Ecology of a Terrestrial Environment
Torrey Pines State Park

INTRODUCTION

Ecology is the science that deals with the interrelationships between organisms and their physical environment. Organisms include plants, animals, bacteria and fungi. The environment includes the physical and chemical factors that influence their success. Some of these factors are soils, wind, rainfall, fog, temperature, salts, and sunlight exposure.

The Torrey Pines State Reserve is a unique vegetational complex mainly because of the tree for which it is named. This pine is naturally found only here at the State Preserve and on Santa Rosa Island off the coast of Santa Barbara. The tree was discovered as a new species in 1850 in San Diego, and the Island population was discovered in 1888.

San Diego City set aside 369 acres in 1900 to protect these trees, as firewood was scarce near the town. In 1910, Miss Ellen Browning Scripps purchased additional land on the North end, including some of the best specimens of Torrey Pines and added them to City acreage. Miss Scripps was instrumental in setting up this area as a plant preserve along with Mr. Guy Fleming who served as caretaker and naturalist for many years in the Reserve. In 1924, the City added some additional land including marshlands and adjoining cliffs to bring the Park up to about 2000 acres with about five miles of natural ocean frontage.

PHYSICAL DESCRIPTION

The steep weather worn cliff face is composed of sedimentary layers that were once under the sea as bay bottom, sand bars or above water coastal sand dunes. You can observe the layers by standing at the base of the cliff or you may obtain information on the geology at the information center along the Guy Fleming Trail.

The soils in the Park are shallow, sandy, and generally lacking in organic content. They range from loose sandy sediments to highly compacted shales, and some have a slight layer of litter (dead plant material). The color indicates the relative organic content, with the darker soils being richer than the loose light colored soils.

The ocean influences the coastal temperature by keeping extremes to a minimum. The activity of waves not only wears away at the cliff face but also sprays moisture and salt into the air, which then falls on the surrounding terrain. The wind, flowing from the sea, provides both a cooling and a drying effect. The competition for moisture is influenced by slope exposure, wind exposure and on the development of upper story plants. The area around Torrey Pines receives about the same amount of rainfall that the adjacent coastal areas receives, but it is supplemented by fog.

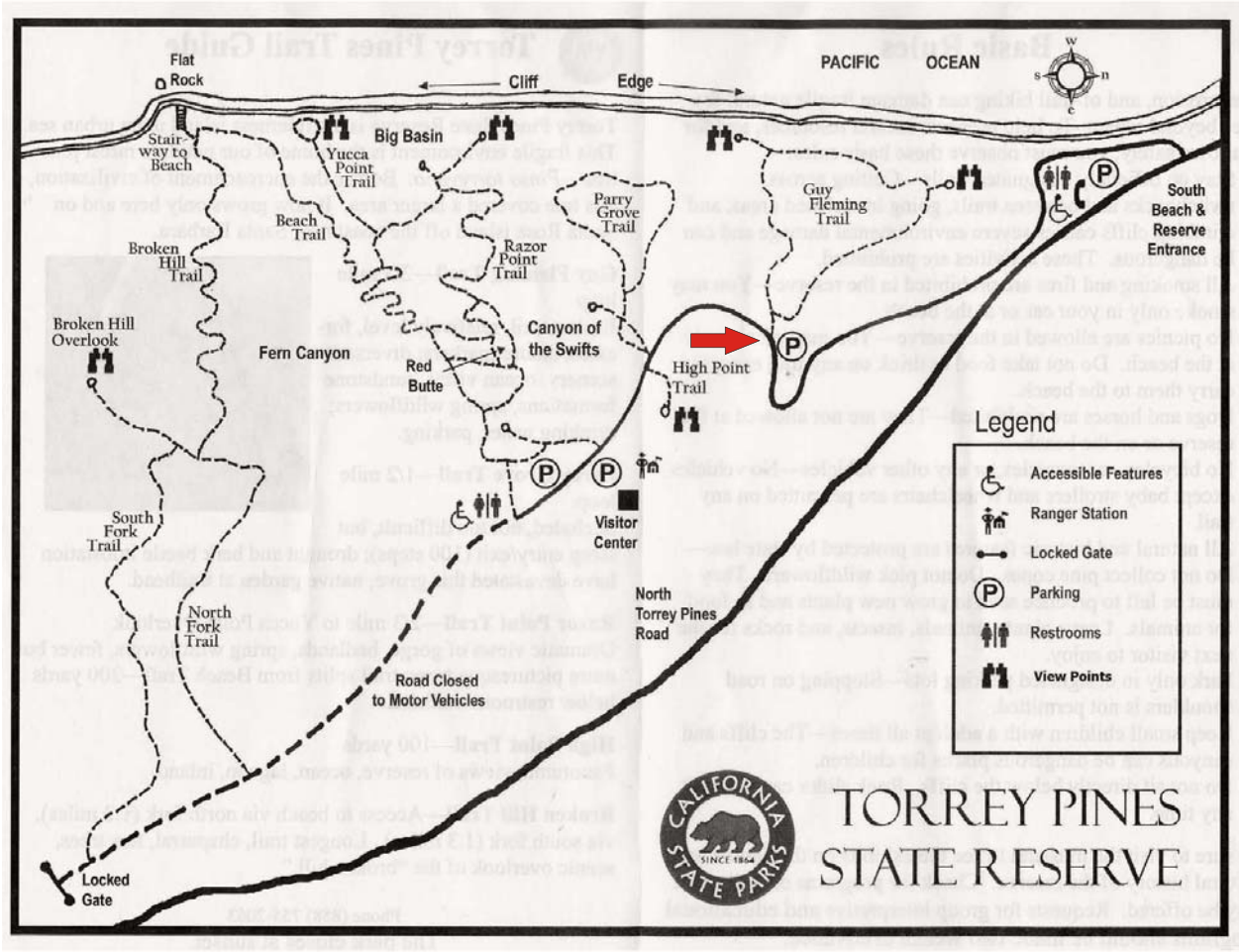
THE VEGETATION

The sea cliff is a harsh environment. Soils are nonexistent, a foothold in the loose sands is difficult to establish, and moisture retention is low. Still there are a few plants capable of surviving these conditions such as sea cliff buckwheat, sea fig, and a few cacti. Some plants, such as the peas, deerweed, and lilacs, are important manufacturers of nitrates, an essential nutrient for plants.

The protected bluffs are more hospitable to plant life supporting the pines and plant complexes of chaparral and coastal sage scrub. The chaparral plants are densely clustered, uniform in height, with dense rigid branching. Their leaves are evergreen (retaining year around), thick, often waxy and usually small. The coastal sage scrub is found in more open stands than the chaparral. The coastal sage scrub plants are usually shorter lived, less woody having thinner and softer leaves, and are often aromatic.

Guy Fleming Nature Trail (North Grove)

Take the first nature trail on the north west side of the park. It includes some of the best stands of Torrey Pines in the Reserve. You must first pay for admission at the ranger station if there was no attendant at the gate. You can drive back to the trail head and park.



The Guy Fleming trail makes a loop from this display. Going directly west you travel along the north side of a canyon, then out onto the top of the exposed bluff, and next back behind the hill on protected bluff and finally returning back to this point.

Observations are made in reference to the Park Services' sign posts. These sign post are about six inches high, and contain the description of a plant or region. The questions are answered by reading these signs or by observations made at the site. The questions and observations are arranged in order by following the trail in a clockwise fashion.

The more protected areas have many layers of plants. A layer consists of a group of plants occupying a distinct height. For example, grasses, small annuals and ferns make up a turf layer. Look around, how many different vertical plant layers or strata do you see? The tree canopy is the highest layer, grasses or moss would be the lowest layer.

_____

Toyon

Note the thick leathery leaves with toothed edges for this plant along the trail. The winter time find this plant adored with bright red berries, giving it the nickname as California Holly.

The hills above Los Angeles at the north end were abundant with Toyon and give a section of Los Angeles the name of:

_____

Is this plant a member of the chaparral or coastal scrub?

_____

Coastal Cholla

Coastal cholla is common in lower elevations along the coast. It usually attains a height of about three or four feet. The succulent stem in jointed; each joint is characterized by small bumps that bear very sharp spines located in specific regions called areoles. Note the absence of leaves, although they may occur in immature plants. The stem joints are easily detached and often root to form new plants.

Reddish flowers about one inch in diameter are produced in late spring. The greenish fruit may remain on the p1ant for several years, with additional fruit and flowers produced by the retained fruit.

There are three kinds of cactus: the cane cactus, the pad cactus, and the barrel cactus. Which group of cactus does **Coastal Cholla** belong?

_____

Black Sage

The aromatic black sage grows to about four feet in height, but is much more shrubby in appearance. The medium-green leaves are about two inches in length, about ha1f the size of the leaves of the white sage. The leaves also appear quite roughened on the upper surface. It grows on dry hillsides and mesas below 2,000 feet, often in association with more dry adapted chaparral species. Like the white sage, this species is also an important source of nectar for the manufacture of honey.

Describe the leaf arrangement and shape of the stem of **Black Sage.**

Leaf Arrangement_____

Stem Shape _____

Warty Stem Ceanothus (Lilac)

The coastal white lilac is found along coastal southern California and northern Baja California. This medium-sized, evergreen shrub, produces white, showy flowers from January through April. The leaves are small, about 1 ½ inch, rounded and thick. The stems are ridged, thick, and exhibit conical stipules which give this species a warty-stemmed appearance.

Why would this densly leaved plant be important to the watershed of a hillside?

_____

What nutrients could **Ceanothus** provide the soil (refer back to the introduction)?

_____

Laurel Sumac

This medium-sized shrub, common in the canyons and mesas, is often found in association with the chemise and, at lower e1evations, the yerba santa. Examine the leathery leaves of a representative of this species, noting their long, pointed, folded, and slightly curled shape. Young spring growth appears reddish in color. Clusters of white flowers at the tips of the branches are favorite sources of nectar for bees.

This plant is known for its aromatic odor. What could a possible function be for this smell?

_____

What is the adaptive advantage of the curled and folded leaf?

_____

The statement about Laurel sumac's distribution "might indicate that tropical plants such as avocados might grow there," indicates what about its temperature preferences?

_____

Holly-leaved Redberry

Redberry is an evergreen, alternate-leaved shrub that grows to a height of about six feet. The leaves are somewhat leathery, dark green, about ½ inch in length, and finely toothed on the margin. This plant grows on dry hillsides at lower elevations. The small red berries are edible. These plants found on the open wind swept areas are likely to wind burned.

How would you describe the condition of this plant (healthy, under stress) ?

_____

What parts of the plant could be consumed?

_____

Prickly Pear Cactus

The stems of the prickly pear cactus are flattened into pads that usually bear we11-developed spines. The characteristic thick, waxy cuticle reduces water loss from the plant surface. The cacti spines may repel grazers, create shadows on the stem, and serve as co11ection sites for droplets of water that may fa11 to the ground around the cactus.

The typica1 coastal prickly pear wi11 form a c1ump two or three feet high and severa1 feet in diameter. The pads are usua11y about seven inches 10ng and three to four inches in width.

Bright yellow flowers about three inches in diameter are produced in the early summer. Purp1e fruit about 1 ½ inches in length can be pee1ed and eaten raw or boiled to make syrup for je11y and candy. The pads can be stripped of their spines and boiled or pick1ed. Sp1it pads have also been used as a poultice for wounds.

Is this cactus a cane cactus, a pad cactus, or barrel cactus?

_____

A part of the cactus can be eaten. What part of the plant would be eatable?

_____

Spice-bush or Bush-rue

Spice bush is an aromatic, low-growing shrub that grows on the brushy mesas and slopes below 2500 feet. The bark is gray and the branches are flexible and finely divided. The dark green leaves are usually less than one inch in length, very narrow, and dotted with glands. The white flowers are about t/. of an inch in length. the fruit is about 1/4 of an inch in diameter and changes from a green to a reddish brown color when it matures.

The spice bush often grows beside the redberry, with which it can be confused. Compare the leaves of the redberry with those of the spice bush.

What is the difference between **Spice Bush** and **Redberry**?

_____

Is this plant a chaparral plant or coastal sage scrub plant?

_____

Lemonade Berry

The lemonade berry is found in association with scrub oak and toyon. The reddish, flat fruits can be boiled or soaked in water to produce a sour-tasting beverage. Note that the leaves appear to be thicker and larger than the leaves of the scrub oak. Fine serrations on the margin of the leaf are usually present.

How did this plant become known as **Lemonade Berry**?

_____

Is Lemonade Berry a chaparral plant or coastal sage scrub plant?

_____

Bush Sunflower (*Encelia*)

(If you miss this one, there are others further down the trail)
Bush sunflower is a yellow-flowered perennial common to the coastal bluffs and mesas to about 2,000 feet in elevation. The flowers have yellow rays with a dark purple disc and are about 2 ½ inches in diameter. The oval to elongate leaves are about 2 inches long and half as wide. California Encelia flowers in the spring from March through June.

Describe the condition of this plant._____

Is this plant a chaparral species or coastal scrub species?

_____

Torrey Pine

Torrey pines are restricted in their range to Santa Rosa Island and to the coastline of San Diego County near Del Mar. They are found on dry slopes exposed to high humidity and ocean breezes.

This species ranges in height from 20 to 60 feet and is about 1 to 1 ½ feet in diameter. The crown is open and rounded. The bark is about an inch thick, reddish brown, slightly furrowed and rough. The needles are about 7 to 12 inches in length and dark gray-green in color. The 4 to 6 inch cones are dark brown in color and may remain on the tree for several years.

Note the growth form on this wind swept cliff to compare with other exposed areas. Does this plant show any signs of wind or salt stress?

_____

What part of the pine was considered edible?

_____

East-west Canyon

Observe this windswept canyon running from the east to the sea cliff. Note the north facing side of the canyon and how it differs from the south facing side. You should be able to recognize a few of the conspicuous plants.

What plants seem to dominant the north facing slope?

_____

_____

What plants seem to dominant the south facing slope?

_____

What is the reason for the difference in the kind of plants growing there?

_____

Why are the **Torrey Pines** growing so close to the ground?

_____

What are the major limiting factors for survival in this canyon?

_____

Why are the **Prickly Pear Cacti** so abundant in the canyon?

_____

What is the means of dispersal for **Prickly Pear Cactus** plants?

_____

Shaw Agave (Look for this unique plant, with its thick Century plant like growth)
This species of century plant is restricted to a few locations around the coastal sea bluffs in the San Diego area. It has a short trunk with thick, fibrous, dark green leaves bearing red spines. It usually flowers during the winter and early spring with a large cluster of yellow flowers widely spaced on an upright flower stalk.

What do the blooms look like?_____

What seems to be the common method of propagation (reproduction) for the Shaw Agave? (Look around the base of the plant)

_____

Mojave Yucca

The Mojave yucca occurs on dry rocky slopes and mesas from the coast to the Colorado Desert at elevations usually below 5,000 feet. This species of yucca has often been called the Spanish dagger or bayonet because of its rigid, slender green leaves that are armed with sharp spines at their tips. The leaf edges have free marginal fibers that tend to curl slightly.

This perennial species has a distinct trunk, often grows to a height of about 12 feet and may exhibit some branching. Cream-colored flowers, often tinged with purple, are borne in clusters on a rapidly growing stalk.

The fibers obtained from the leaves were utilized by the Indians for a variety of purposes such as baskets, cloth, rope and thread. The fruit was eaten raw, cooked, or dried and stored for future consumption. The flower heads, stems and buds were also cooked. The fleshy root and the stem were pounded and softened to make a soap-like product.

Is the **Yucca** considered a chaparral or coastal sage scrub species?

_____

The **Yucca** provides a habitat for many insects and some lizards. Where on the plant would you think the habitats are located?

_____

Dead Pines
Look for the sign (see right).

What two factors caused the death of these pines in the mid 1960's?

a._____

b._____

If a pine normally protects itself from insect attack by releasing tar or resins, why are these two factors linked together?

_____

South Overlook

Take the trail to the South overlook (if it is open), where a view of the sea cliffs and ocean is available.

How many sedimentary layers can be seen in the sea cliffs?

_____

What is the major force in cutting away the sea cliff, rainfall, drainage or ocean?

_____

Gullies and erosional rills can be seen in the upper layers. Vertical erosional features are typical of dry climates and slanted erosional features are typical wet climates. What would these features suggest about the climate?

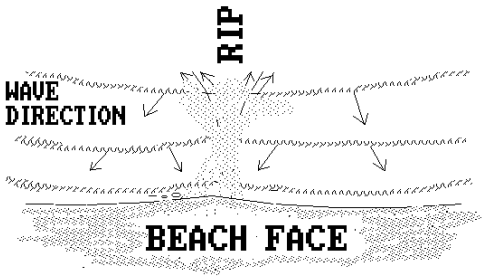
_____

One of the lower layers consists of rounded cobble stones. What does that suggest was the environment when those were laid down?

_____

_____

View the surf line from the overlook. Note the wave pattern as the surf forms on the beach slope (rip).



Are the wave patterns parallel with the beach face or are they coming in at an angle?

_____

Are any areas within the surf zone, show a disturbed wave pattern, with foam and suspend material moving away from the beach face that would suggest a rip current?

_____

What would happen to a swimmer if they happened to swim into one of these areas?

_____

Look out to sea, this is a good spot to see whales and sea birds. Take note of any sea birds or whales.

a. _____

b. _____

c. _____

d. _____

California Buckwheat

The California buckwheat is found on dry, rocky hillsides and mesas at lower elevations. It is a low-growing shrub with numerous spreading branches bearing small leaves in fascicles (bundles). The needle-like leaves are green on the upper surface and whitish on the lower surface. The tiny white-to-pinkish flowers are in clusters at the tips of leafless branches. Old flowers turn brown, giving the plant a rusty appearance. Buckwheats are important bee plants. The leaves and flowers were used by the Indians for a variety of medicinal purposes.

How is this plant adapted to the windy conditions of the exposed bluff (look at its growth form)?

_____

Describe the leaves of California Buckwheat.

_____

Coast Barrel Cactus

The barrel cacti of the coast are much smaller than those of the more arid desert environment. Representatives of this species are usually broadly oval, about ten inches in diameter and slightly broader than tall. The top of the cactus is slightly indented. They are found growing solitarily or in clumps on sandy or gravelly hillsides at lower elevations.

Strong ribs bear clumps of rigid spines that are straight or curved and vary from gray to red in color. The flowers, produced in late spring, are usually yellow green (often with some red) and about 1 ½ inches in diameter. The fruit produces a large number of seeds which were dried and ground into meal by the coastal Indians

How is this plant adapted for the hot dry, windy bluffs?

_____

Can you guess some early uses for the spines from this cactus?

_____

As you stand on these open bluffs and note the wind pruned nature of many of the plants. You might notice the lack of heavy chaparral vegetation to the east of the cliffs.

Why are there so few woody shrubs?

_____

During the early spring (unless this is early spring) this open area in filled with flowering annuals. What is the reason that these annuals are dominant on the exposed bluff, but not in the protected bluffs?

_____

Notice that a group of Torrey Pines survived the drought right along the sea cliff. What is different about this small stand that allowed that to occur?

_____

What indications are there that the Torrey Pine stand is coming back?

_____

Sea Cliff Buckwheat

Look for the sign (one of few that remain) for Sea Cliff Buckwheat. A relative of the more common California buckwheat, this species occurs on sand flats and coastal bluffs from central California to northern Baja California. The triangular-shaped leaves have undulating, under-turned margins, and thickly cover the stems..

What is the distribution of this plant?

_____

What kind of growth form makes it successful along the open coast?

_____

North Overlook

Why do the cliffs give way to an open sandy beach to the North?

_____

What effect has the coastal highway had on the open beach and the estuary behind?

_____

Scrub Oak

In Mexico it is customary to name a plant community for its dominant floral representative. Since the scrub oak (chaparro in Spanish) is often the dominant member of coastal plain vegetation, this vegetation has come to be known as chaparral.

Scrub oak is a large evergreen shrub with rigid and twisting branches. Its small stiff leaves have a waxy covering, and are armed with sharp spine-like lobes. In spring, inconspicuous chains of flowers emerge, which produce many acorns in the fall. These are eaten by coastal animals such as ground squirrels and scrub jays. Coastal Indians once gathered large quantities of these nuts which they ground into flour and leached with water.

Oak galls, sometimes called oak apples, also appear on oak branches in the spring. These are yellow and reddish globular structures, up to two and one-half inches in diameter. Galls are formed when a tiny female wasp lays an egg on a twig of the oak. The egg secretes a growth hormone-like substance which causes the plant to produce a pulpy, fluid-filled growth or gall. As the gall develops, it engulfs the egg; later, when the egg hatches into a larva, it uses the gall for food and protection. Finally, as the insect completes its life cycle to become an adult wasp, it bores a hole through the gall to escape. The gall wasp can reproduce itself only in this manner.

Scrub oak produces a thick and rich leaf litter, which serves to protect the soil, absorb moisture, and provide a micro-habitat for other invertebrates such as the centipede, millipede, and scorpion.

What was the Spanish name for this plant**?** _____

Black Sage

What is the difference in condition between this specimen and the one seen on the exposed bluffs?

_____

Bird Bath

This is a major watering station for many animals found in the park. Foxes, coyotes, rabbits, deer and many rodents can be seen in the early morning and late afternoon taking water from this spot. Try coming alone with some bird seed or bread and throw them around the grounds near the water. Then sit down quietly and wait. It also has a drinking fountain for people.

Check off any of these birds below that you see at the bird bath.

Black-throated Gray Warbler

Brown Towhee

Scrub Jay

California Thrasher

California Quail

Hermit Thrush

House Finch

English Sparrow

Bushtit

Torrey Formation

Describe the nature (what it looks like) of this formation**.**

_____

The sediment was what part of the marine environment? (Bay bottom, sandy beach, sand dune)

_____

Chamise

Chamise is common on dry slopes and ridges at low to medium elevations in the chaparral. Note the short, needle-like leaves and the dark bark that tends to peel slightly. White flowers are produced at the tips of the branches in late spring and early summer. This plant is quite resinous or oily and burns readily

This species is well adapted to the shrub forest and will become a dominant species in old stands. Oils contained in the leaves will act as germination inhibitors. Why are so few plants growing around the base of this plant?

_____

Why is this plant sometimes called greasewood?

_____

Mission Manzanita (Locate this red stemmed bush by the illustration below there are some plants by the parking area.)

This species of manzanita, found on dry slopes below 2,000 feet, produces white to pink urn-shaped flowers during the winter months. The fruit is deep red to black in color and about 1/4 of an inch in diameter. Note the deep-green upper surface and the enrolled pale lower surface of the leaf.

This species doesn't look like other manzanitas, especially the leaves, what about it does resemble other Manzanitas?

_____

What were the fruits used for?

_____

Bush Poppy

This alternate-leaved evergreen shrub grows to a height of about nine feet. The gray-green leaves are oblong, two to four inches in length and about four times longer than wide. The venation is reticulate. The four-petaled flowers are bright yellow and about two inches in width. This member of the poppy family is found growing on dry slopes and in stony washes at lower elevations. It is particularly abundant along the coastline.

What other flower does the Bush Poppy look like?

_____

How does this plant differ from the California Poppy?

_____

Plant Species	Found In:			Member of the:	
	Sea Cliff	Exposed Bluff	Protected Bluff	Chaparral	Coastal Sage Scrub
Coastal Barrel					
Lemonade Berry					
Bladder Pod					
California Buckwheat					
Sea cliff Buckwheat					
Warty Stem Ceanothus (lilac)					
Chamise					
Coastal Cholla					
Deerweed					
Warty Stem Lilac					
Mission Manzanita					
Scrub Oak					
Prickly Pear Cactus					
Torrey Pine					
Redberry					
Black Sage					

Plant Species	Found In:			Member of:	
	Sea Cliff	Exposed Bluff	Protected Bluff	Chaparral	Coastal Sage Scrub
Spicebush					
Bush Sunflower					
Toyon					
Mohave Yucca					
Bush Poppy					
Shaw Agave					

SUMMARY QUESTIONS

What is relationship between air temperature, soil temperature and wind velocity ?

_____

What is the relationship between relative humidity and wind velocity ?

_____

What is the relationship between relative humidity and air temperature?

_____

Which one of the physical factors is the most important in influencing the type of vegetation found at Torrey Pines State Preserve?

_____

What factor(s) influence the nature of the soil at the three different sites?

_____