily from mice, packrats and deer. The tick is about 1/8 inch long before feeding.

THE RANGE: A low percentage of the ticks tested so far (1995) are found to be carriers, but the tick's range in the state is wide. It can be found on grasses and brush in both urban and rural areas, and are most common in the humid coastal areas and on the western slope of the Sierra Nevada range. The tick does not occur in the arid parts of the Central Valley or in the deserts but a small number of cases have been reported from the San Bernardino mountains.

AVOIDING CONTACT: Wear long pants and long sleeved shirts. When hiking, tuck pants into boots or socks and shirt into pants. Use an insect repellent that is effective against ticks. Avoid contact with brush (not an easy suggestion to follow when you are working in the brush).

If bitten, pull out the tick promptly with tweezers **so that the mouth parts are removed** from your skin.

SYMPTOMS OF LYME: Spreading rash accompanied by flu-like symptoms and aches. Long-term possible complications may include disorders of the heart or nervous system, as well as severe arthritis. A blood test is needed to make a diagnosis. f you have been bitten by a tick, consulting your physician is certainly prudent.

TREATMENT: Antibiotics during the early stages can cure the infection, but may not always be successful in the later stages of the disease.

SOURCE: California Department of Health Services.