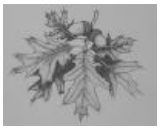
CHAPTER SEVEN



PLANT COMMUNITIES

The very earth itself is a granary
Henry David Thoreau

WHAT IS A COMMUNITY?

A community is a group of species living in the same environment that are interdependent and mutually sustaining, while fixing, utilizing, and dissipating energy. In more general terms, we can think of a community as an association of interacting populations. When speaking of the interactions between organisms and their environment as part of the classification of natural systems, the term "ecosystem" is often used.

Among the species that make up any community, a small percentage may exert a dominant role. Usually plants are the dominant producers in a community and therefore have the largest effect on the total species composition. Thus, it is usual to define communities on the basis of their dominant plants. Since the term "community" may be applied to almost any group of interacting populations, definition by dominant producer does not always work. Some communities are defined by other criteria, such as physical substrate, i.e. riparian community or serpentine community. Nevertheless, one of the most useful ways of thinking about natural systems is to think in terms of "plant communities."

Scientists classify communities in different ways: some view the plant community as a kind of super-organism, others view the plant communities as the result of each species independent distribution along a gradient of its own and finally, some botanists deny the concept of plant communities altogether.

Plant communities are a useful way to talk about natural areas, however, exceptions abound. At Jasper Ridge there are many disturbed areas, and maintenance of trails and fire roads keeps some areas in an early successional state. The Preserve also has many boundaries between communities and areas with small isolated patches of different communities.

INTRODUCTION TO THE PLANT COMMUNITIES IN THE PRESERVE

Within its approximately two square miles, it is thought that the Jasper Ridge Biological Preserve contains representatives of 82 of the 162 vascular plant families that grow in all of California's 158,693 square miles. The Preserve also contains seven of the ten plant communities, which exist in the Coast Ranges of Central California. The only communities missing are those associated with the coast—the coastal strand (vegetation of beaches and sand dunes), saltwater marsh, and coastal scrub. Many coastal scrub plants do occur in the Preserve as components of other communities.

When counting the plant communities frequently more than seven are mentioned. Here, roughly in order of decreasing water availability, are seven plant communities and some of their sub-communities, with other names and complications.

- **The lake** is a community but does not count as a plant community. It is also called a fluctuating reservoir
- **Fresh Water Marsh** Also part of a fluctuating reservoir.
- **Streambank Vegetation** The area along San Francisquito Creek below the dam is a classic riparian woodland except in the areas of redwood stands. The area south of the marsh is probably better termed recent riparian and is also subject to fluctuating water levels.
- **Redwood Forest** Better called redwood stands. Douglas fir grows intermingled with the redwoods. Also called moist coniferous forest.
- **Mixed Evergreen Forest** Also called broadleaf evergreen forest.
- **Foothill Woodland** Now generally called oak woodland in the Preserve, also called open woodland.. Sometimes the blue oak woodland is discussed as a separate community.
- **Chaparral** Some authors class pure chamise chaparral as an association separate from mixed chaparral. Some chaparral in the Preserve grows on serpentine and is referred to as serpentine chaparral. Some of the most interesting studies in the Preserve have been done in areas that look very much like northern coastal scrub. Some people consider northern coastal scrub a transitional community in the Preserve and call it soft chaparral, which is what mixed chaparral is called.
- **Grasslands** There are two types of grasslands, serpentine grassland and what we refer to as nonserpentine grassland. The nonserpentine grassland is subdivided into that with a greenstone substrate and that with a sandstone substrate..

CHAPARRAL

GENERAL DESCRIPTION

Walking through the chaparral on a sunny spring day is an olfactory experience with the fragrance of some chaparral shrubs almost overwhelming

The word chaparral is derived from Basque *chabarra*, a scrub oak growing in the Spanish Pyrenees. The Spaniards reaching southern California called the brushy hill vegetation *chaparro,* even though oak was not the dominant species. Californians then called it ch*aparral,* meaning the place where *chaparro* grows. Today, the word *chaparro/a* is used to describe someone of short stature in Mexico.

Similar forms of vegetation can be found in many other areas of the world where Mediterranean climate prevails. In France it is called *maquis*, in Chile *matarral*, in South Africa *fynbos*, and in South Australia *mallee-scrub*. These areas, like much of coastal California, have between 300 and 600 mm average annual precipitation, primarily during the mild winters. The long summers are sunny, hot, and dry.

Most of the woody species found in the chaparral grow only in western North America, suggesting that they evolved here. These plants originated as an understory in woodlands during the Pleistocene era and evolved tolerance as the climate gradually changed to summer drought. Fire was important in shaping the chaparral during the last two million years. Chaparral communities cover approximately six percent of California.

TYPES OF CHAPARRAL

The chaparral in the Preserve is dominated by chamise, *Adenostoma fasciculatum*, a one to two meter tall shrub with small needle-like leaves and interwoven branches. Other shrubs: buckbrush, *Ceanothus cuneatus*, brittle-leaved manzanita, *Arctostaphylos tomentosa*, mountain mahogany, *Cercocarpus betuloides var. betuloides*, holly-leaved cherry, *Prunus ilicifolia*, and toyon, *Heteromeles arbutifolia* are found associated with the chamise. All of these species are evergreen, winter active, and summer dormant. They are sclerophyll (hard-leaved) and well adapted to the Mediterranean climate.

Along the borders and in disturbed parts of the chamise chaparral, other species establish populations. These plants are lower in stature, less woody, not very long-lived, and often deciduous. This successional or "soft chaparral" includes sticky monkeyflower, *Mimulus auiantiacus,* California sagebrush, *Artemisia californica,* coyote brush*, Baccharis pilularis,* yerba santa*, Eriodictyon californicum,* California broom, *Lotus scoparius,* and the ever-present poison oak, *Toxicodendron diversilobum*.

A third type of chaparral is found on serpentine soils and includes leather oak, *Quercus durata*, which is endemic on serpentine soil. This type of chaparral is more open, lower, and looks more depauperate than the chamise chaparral, as might be expected on such difficult substrate.

Chaparral covers the sunny south- and west-facing slopes of the Preserve, where the soil is nutrient-poor and often shallow with low water-holding capacity. It grows on the steep hot slopes little else can survive and is therefore a superb watershed cover. The deep roots hold the soil and prevent it from sliding during the winter rains.

Most chaparral has little or no understory. However, the first rainy season after a chaparral fire, huge numbers of seeds germinate and grow. What prevents seeds from germinating during other rainy seasons? Chaparral shrubs are dense and less than half the sunlight reaches the ground, but still there is enough for seeds to germinate. The moisture content under mature chaparral is typically higher than after a fire when the sun heats the bare ground and the seeds readily germinate. Many seeds are stimulated to germinate by temperatures of 70^{o}C and higher either by direct intense sun or fire while other seeds, specifically*, Adenostoma* are stimulated by charred wood. However, there remain many other seeds that will germinate with only water. This forces the question of why the barren ground? One possible answer is allelopathy, a process by which plants produce compounds known to inhibit germination of seeds. Experiments have indicated that nonnative species such as *Bromus* and *Avena* (also *Festuca)* were inhibited. None of these grasses, however, grow in the chaparral. In contrast, when 30 species that typically emerge after chaparral fires were tested, only three were inhibited and only with concentrated leachate; eight other species were stimulated possibly by nitrogen. (Keeley et al. 1985) Furthermore, the toxins believed destroyed by fire, appear to be increased after a fire.

Another explanation is that the chaparral is a sheltered habitat for a large number of birds and small mammals that eat available seeds and seedlings and maintain a "bare zone" along the border between the chaparral and the grassland. Even the harvester ants can remove a sizable cache of preferred seeds like ceanothus. After a fire, surviving rodents are forced to move to other shelters, perhaps giving seedlings an advantage.

DROUGHT ADAPTATIONS IN THE CHAPARRAL

In general, chaparral plants are deep rooted, enabling them to reach water sources, but they also have shallow roots to utilize water near the surface after rain. This is especially true of the species that re-sprout after a fire. Conversely, those species that die in fires and must recover via seed have less of a taproot and shallower roots. Davis and Mooney (1986) determined in the serpentine chaparral that *Quercus durata* had the deepest roots, *Rhamnus californica* the shallowest, while *Adenostoma* and *Heteromeles* had roots somewhere in-between, The shrubs are sclerophylls, and have adapted to annual drought conditions. Often the leaves are small, even needle-like, and can be hairy or have a waxy coating, as well as light green or gray in color to reflect the light. Some species permanently orient their leaves vertically, thus reducing the area reached by the sun. Others have 'sunken stomata', which provide a boundary layer of moist air. All these characteristics reduce water loss.

Fire is a major factor in the evolution of chaparral communities. Fire dramatically reduces invasive plant populations that are not adapted to withstand fire, stump sprout or repopulate from seed after a burn. Historically, chaparral was ignited by lightning and burned with an irregular frequency of 20-40 years before human intervention. The shrubs burned above ground, returning nutrients as ashes to the soil, removing the duff, and increasing the light. Many species of chaparral shrubs re-sprouted from the surviving roots, which had thickened burls with latent buds and a long taproot. Others species regenerated from seeds triggered by the heat or charred wood. Many of the seeds from chaparral plants, including annual forbs, retain viability for decades. These seeds are dormant in the ground, resistant to fire and need heat-shock to provoke germination.

In the first years after a fire, the ground is covered by annuals not seen since the rejuvenation period following the previous fire. With time, the shrubs increase in stature and are large enough to dominate the community. Ten years after a fire, the chaparral community is basically restored to pre-fire appearance.

There has not been a chaparral fire in the Preserve in recorded history. The fuel load of dead branches decomposes slowly in the dry climate and creates a significant fire hazard. Annual controlled burning of small parcels of the chaparral would make interesting study areas, but until a burn can be initiated with extreme confidence for control, it is not likely that the chaparral will be the subject of a research burn. In 1999 and 2001, successful controlled burns were initiated on grassland along the SLAC corridor and it is hoped that successive opportunities for controlled burns in the same locale will provide much needed information in fire ecology.

HARD CHAPARRAL

Chamise, *Adenostoma fasciculatum*, is the most common shrub of the hard chaparral community. It has small, hard needle-like leaves with stomata all around. The leaves contain toxic compounds. Chamise flowers in the spring. After fire or cutting, the shrub

stump-sprouts. Seedlings are rarely found between fires because the seeds need heat to germinate.

Manzanita, *Arctostaphylos tomentosa,* produces fruit that looks like small apples (*manzana* is apple in Spanish). The leaves are light-colored and can orient to minimize heat absorption. This species stump-sprouts after fire, but some *A.* sp. recover only from seed.

Buckbrush, *Ceanothus cuneatus,* has aromatic white flowers and small, shiny, green leaves. Jim brush, *Ceonothus oliganthus var.sorediatus* has lavender flowers and is not as drought-resistant.

Toyon*, Heteromeles arbutifolia,* is also called Christmas berry because of the red berries it produces in the fall. Toyon stump-sprouts after fire.

Leather oak, *Quercus durata*, has small convex leaves, and is endemic on serpentine soil in the Preserve. Leather oak is deep-rooted and does not respond immediately to winter rain, but can remain active into August when other shrubs are dormant. Acorns of leather oaks do not survive fire. Leather oak's recovery method after fire is stump-sprouting.

Holly-leaved cherry*, Prunus ilicifolia*, has shiny leaves with wavy, spiny edges much like a coast live oak. Bruising a leaf will produce the fragrance of bitter almond.

Mountain mahogany, *Cercocarpus betuloides,* has small green "striped" leaves that can easily be identified while bearing seeds in late spring. Each seed has a feather-like elongated style and is transported by wind. Seeds are destroyed by fire and the shrub must stump-sprout to recover.

SUCCESSIONAL SPECIES

Sticky monkey flower, *Mimulus aurantiacus,* is the food plant for the *Chalcedona* butterfly larvae. The plant name is derived from the Greek word for smiling face, which is thought to be visible in the yellow flower. In late summer, the surviving leaves become dry and leathery, with only the tip remaining green and performing photosynthesis.

California sagebrush*, Artemisia californica,* has delicate gray foliage, is soft to the touch and extremely aromatic.

Yerba santa, *Eriodictyon californicum,* is often covered by a black fungus, *Heterosporum*. In spring, new plant growth protect itself chemically from the fungus and remains green for a few months. Yerba santa's lavender flowers are nectar sources for many butterflies.

Pitcher sage, *Lepechinia calycina,* is intensely aromatic. The name is derived from the shape of the flower, which resembles a pitcher.

THE NON-SERPENTINE GRASSLAND

GENERAL DESCRIPTION

At first glance, the non-serpentine grassland can be described as a vast expanse of grasses which sprout in late fall. The grasses are tall and green in spring, golden by summer, and are interspersed with isolated clumps of oaks, bay trees, poison oak and *Baccharis.* This landscape, combined with the expansive vistas of the San Francisco Bay

and the local mountains, can evoke the feeling that this must have been the way it was before the Europeans arrived—but it wasn't.

In actuality, non-serpentine grassland is the Preserve's youngest terrestrial community. The grasses are primarily exotics from the Mediterranean; invasive species that cannot tolerate the harsh serpentine environment, but thrive and displace natives on more fertile soils. This community is distinguished by having the fewest native plants of any on the Preserve. In February of 1984, Hal Mooney estimated that 98 percent of plant species in the non-serpentine grassland were exotics. Ornduff (1974) suggested that invasion of California's grasslands by exotics changed the appearance of much of the state. He believes that 200 years ago, the summer hills of California were the gray-green of perennial bunch grasses and not the "gold" of dry Mediterranean annuals.

COMMON PLANTS

Aside from the isolated stands of bay and oak, and the few invasive shrubs in this community, most of non-serpentine grassland plants are annuals. A few are bulbous or stolonaceous perennials. Most common are grasses in the genus *Avena* (wild oats). In early May, a close look at an *Avena* inflorescence reveals stamens protruding from purple-tipped lemmas and bearing bright yellow pollen. Later, isolated seed heads may be covered with a black fungus. By late May, most of the spiky *Avena* seeds are dispersing in the fur, feathers, socks, boot laces, and butterfly nets of passing animals. Cattle and horses can eat *Avena* species, but other imported grasses are less desirable. For example, the aptly named, ripgut grass, *Bromus diandrus,* is harmful to cattle, and the farmer’s foxtail, *Hordeum murinum*, works its way into the ears and between the toes of dogs.

Some native plants do well in the non-serpentine grassland; mule ears, *Wyethia,* and mariposa lilies, *Calochortus,* both flower there in the spring. Farewell-to-spring, *Clarkia,* flowers as the grasses dry and isolated stands of milkweed, *Asclepias,* attract monarch butterflies and tarantula hawks. Nonnative forbs are also common; including Italian thistle, *Carduus,* yellow star thistle, *Centaurea,* and teasel *Dipsacus.*

During the summer drought, green plants persist; bird's beak*, Cordylanthus,* yampa, *Perideridia* and resinous tarweeds, *Hemizonia,* all thrive in the non-serpentine grassland. A native perennial grass, purple needlegrass, *Nassella pulchra*, is found there as well as on the serpentine.

COMMON ANIMALS

Although most of the plants are exotic, almost all the animals in this community are native, and many are found in the serpentine grassland and other plant communities.. One exception is the European honeybee (*Apis mellifera).* Two trees (an oak and a bay) in the non-serpentine grassland have sheltered feral honeybee colonies, although it is not certain that they are still present.

Small tunnels through the grass lead to underground burrows where short-tailed voles, *Microtus californicus,* spend most of the daylight hours. Brush rabbits, *Sylvilagus sp.* can sometimes be seen as they venture out beyond the bare zone into the grassland.

In most areas of non-serpentine grassland it is possible to see blacktailed deer, *Odocoileus* and to locate "beds" of crushed grasses where they have rested. In the autumn, broken, scarred branches of trees and shrubs indicate the presence of bucks that

have rubbed the velvet from their new antlers. In late spring and summer, the Acmon blue butterfly, *Icarica acmon,* hovers around its favored larval food, a delicate pink-flowered legume, *Lotus purshianus*.

Pocket gophers, *Thomomys bottae,* plow the soil in both serpentine and non-serpentine grasslands, digging burrows and feeding on roots and stems. Their tunneling aerates the soil, but by midsummer entire plots are bare as a result. Common predators are bobcats, *Felis rufus,* coyotes, *Canis latran,* and gray foxes, *Urocyon*.

Although (puma) mountain lions, *Felis concolor,* have been sighted upon occasion in the grassland, large predator sightings are rare. Their presence is primarily verified by tracks, scat, signs and evidence/bones left from kills.

Unfilled excavations indicate foraging by predators.Excavations in very late summer and fall are often surrounded by the broken nests of paper wasps. Striped skunks, *Mephitis,* are among those reported to feed on the unguarded late larvae and pupae of dying wasp colonies.

Gopher snakes, *Pituophis,* western rattlesnakes, *Crotalus viridis,* and common king snakes, *Lampropeltis,* are often seen in the non-serpentine grassland, as well as "sign" including shed skins.

Throughout the year, dragonflies, patrol both grasslands for their food, which is other insects. During most of the year, the California ringlet butterfly *Coenonympha California*, flutters in low bouncing flight, looking like a nondescript moth. *Coenonympha* larvae feed on grasses, particularly any perennial grasses that have survived the invasion of the exotics.

During the summer, the orange-winged, "metallic bodied" tarantula hawks, search both grasslands for tarantulas, their prey, and can be observed pausing to take nectar from milkweeds. In late summer, when abundant grasshoppers provide prey, orb-weaving spiders hang their snares between grass stalks. Some spiders weave stalks together to hold their egg cases. Many spiders abandon their eggs, but some species remain to guard their offspring. Dr. Irene Brown once observed a green lynx spider, *Peucetia viridans,* guarding her egg case; returned a week later to find the spider still there and finally returned a third week to find the spider guarding her hatchlings.

Meadowlarks can be seen and heard in both grasslands and ash-throated flycatchers perch on *Baccharis* bushes. Swallows fly overhead, and still higher, kestrels with bluish-gray wings hover and dive for insects, their most common prey; not small birds as their common name "sparrow hawk" implies. .

ISSUES AND OTHER POINTS OF INTEREST

Why the awkward name "non-serpentine grassland" for this community? In 1968, McNaughton wrote about the Preserve grasslands as though they were grown on either serpentine, or sandstone soils. This is <u>not</u> accurate. Only a thin band of sandstone grassland exists at the Preserve (NE of the serpentine). Most of the non-serpentine grassland at the Preserve is S and SE of the serpentine, and grows on soils derived from greenstone, shale, chert, etc.

Avena and *Centaurea* species now dominate the grasslands and make its hillsides green and golden. Just how long *Avena* and its fellow invaders have been here is uncertain. According to Ornduff (1974) the first Mediteranean weeds were here in time for their seeds to be imbedded in adobe bricks made before 1769 when the Mission

period began. *Avena* was certainly here by 1824 when the Mission period ended. Some say the first weedy invaders arrived on the feet and feathers of migratory birds in the early 1500s carried from Spanish conquests in South America. With the Missions, Presidios, and then the Gold Rush, came cattle with seeds in their hooves, and hay. Some believe the final conquest of California's non-serpentine grasslands by exotics happened in the 1850s, following overgrazing and a three year drought.

Why is the top of Jasper Ridge covered with grassland? Was it always that way? One hypothesis is that the soil there is too porous and shallow to hold enough water for most deep-rooted perennial plants to become established, leaving only grasses to survive. Whatever the reason, the pattern is repeated throughout California—grassy hilltops with chaparral and woodland covered sides.

We do not know how this community of imported grasses and herbs has maintained itself on top of the ridge, or if it will continue to do so. We do not know what grew on these soils before. Perhaps the area was covered with native bunch grasses and resembled the serpentine grassland—perhaps it was covered with shrubs, and resembled chaparral. Several lines of evidence point to the last; i.e. shrubs are invading, and there is evidence that the land was once cleared.

Since 1968, the poison oak "islands" in the grassland have grown larger, and new stands of *Baccharis* have appeared. Can the non-serpentine grassland continue to maintain itself, or will it turn into chaparral or woodland? One research project found that the *Baccharis* invasion actually began in the 1940's. Most of the new plants there now got their start during the 1981-82 El Niño years of unseasonably late rainfall.

Perhaps the top of the ridge was brushland when Europeans arrived, and they cleared it for agriculture. A 1922 aerial photo of the area near the Escobar gate shows a straight line where brush had obviously been cleared on the Preserve side. Mysterious furrow-like ridges can be seen in some aerial photos of the grassland (and from certain vantage points on the ground) suggesting that some form of agriculture was once practiced there. Wheat may have been grown, or some sort of orchard. We do know that cattle were grazed on both the serpentine and non-serpentine grasslands for many years.

On the other hand, perhaps the area now occupied by the non-serpentine grassland was maintained by the local Native Americans with fire. According to Pyne (1982) the Costanoan people used seasonal fires to maintain many grasslands in California.

Cattle have left a mysterious legacy in the grassland; under certain oak trees where they rested grow clusters of exotic milk thistle (*Silybum marianum*). Clusters of thistles under oaks are seen elsewhere on Stanford lands still grazed by cattle.

The serpentine and non-serpentine grasslands provide rich research opportunities because most of the plants are annuals. Dominant plants in the chaparral are twenty to thirty years old or older, while dominant plants in the forest are maybe hundreds of years old. Dominant plants in the grassland are annuals, and produce a new generation each year for researchers to study.

DISTRIBUTION AND DIVERSITY OF THE PLANT COMMUNITIES IN THE PRESERVE

The state of California contains a great diversity of plant communities. Munz and Keck (1959) list 29, ranging from coastal strand through sagebrush scrub to sub-alpine

forest and alpine fell-fields. In the state and locally in the Coast Ranges, there is an exceptionally high number of species of plants. There are approximately 1,800 species of vascular plants in the Santa Cruz Mountains and only about 2,000 in all of England. The explanation for the large number of plant communities in the state as a whole seems to be the great climatic diversity that ranges from desert conditions to temperate seashores to high alpine areas where there is frost every month of the year.

This diversity of plant communities is also evident at Jasper Ridge Biological Preserve. The reason for this diversity cannot be the same as for the state as a whole, because the entire ridge is exposed to the same macroclimate. The explanation must lie in small differences in microclimate, in soil, and in the past history of the area. Some of the plants may be left over from communities that were widespread in the area in the past when the climate was different. Fire may have played a role, and perhaps chance in the form of accidental dispersal of seeds by birds. Human intervention has also played a role; the lake, marsh, and recent riparian areas of the Preserve all result from the building of the dam and its use in water management. Grazing and logging have also had their effects on the plant communities in what is now JRBP.

The effects of micro-climate are shown in the distribution of the communities on the ridge. The broadleaf evergreen forest and the redwood stands are on north-facing slopes. The south facing slopes of the ridge have chaparral; thus the most drought-adapted community is on the hottest side of the ridge. More studies are needed in the Preserve to explain the abundance and distribution of communities. Studies of microclimate and soil substrates need to be correlated with studies of vegetation types.

COMMON PLANTS OF SEARSVILLE LAKE

Algae form floating mats at certain seasons. American water fern, *Azolla*, duckweed, *Lemna spp* (one of the smallest flowering plants), and parrot feather, *Myriophyllum* are also found on the lake surface. Hornwort, *Ceratophyllum,* may also be seen when lake water is low. Rushes, cattails, and tules thrive at the lake edge.

COMMON ANIMALS

At certain times in spring, the water flea, *Daphnia,* may be the most abundant animal in the lake. It is possible to observe hundreds of these tiny crustaceans in a single glass of water. Exotic crayfish are common and are fed on by exotic largemouth bass who also eat exotic sunfish. The green sunfish prefer to hide in *Myriophyllum* when they are small, while black crappies and bluegills prefer *Polygonum*. Brown bullhead, hitch, and mosquitofish are found in the lake. Many aquatic birds use the lake as a stopover site during migration. Great blue herons fish along the shore, and double-crested cormorants can be seen drying their feathers perched on snags near the shore. Coots, pied-billed grebes, and mallards can almost always be seen floating and feeding. Violet-green swallows and barn swallows swoop low over the lake to eat winged insect. There is almost always a black phoebe flitting out from its perch near the dam to catch an insect and then returning to watch for its next prey.

THE LAKE'S FUTURE

The lake is teeming with microscopic life; bacteria, protozoa, larvae of many insects, eggs of frogs, etc. which are not easily seen but are important in the food chain. Two mollusks are found in the lake. The fresh water clam is only seen in years when the water level gets very low in the summer. An introduced snail, *Viviparus* lives below the surface of the lake because it cannot breathe air. Birds feed on it and its shells are frequently found around the edge of the lake.

The future of the lake is uncertain. If conditions are allowed to remain as they are, the lake will silt in completely, undergo succession and become a meadow.

In the past, the lake has been the site of much research. In the 1930's, after the lake became heavily used for recreation, research became impossible. Heavy doses of herbicides were used to kill waterweeds and Stanford limnology classes stopped their field trips when there was nothing left of interest in the lake.

Water quality testing and biotic surveys have been part of ongoing research at the Preserve since 1997 or earlier. This research and data provides a baseline of information about species diversity, exotic populations and basic water quality such as dissolved oxygen content, pH, and conductivity levels.

There are many issues regarding the lake and the watershed. One is the long-term management of Searsville Dam. Decisions regarding the fate of Searsville Dam require assessments developed from baseline surveys and continued monitoring, and represent a unique opportunity for research on the ecological, hydrological, and technological criteria and consequences of dam removal.

Challenge Questions

1. Briefly define an ecosystem. Think about all of the combinations of boundary areas between two ecosystems. Give examples of plants and animals that are primarily in these boundary areas. Give an example of how a boundary could extend due to global warming. What other causes result in movement of boundaries between ecosystems.

2. What are vernal pools? Where can they be found on the Preserve? Name 3 species that are dependent on vernal pools.