Windows into the Wild

Docent Naturalist Training Manual

County of Los Angeles Department of Parks and Recreation
in cooperation with
Nature Center Associates of Los Angeles County

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Acknowledgements

This new manual is a rewriting and update of the 1994 version. We acknowledge the rewriting of the geology section by Richard Crook, arthropods by Bill Peet, birds by Judy Bass, plants by Cliff McLean, herps by Mickey Long and Native Americans by Cynthia Null. Many others contributed reviews and suggestions. Kris Kaul did the compilation and formatting. Coordinating editors were Chuck Haznedl and Jim Bradley. We also gratefully acknowledge S.R. Dudgeon and J.E. Kubler who created the Tree of Life illustration for use in the manual.

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July 1994

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August 1990

Mickey Long, Editor

Table of Contents

Los Angeles County
Department of Parks and Recreation

Natural Areas and Facilities Programs

Main County Website: Web: http://parks.lacounty.gov

The Natural Areas of Los Angeles County**Error! Bookmark not defined.** Department of Parks and Recreation are some of the finest wilderness parks in Southern California. These facilities are distributed from near sea level to above 5,000 feet, encompassing such diverse natural communities as coastal sage scrub, chaparral, oak woodland, desert scrub, pinyon and yellow pine forests. Some of the areas are maintained as undeveloped or sanctuary land with limited on-site facility construction. Other areas include Nature Center complexes, with self-guided trails, historical sites, picnic, and youth group camping areas.

Nature programs at the Centers are available to school, youth and special groups by advance registration. As of Aug. 2013 most Natural Area Centers are open daily except Mondays. Natural Areas park lands are usually open every day. Driving directions to specific parks can be generated from a link found in the county web site for each park, or by entering the address in any web mapping system.

Antelope Valley Wildlife, Wildflower Sanctuaries and Wildlife Habitat

Check website for specific addresses
Phone: (661) 944-6881

County Website: Web: http://parks.lacounty.gov/wps/portal/dpr/parks/

Within the Natural Areas system there are several separate nature sanctuaries: two Wildflower Sanctuaries, ten Wildlife Sanctuaries and one Wildlife Habitat.

The Wildflower Sanctuaries include Butte Valley and Phacelia. The Wildlife Sanctuaries include Acton Wash, Alpine Butte, Big Rock Creek, Blalock, Carl O. Gerhardy, George Bones, Jackrabbit Flats, Longview, Mescal, and Theodore Payne. The Wildlife Habitat is Neenach Habitat Preserve.

The plant communities encompassed vary from Creosote Bush Scrub to Joshua Tree Woodland, with most sanctuaries exhibiting showy wildflower displays in the Spring. Several sanctuaries are difficult to locate but can be found on MapQuest, Automobile Club maps, or Google Maps. For information please contact the Superintendent of Wildlife and Wildflower Sanctuaries (661) 944-6881. A website for each location can be found by going to the above web site, and selecting the name you are interested in from the list on the left.

Deane Dana Friendship Park and Nature Center

1805 W. 9th Street
San Pedro, California 90732
Phone: (310) 519-6115

County Website:
http://parks.lacounty.gov/wps/portal/dpr/Parks/Deane_Dana_Friendship_Park_and_Nature_Center
Park Hours: Sunrise to Sunset
Nature Center Hours: Tuesdays-Sundays: 9:00 am to 5:00 pm, Closed Mondays
Parking Lot hours: 7:30 am to 5:00 pm (7:30 am to 7:00 pm during Daylight Savings Time)

Deane Dana Friendship Park and Nature Center is located on the Palos Verdes Peninsula. The entry gate is located in San Pedro, however, the 124 acre park is situated on a bluff in Rancho Palos Verdes. Views from the nature center include the Los Angeles and Long Beach Harbors, Catalina Island and Terminal Island. There are hiking trails throughout the park, some ADA accessible. The beautiful new 4,000 square foot nature center features a natural history museum, live animal displays and both indoor and outdoor classrooms. Excavation of the site for the nature center revealed artifacts from the Tongva/Gabrielino culture who lived on or visited this bluff over a period of hundreds of years.

Devil's Punchbowl County Natural Area

28000 Devil's Punchbowl Road
Pearblossom, California 93553
Phone: (661) 944-2743
(661) 944-9151
Web: www.devils-punchbowl.com

County Website: http://parks.lacounty.gov/wps/portal/dpr/Parks/Devils_Punchbowl_Natural_Area
Park Hours: Sunrise to Sunset
Nature Center Hours: Tuesdays-Sundays: 9:00 am to 5:00 pm, Closed Mondays

The "punchbowl" is one of the most spectacular geologic formations in California, with the smoothed and shaped sedimentary rock walls of the basin towering hundreds of feet above a seasonal stream. The 1310 acre park rises 2000 ft. in elevation, with natural plant and animal communities ranging from desert scrub to pine forest. Wildlife abounds along the network of hiking and self-guided nature trails, and there is a small interpretive exhibit facility on the rim of the "bowl" near the park office.

Summer temperatures are generally mild, and there is usually lasting snow each winter. The rocks and weather frequently combine for spectacular photographic effects, and picture-taking, birding and hiking are "in season" all year. Park improvements include paved parking, picnic tables, braziers and drinking fountains. Devil's Punchbowl Park is open daily from dawn to dusk.

Eaton Canyon Natural Area and Nature Center

1750 N. Altadena Drive
Pasadena, California 91107
Phone: (626) 398-5420
Web: www.ecnca.org

County Website: http://parks.lacounty.gov/wps/portal/dpr/Parks/Eaton_Canyon_Park_Nature_Center
Park Hours: Sunrise to Sunset
Nature Center Hours: Tuesdays-Sundays: 9:00 am to 5:00 pm, Closed Mondays, Christmas and New Year's day.
Parking Lot Hours: 7:30 am to 5:00 pm (7:30 am to 7:00 pm during Daylight Savings Time)

Eaton Canyon Natural Area is at the base of Mt. Wilson, along the southern flank of the rugged San Gabriel Mountains. Its 190 acres are a zoological, botanical, and geological nature preserve. Visitors can enjoy its hiking trails, equestrian trails with a staging area, picnic areas, seasonal stream, rocks and minerals, various natural habitats, native plants, and wildlife. The park contains elements of several plant communities, including chaparral, coastal sage scrub, oak woodland and riparian growth.

The new Eaton Canyon Nature Center was opened in November of 1998, replacing the old one which burned in the Altadena fire of October, 1993. The 7,600 square-foot building contains many fascinating displays, live animals, offices, classrooms, an auditorium, restrooms, and an information desk/gift shop.

Center staff and volunteers are present to help you find information about hiking trails, animals, plants, geology, history of the Canyon, ecology, docent-guided tours, scheduled walks, and other programs.

Placerita Canyon Natural Area and Nature Center

19152 West Placerita Canyon Road
Newhall, California 91321
Phone: (661) 259-7721
Web: www.placerita.org

County Website: http://parks.lacounty.gov/wps/portal/dpr/Parks/Placerita_Canyon_Nature_Center
Nature Center & Parking Lot Hours: Tuesdays-Sundays: 9:00 am to 5:00 pm, Closed Mondays and Christmas Day.
Park & Walker Ranch Trailhead Hours: Sunrise to Sunset

Placerita is a unique east-west running canyon featuring cool, shaded oak groves, a willow and sycamore-lined seasonal stream and numerous other interesting plant and animal communities. The historic "Oak of the Golden Dream," site of California's original gold discovery in 1842, is in the park.

The Nature Center museum contains exhibits on the natural history of Southern California, and there is a small collection of live animals. A renovation of the exhibits is expected to be completed in 2014 which will integrate the natural and human history of Placerita Canyon with the modern visitor's experience. There is also a historic building at the park, Walker Cabin. A network of self-guiding nature, history and hiking trails radiates out into the park from the Center, with longer hikes leading to a seasonal waterfall and to the top of the Santa Clarita Divide. Walker Ranch Campground, at the east end of the 351 acre park, is available by registration for organized youth groups; capacity is 83 people.

San Dimas Canyon Natural Area and Nature Center

1628 North Sycamore Canyon Road
San Dimas, California 91773
Phone: (909) 599-7512
(909) 305-0665
Web: www.sandimascanyonnaturecenter.com

County Website: http://parks.lacounty.gov/wps/portal/dpr/Parks/San_Dimas_Canyon_Nature_Center

Nature Center Hours: Tuesdays-Sundays: 9:00 am to 4:30 pm, Closed Mondays

Located between San Dimas and Sycamore Canyons and bordering the Angeles National Forest, this park offers a wide variety of plant and animal communities. Nature trails meander through 100 acres of chaparral and riparian stream vegetation. Hawks, deer, rabbits and numerous other wildlife species thrive in these protected habitats. Native coast live oak trees shade a large grassy picnic area, an overnight group campground and a wildlife zoo containing live native animals. Other natural history exhibits and displays can be viewed in the Nature Center building. The Park and wildlife zoo offer a complete outdoor educational experience for everyone.

Vasquez Rocks County Natural Area

10700 W. Escondido Canyon Road
Agua Dulce, California 91390
Phone: (661) 268-0840

County Website: http://parks.lacounty.gov/wps/portal/dpr/Parks/Vasquez_Rocks_Natural_Area
Park Hours: Sunrise to Sunset (Gated - Check website for specific seasonal hours)
Interpretive Center Hours are Tuesday – Sunday 8:00am to 4:00 pm Closed Mondays, except Holidays.

The massive upthrust rock formations of Vasquez Rocks are possibly the most familiar (to TV and movie viewers) geological silhouette in California. Hundreds of westerns, science fiction thrillers, and outdoor commercials have been filmed in the shadows of the scenic sedimentary outcroppings that dominate much of the park's 932 acres. The rocks are named for the colorful early California bandit, Tiburcio Vasquez, who used the many caves and canyons to thwart would-be captors. The local Tataviam Indians also lived in the shelter of the rocks, and the park contains numerous certified archaeological sites.

Much of the park is covered with desert or chaparral plant communities, with California juniper, yucca, scrub oak and buckwheat among the more common shrubs. A seasonal stream, bordered by riparian vegetation, meanders through the south portion of the park. Picnicking is permitted in the main rock formation area, and visitors find the park an excellent locale for hiking, birding and photography. Camping for organized youth groups, capacity 60 persons, is available by registration.

Whittier Narrows Natural Area and Nature Center

1000 North Durfee Avenue
South El Monte, California 91733
Phone: (626) 575-5523

County Website: http://parks.lacounty.gov/wps/portal/dpr/Parks/Whittier_Narrows_Nature_Center
Park Hours: Sunrise to Sunset
Parking Lot Hours: 8:00 am to 5:00 p.m.
Nature Center Museum Hours: Tuesday through Sunday: 9:00 am to 5:00 p.m. (Closed Christmas Day)

Whittier Narrows Natural Area consists of 400 acres of riparian woodland along the San Gabriel River. Examples of plants and animals found in the riparian (riverbank) community are raccoons, Audubon cottontail rabbits, numerous species of migratory wildfowl, cottonwood, alder and sycamore trees, and a variety of shrubs and aquatic plants.

The Nature Center emphasizes the river environment, with graphics and live displays of plant and animal life. A network of self-guided trails loops through the natural area, affording a view of the ponds and riparian habitats. Three additional wildlife lakes are available for birding and photography, by key and permit.

Camping reservations for San Dimas Canyon, Placerita Canyon ("Walker Ranch") and Vasquez Rocks County Parks may be obtained by contacting the parks directly.

A fee is charged for camping or a work project may be assigned.

Please include the following information:

1. Group name.
2. Name and address of the sponsor.
3. Number of campers and adults.
4. Date and times of campout.
5. Park name for which application is made.

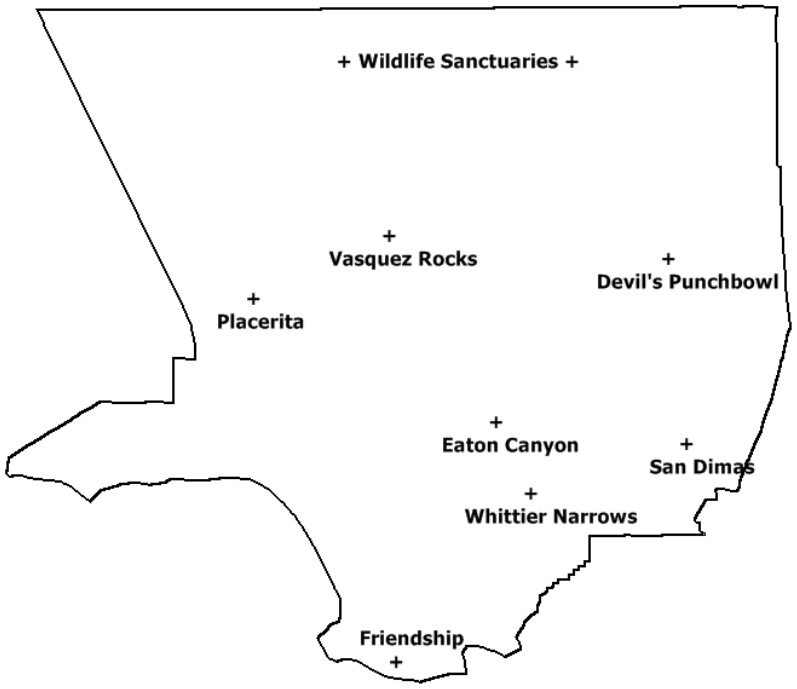


Figure 1. County of Los Angeles Dept. of Parks and Recreation Natural Areas.

Nature Center Associates Of Los Angeles County

The Nature Center Associates, or NCA, is the organization of docents and other volunteers at the nature centers and natural area parks of the Los Angeles County Department of Parks and Recreation. NCA has chapters at most of the nature centers in the County's park system, including those at Placerita Canyon in Newhall, Eaton Canyon in Pasadena, San Dimas Canyon in San Dimas, Whittier Narrows in South El Monte, and Vasquez Rocks in Agua Dulce.

NCA, through its chapters, is a major partner with the County of Los Angeles. NCA volunteers provide much of the manpower to help County staff operate the nature centers. Most of the programs of the nature centers would not be possible without the volunteers of the NCA chapters. Docent-naturalists work with County staff to lead walks for thousands of school children and adults every year. In addition, volunteers perform a majority of the animal care duties, assist in park maintenance, staff the phones and information desks, manage libraries, conduct training, and many other activities. In 2012, it is estimated that volunteers contributed over 27,000 hours of their time to the nature centers.

As the 501(c)3 tax-exempt organization, NCA provides services, such as sales tax reporting for gift shops, annual non-profit reporting to the IRS and the State of California, and insurance coverage, on behalf of the nature center chapters. The legal relationship between the County and the NCA, and its volunteers, is defined by a written agreement.

All members of the volunteer organizations at the nature centers are automatically members of the Nature Center Associates. NCA is managed by its board of directors, which includes officers, elected by the members, and an official representative from each nature center. Parks Department managers participate in board meetings, but do not vote. Board meetings provide for communication among the chapters, and between the NCA and County management.

Each chapter is managed by its own elected board of directors, which works closely with the nature center director and staff. They each have their own budgets and manage their own financial assets.

The day-to-day working relationships of the nature center volunteers and the individual nature centers are extremely positive and cooperative. These relationships are among the major reasons that the volunteers come back to the nature centers, often for decades.

The NCA Welcomes Your Interest and Support

Join Us!!

Introduction
to
Docent Program

Introduction to Docent Program

Docent Training Guidelines

1. Maintain a notebook with class notes, handouts, and other supplementary materials.
2. Don't miss classes as they are difficult to make up.
3. Become acquainted with the plants and animals on the lists given out in class:
   a. observe in the field
   b. know about each species' habitat
   c. if you have not been able to observe a particular species, know why not.
4. Be able to explain in your own words the following concepts and terms:
   a. ecosystem
   b. water cycle
   c. food chain and food web
   d. plant community
   e. habitat
   f. Mediterranean climate
   g. carrying capacity
   h. limiting factors
5. For your purposes prepare a 1-2 page report with a simple illustration on a particular feature, species, or interaction found in your nature area that particularly interests you. Share it with the class.
6. Docent trainees should attempt to attend scheduled in-service training sessions to supplement the basic training course and improve their working knowledge.
7. Docent trainees should volunteer regularly for various service duty at the Center.
8. Learn about the guided tour schedule so you can sign up to assist as a guide.
9. Trainees should audit (accompany a senior docent on a walk) at least two guided nature walks during or shortly after training.

Docent Procedure for Guided Walks

1. Sign up for walks as far ahead as possible.
2. Call scheduler if necessary to change walks; docents are responsible for their assignment and should attempt to find a substitute docent.
3. Arrive 15 minutes before scheduled class arrival.
4. Wear your ID, whether a trainee, docent or County picture ID badge
5. Sign docent worksheet or log book.
6. Docents assigned that day: scheduler plans for one docent each 10-12 students.
7. Lead docent will check with staff regarding:
   a. Their use of classroom
   b. Any special or helpful information
8. Decide among fellow docents:
   a. What trails to use
   b. Classroom management
   c. Museum use management
   d. Who will be major lecturer for the day
   e. Who will show what animal(s) for the day
9. Lead docent will check with teacher(s) upon arrival:
   a. Make sure it is the proper group to be guided (school name, no. of children)
   b. Introduce self and other docents
   c. Restroom use management
   d. Ask about any special emphasis placed on a particular topic
   e. Ask about time limit and return time.
   f. Ask teacher to divide students into groups.
   g. Direct bus to proper parking area.
10. Each docent introduces self and gives rules of trail, etc.
    a. Interact with group on the trail.
    b. Face the group when you speak.
    c. Know how many are in your group.
    d. Try to have an adult walk at the rear of the group.
    e. Try to keep the tour within the interest span of the group.
    f. Return at decided time limit and review the trip with children while waiting for other groups to return. Never leave a group unattended.
11. If someone is injured:
    a. a minor injury--can have other adult take student to building for aid.
    b. major problems--either send for help (if someone shouldn't be moved) or return with injured person and group.
12. Unhappy/Happy--if you are unhappy with your assignment, discuss it with your supervisor or the volunteer coordinator. If you are happy, let us know, too!

How to Be a Great Guide

The following suggestions are from the City of Long Beach, Dept. of Parks, Recreation and Marine

1. Have a theme or objective: introduction to the ecosystem, seasonal changes, succession, community comparisons, plant adaptations, animal adaptations, insect interrelationships, aesthetics, communication, energy flow, decomposition, predator-prey relationships, insect habitats, seed dispersal and plant survival, geology, etc.
2. Go over the trail in advance, noting new happenings, and outline your entire plan—physical layout, overview, stops—what you want to lead people in discussing. The degree of your being prepared makes the difference between just a disconnected outing and a rich, well-developed learning experience.
3. Know your subject. Study current authoritative materials and contact resource people. Don't be bashful about admitting to yourself something unknown that seems very obvious. Read many books written for children to learn "catchy" phrases at certain grade levels. Talk just a little above that level.
4. Use stories, don't just name things. Find unusual examples of how birds use trees, look for evidence of presences of animals, scats, bits of fur, plant feeding, scavenger signs, tracks, butterfly and bird territory homes, trails, effects of man or natural catastrophes, or effects of disease or parasitism.
5. Look for examples of man-made and natural erosion and be prepared to suggest some practical conservation projects which might be undertaken. Look for evidence of fire, flooding, land slippage, microclimates.

Personal Attributes

1. Be forever enthusiastic. You may have said the same thing a million times but work on making it sound like the very first time you noticed it.
2. Help people view their natural world in a questioning manner, wondering, discovering and solving problems. Use the process of science in analyzing a situation, to discover relationships and find satisfactory answers to some questions.
3. Accept everyone's suggestions about possible answers to problems--be patient and wait for the group to arrive at what you think may be the most probable solution. Always keep an open mind and you will find that people are a wonderful resource in analytical thinking and you will be learning a great deal from a group. Be sure to compliment people on participation.
4. Be happy, relaxed, laugh as much as possible, be friendly, be positive, not negative.
5. Be firm in stopping someone who starts to monopolize the conversation. Give them some concrete evidence to record for a certain length of time and then report.

Safety

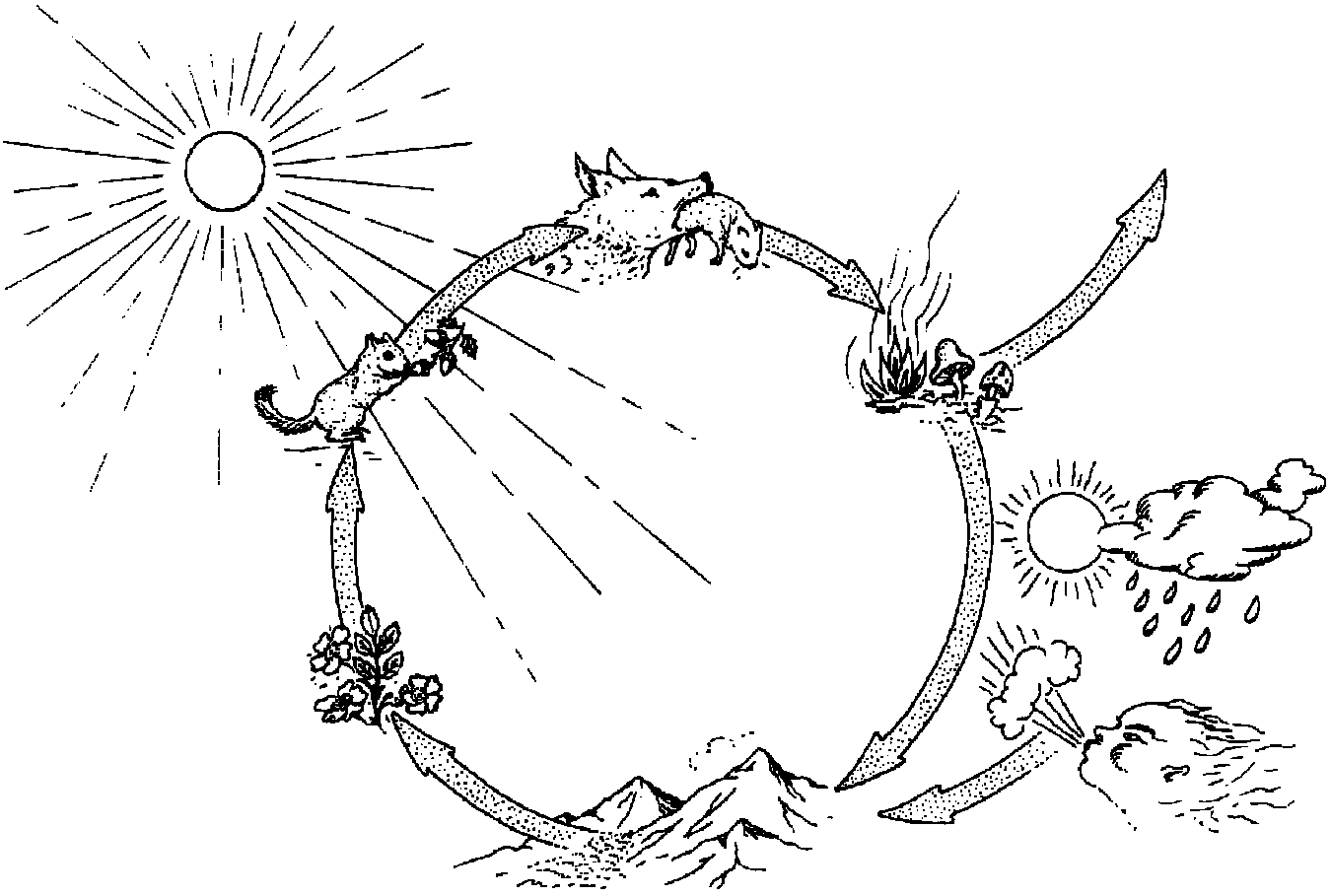
1. Discuss real and fancied hazards at start of walk.
2. Explain ecological and safety reasons for remaining on the trail and staying with the group. Discuss human compaction effects, also.
3. If there is a need to leave the trail for a short distance, ask everyone to walk in a different space to avoid too much disturbance.

Techniques on the Trail

1. Explain theme or objectives and how the walk is going to be conducted. “Nature Notebook” techniques of observing, conservation, moving hands, body, mouths, demonstrate “stalking.” Practice going over previously prepared leaf and twig hazards to make the least amount of noise.
2. Plan to move out rapidly to the first stop, especially if children are present.
3. Use some equipment such as a mirror to light up dark patches of foliage, holes, etc. Use binoculars and magnifying lenses but assign care and returning of objects to you at each stop.
4. At each stop, focus on something large first and then work down to smaller objects if possible.
5. Discuss your signals for: form half circle, gather round, stop, freeze, quiet, single file.
6. Keep stops short or break up into number of stops.
7. Speak clearly. Stop if group is not paying attention. Speak loudly to one individual about some nearby object.
8. Don’t lecture. Talk as in a conversation.
9. Try not to get too technical since many concepts in ecology might be interpreted on too high a level. Stay at the same level throughout trip if this seems right.
10. Look for similarities and differences.
11. Try to relate to something familiar at home.
12. Use senses and games using senses to identify something already observed such as blindfolding to know the feel of a certain leaf, oak gall, etc. Hear, smell, touch, and even taste.
13. Have a particular climax, spectacular view, before returning. Have fewer stops on return.
14. Have review stops along trail, sit down sessions.
15. Leave people wanting to know more rather than being satiated.
16. When stopping to talk, stand so that the participants are not facing into the sun.
17. Stalk for silence and to show an animal’s presence.
18. Circle scats, tracks and other evidence of living creatures.
19. Play the Living Notebook: form two lines with a wide valley between; have your partner opposite you. The first two to four people will be given 10 points to remember everything that happened and what was said at each stop. At the end of the stop, a page in the Living Notebook, the couples face the valley and go down the valley to the end and the next page is then at the front of the line. Open the Living Notebook after three stops and give the couples a few seconds to review among themselves and then start counting as they relate the page. At the end of the counting time, everyone tries to take points from the couples reciting by remembering something they forgot.
20. Dramatize life histories of animals such as the cynipid oak wasp that is involved in the gall story, or the difference between bugs and beetles.
21. Show location of objects using the nature clock method. You are standing at the base of a giant nature clock and without pointing, you might say, “I am looking at a bird in the tree in front of me--at one o’ clock.”
22. Call scrub jays closer by breaking up your outline and squeaking on your closed fist below the closed hollow or echo chamber, or use the tips of your fingers to squeak on for small song birds. Squeak over echo chamber as you quickly pull fist away from your mouth to “talk” to ground squirrels--scrub jays also.

23. Show extreme enthusiasm as you discover plants and animals and/or evidence of feeding on plants and other animals.
24. Try not to memorize or have a "canned" speech, but develop many ways of saying the same thing.
25. Ask many, many (Socratic) questions in which the answer is in your question in order to give people an opportunity to discover objects, meanings, interrelationships, names, etc. Don't lecture!
26. Everyone likes to have the feeling you are talking directly to them. Focus your eyes on individuals but keep your focus changing.
27. Be firm but friendly when interrupting long-winded dissertations.
28. Be flexible; be sensitive to a group's attention span. Don't get hung up in your own interests.
29. The leading of group conversation is an art and as such it needs a climate of spontaneity and freedom. No artist succeeds who does not love his materials. Just so, the group conversation leader, you, must love people--all kinds of people. We expect of a docent a sensitivity to persons and their personality needs, and artistry in handling her subject. Nothing is as important as helping all participants to feel comfortable and accepted so that each can take part spontaneously and contribute to the creativity and growth of the group. Here then is the aim, to help each person communicate more easily and build a group spirit which allows each person to be himself--so the docent should be warm and outgoing. She should be able to absorb hostility without becoming defensive.

General
Natural History
and
Ecological Concepts



General Natural History and Ecological Concepts

Introduction to the Ecosystem

A living community of plants and animals is far more complex than most people realize. When one begins to ask questions, the hidden complexities become apparent. Where does the community get its energy to operate? How does it keep going year after year in a relatively stable condition? Where does food for the plants and animals come from? What happens to the plants and animals when they die? Questions like these help probe the depths of the interdependencies and interrelationships found in any living system.

To help answer these questions and to formulate a deeper understanding of the maintenance of life on this planet, ecologists have devised a way to study whole life systems. They have called this the ecosystem approach.

An ecosystem can vary in size from a jar containing soil, water, plants and air, to the entire surface of the earth. Ecosystems have two major components which are really operating together to produce a functioning living-system. The first component consists of the physical environment and includes sunlight, soil, air and water in all of their forms. The second component includes the living organisms.

Ecosystems include many cycles such as the water cycle and the carbon cycle (described in more detail later). The overall dynamics of ecosystems are that energy flows through and the nutrients (AKA materials) cycle. The energy comes from the sun and ultimately radiates from the Earth as heat. In between, that energy, from the sun runs all the processes of life. The chemical elements and materials that nature is made of are present on Earth and for the most part, stay on Earth. The processes of life can shape those materials into millions of different forms but there is a finite supply of material which is recycled over and over.

All of the plants and animals eventually must die and decompose. The microscopic bacteria and fungi then return the organic substances back to the soil as inorganic material, so that future living organisms will be assured nutrients for their development. After decomposition, all of the sunlight (energy) originally stored in the green plants is lost. The ecosystem, therefore, is like a machine which operates on sunlight and is renewed by decomposition. Every living thing had a role in the ecosystem. That role is its niche.

The Ecosystem

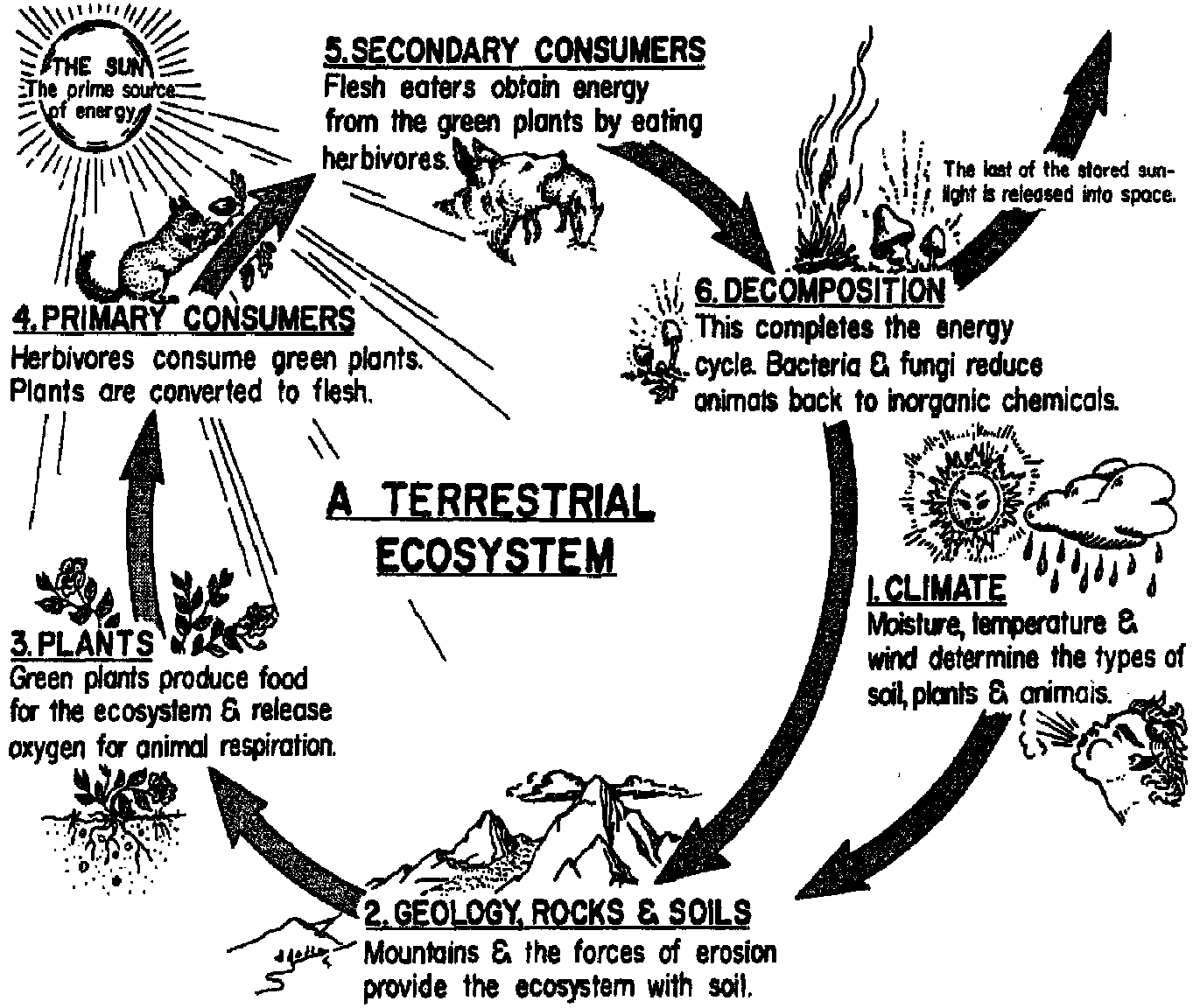


Figure 2. The ecosystem.

Climate

Vocabulary words: subtropical, latitude, Mediterranean climate, humidity

We live in a **subtropical** or **Mediterranean climate** primarily because of our location on the earth's surface. Southern California is between 30 and 45 degrees North **latitude** on the west side of North America, with the Pacific Ocean on its west border. The conditions produced by this location are long, hot, dry summers and cool, moist winters. This kind of climate does not have large amounts of excess water for use by the plants and animals.

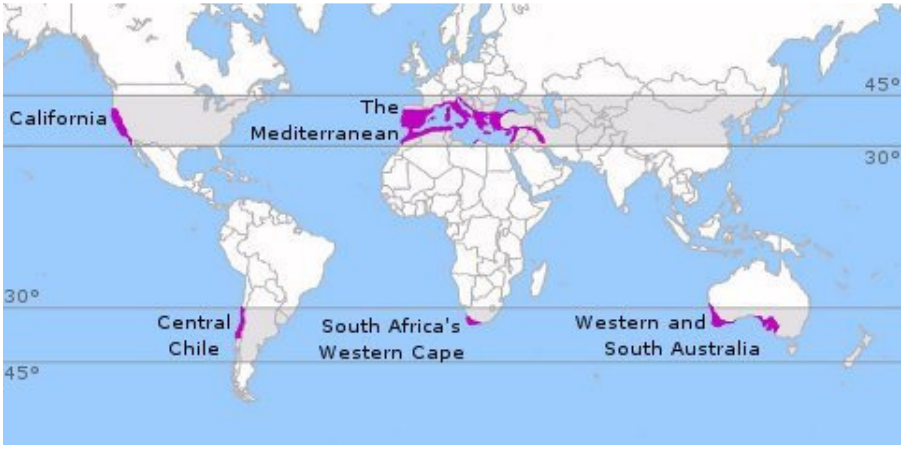


Figure 3. Locations with a Mediterranean climate.

These factors have stopped certain plants and animals that need more water from entering our area. They may also determine the course and development of the adaptations on the local plants and animals. These adaptations will be illustrated in the following section.

Very few places on earth have a climate similar to ours.

Scanty water, coupled with hot, long summers, restricts animal activity to cool periods, such as early morning or night. The plant or animal living area (habitat) and its location may be determined by the physical factors of temperature and moisture. Most animals seek cover where **humidity** is higher and temperatures are moderate. If animals and plants can withstand the hot summers in this area, part of their battle for survival has been won.

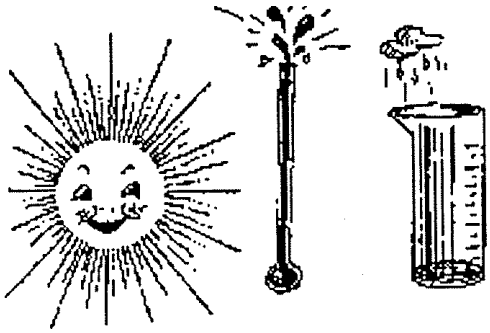


Figure 4. Elements of our weather.

An abundance of warm weather and very little water are part of the ingredients of our climate.

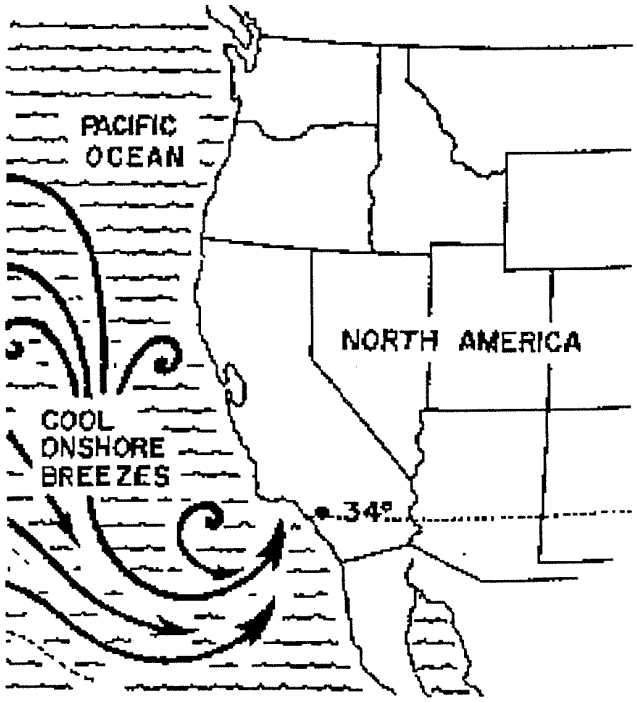


Figure 5. Components for Mediterranean climate.

Position is very important and helps determine our unusual climate.

The Water Cycle

The great source of water for the land surfaces of the earth is the ocean. The water cycle clearly shows how water is removed from the ocean, distributed across the land, and then is returned to the ocean to complete the cycle. If the water cycle should ever cease to function, terrestrial life would die of thirst. A terrarium, which traps water vapor in a closed container, where it can condense as drops of water, is a model of the less obvious parts of the water cycle.

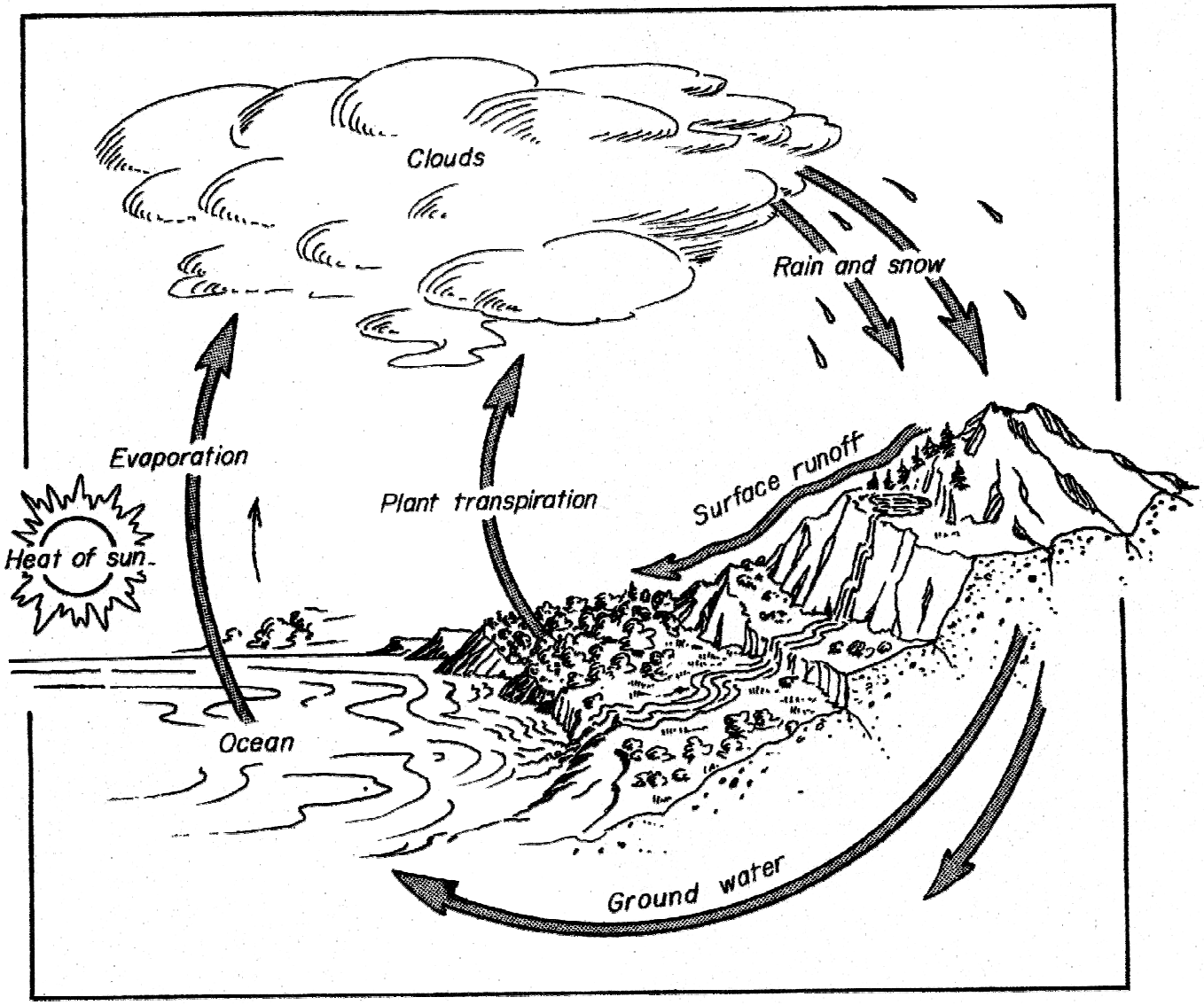


Figure 6. The water cycle.

Vocabulary words:

Transpiration (plants)
Evaporation
Condensation
Precipitation
Percolation

The Carbon Cycle

Chemical elements found on the earth's surface are limited in availability. Carbon, nitrogen and phosphorous are examples of elements. Energy flows through the global ecosystem, coming from the sun, warming the surface of the earth, passing through all living things and ultimately radiating off the earth as heat. All elements must be recycled through the ecosystem if they are to be continuously available for living organisms. Humans depend on the recycling of materials on earth and also participate in those cycles.

The carbon cycle is illustrated in Figure 8. There are substantial reserves of carbon in rocks, dissolved in the ocean and in the form of carbon dioxide gas in the atmosphere. Carbon is stored in the bodies of living things and released when they break down food in metabolism or decay. Bacteria and fungi decompose dead plants and animals, converting the carbon in those bodies to carbon dioxide and sometimes, methane. Carbon is also added to the atmosphere by volcanic activity and by human burning of "fossil" fuels, that were previously stored underground. Carbon is removed from the atmosphere and the water by photosynthesis of plants and algae. Another way that humans affect the carbon cycle is by producing materials that are non-biodegradable – like many plastics. That means that the elements in those materials cannot be broken down by any living thing and are then, taken out of the carbon cycle.

All nutrient cycles are important because they supply the materials needed for life of all kinds. The carbon cycle is additionally important because the amounts of carbon dioxide and methane in the atmosphere affect the climate. The concentration of carbon dioxide in the atmosphere has increased from about 280 parts per million before the industrial revolution to greater than 400 parts per million in 2013.

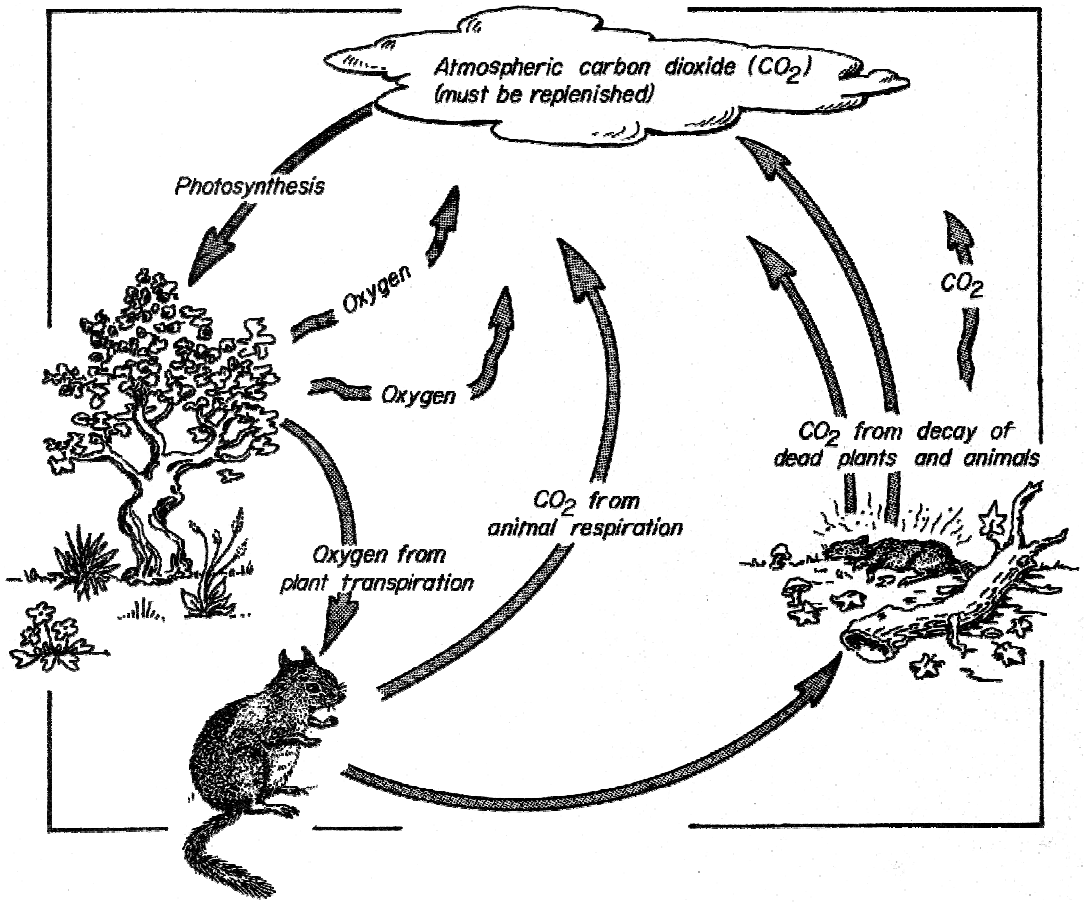


Figure 7. The carbon cycle.

Classification of Organisms

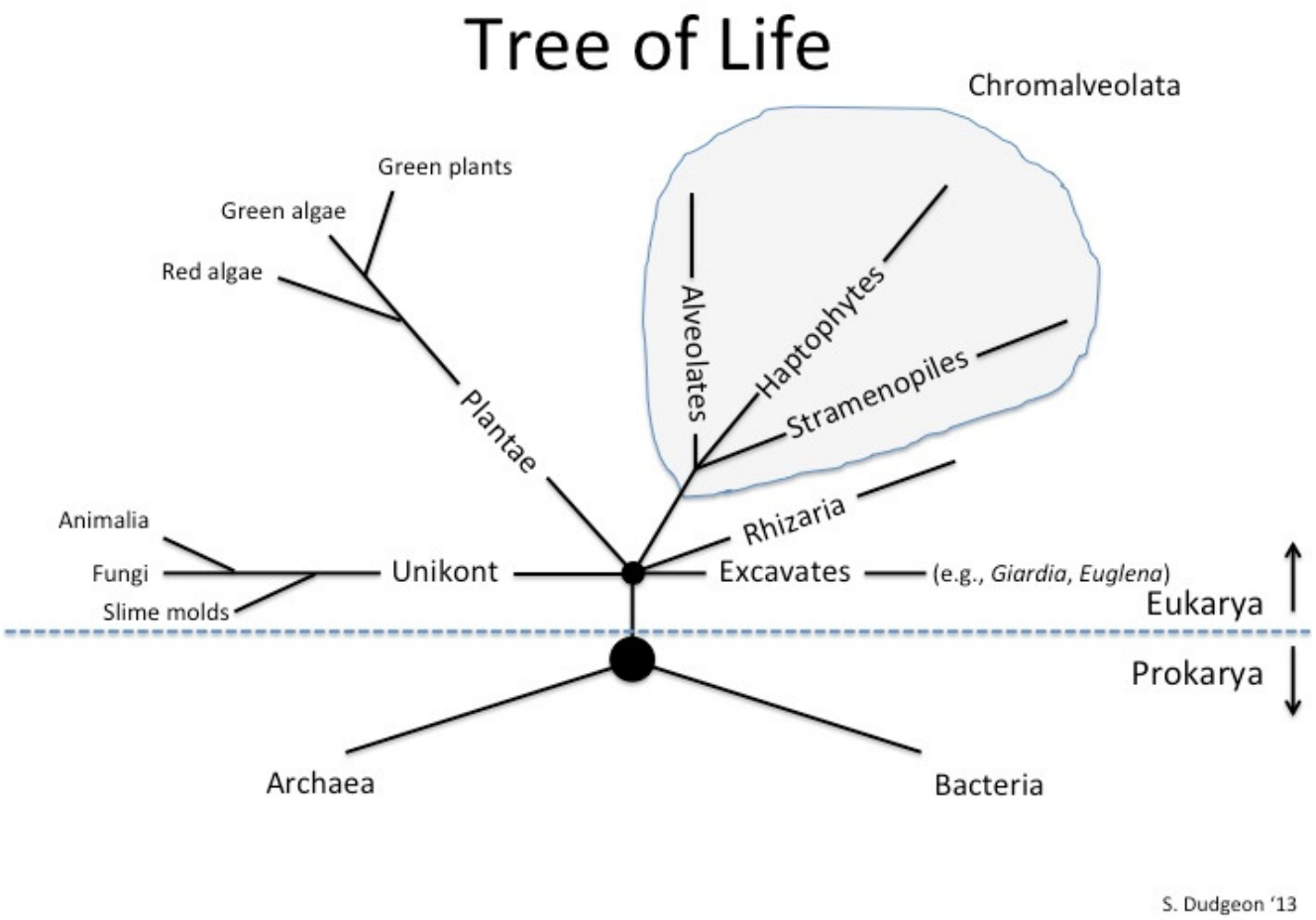


Figure 8. A tree of life.

All forms of life on earth have much of their metabolism, structure, and genetic information, in common. Life appears to have diversified from common ancestors. Organisms with more in common, physically and genetically, are more closely related, sharing more common ancestry. For example, acorn woodpeckers and California scrub jays, are more closely related to each other than are valley oaks and coyotes. All living things are related to each other. They are all part of one family tree of life. Species that are closely related to each other are grouped together as branches in the tree.

At the most basic level, the tree is divided into 3 branches, the Bacteria, the Archaea and Eukaryotes. Archaea and bacteria include small, simple, single celled organisms such as bacteria, but genetically, they are as different from each other as they are from animals or plants. These microbes are important members of all ecosystems even though they are invisibly small.

The Eukaryotes include everything made of many cells or large, complex, single cells. The Eukaryotes are subdivided into five main groups based on genetic similarity. Plants and green algae are in one group. Animals and fungi are in another group. The remaining groups show the diversity of weird and wonderful microscopic organisms on earth. Many of those organisms can be found in soil, ponds and streams. Plants, animals and fungi are explored in more detail in later chapters.

Classification of Organisms

Kingdom: **Monera** (non-nucleate)
- Phylum: Bacteria (Schizophyta)
- Phylum: Blue-Green Algae (Cyanophyta)

Kingdom: **Protista**
- Phylum: Slime Molds (Myxophyta)
- Phylum: Algae (True Algae)
  - Class: Green Algae (Chlorophyta)
  - Class: Golden-Brown Algae (Chrysophyta) (diatoms)
  - Class: Red Algae (Rhodophyta) ("sea weeds")
- Phylum: Protozoa (unicellular and animal-like – classified by movement)
  - Class: Rhizopoda (amoeboid movement, pseudopods)
  - Class: Ciliophora (Ciliates)
  - Class: Mastigophora (Flagellates)
  - Class: Sporozoa (non-motile)

Kingdom: **Fungi** (structural unit is **hypha**)

Kingdom: **Metaphyta** (higher multicellular green plants)
- Phylum: Bryophyta (mosses)
- Phylum: Tracheophyta (vascular plants)
  - Class: Ferns (Filicineae)
  - Class: Gymnosperms (naked seed-cone bearers)
  - Class: Angiosperms (seeds in fruits – flowering plants)
    - Clade: Magnoliids
    - Clade: Monocots
    - Clade: Eudicots

Kingdom: **Metazoa** (higher multicellular animals)
- Phylum: Porifera (sponges)
- Phylum: Cnidaria (Coelenterates) – (hydra, jellyfish, coral, sea anemone)
- Phylum: Platyhelminthes (flatworms)
- Phylum: Aschelminthes (round worms)
- Phylum: Annelida (segmented worms)
- Phylum: Mollusca (soft-bodied)
- Phylum: Arthropoda (jointed appendages and exoskeleton)
- Phylum: Echinodermates (spiny-skinned)
- Phylum: Chordata (animals with a notochord)
  - Subphylum: Urochordata (Tunicates)
  - Subphylum: Cephalochordata (Amphioxus)
  - Subphylum: Vertebrata (vertebrae replace notochord in adults)
    - Class: Agnatha (jawless fish)
    - Class: Chondrichthyes (cartilaginous fish)] Fish (Pisces)
    - Class: Osteichthyes (bony fish)]
    - Class: Amphibia (amphibians – water and land)
    - Class: Reptilia (reptiles)] Four-legged (Tetrapods)
    - Class: Aves (birds)]
    - Class: Mammalia (mammals)]

Figure 9. A hierarchical classification of organisms.

Producers

Vocabulary words: **photosynthesis**, **producer**

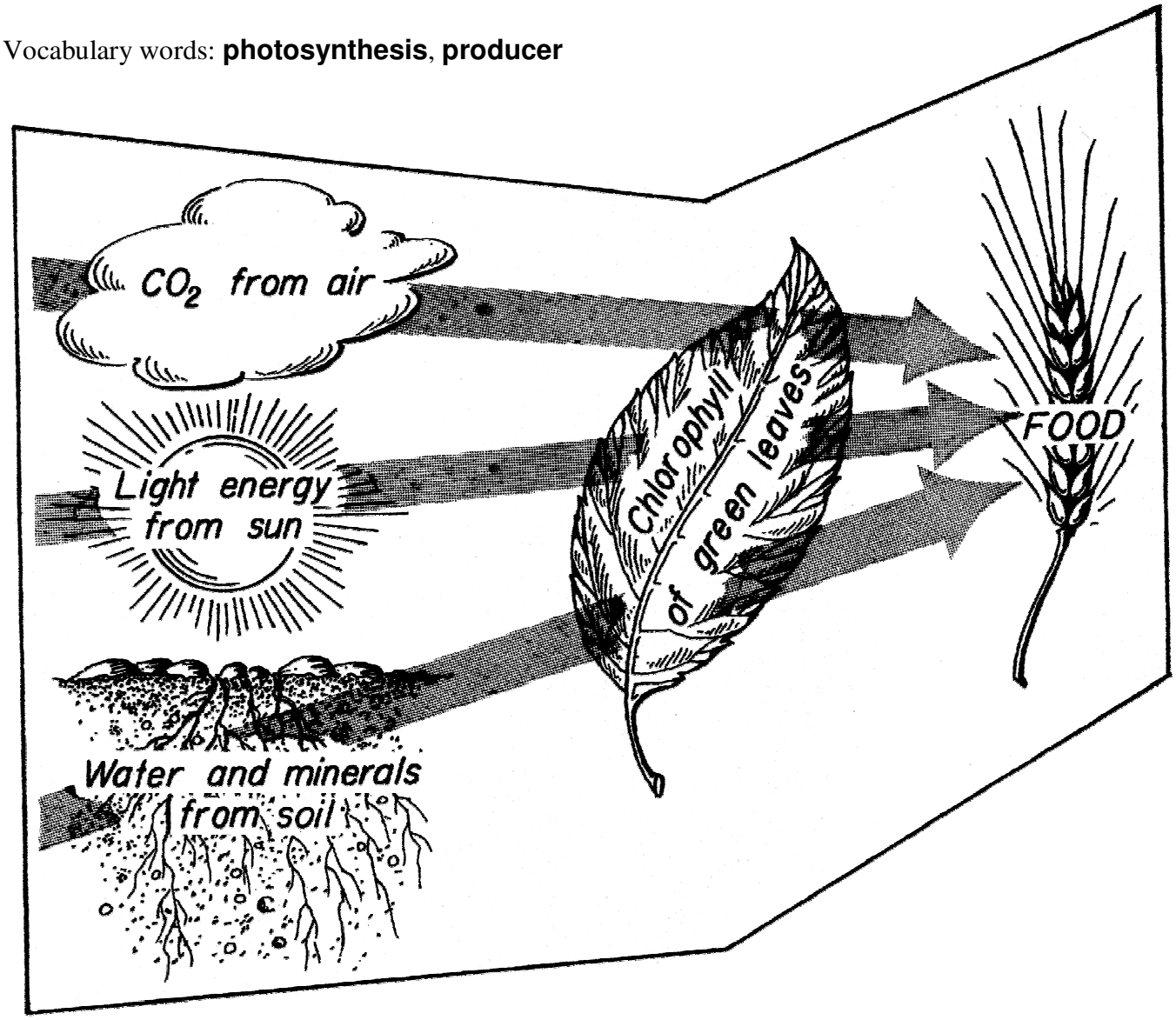


Figure 10. Elements and process for photosynthesis production of food.

Green plants produce food for their own nourishment, and this food is then used for the nourishment of the animal populations of the ecosystem. By using carbon dioxide (CO_2) from the air, water, soil and light from the sun, green plants are able to synthesize sugars, which are then used to produce starches, proteins and amino acids. This food-making process is called **photosynthesis**.

Since plants and algae are the only organisms that can make food, they are called **producers** by ecosystem ecologists.

The chemical equation for photosynthesis is:

$$6CO_2 + 12H_20 + \text{light energy} \xrightarrow[\text{chlorophyll}]{} C_6H_{12}0_6 + 60_2 + 6H_20$$

In other words, carbon dioxide plus water plus light yields sugar, oxygen, and water.

Consumers

Primary Consumers

(plant-eaters)

Vocabulary words: herbivore, protective coloration, adaptations

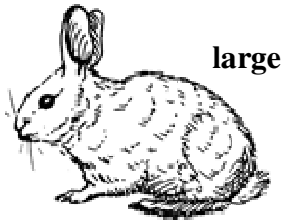
The plant-eating animals (**herbivores**) depend on green plants for their food. They convert the energy stored in the green plants and seeds into flesh. These important steps in what is called a food web provide food energy for the carnivore populations. On average, it takes about 10 times the amount of food to make the flesh of one step along the food web. So, ten pounds of grass are needed to make one pound of rabbit. Ten pounds of rabbit (100 pounds of grass) are needed to grow one pound of coyote, and so on. That's why it takes a very large territory to support a large predator. All living things, including plants, fungi and microbes are part of the food web as they recycle materials to make new bodies and recovery solar energy that was fixed into living material by plants.

Since most herbivores cannot defend themselves they use other special adaptations for defense. **Adaptations** are characteristics that enhance a living thing's odds of reproducing in a given environment.

Adaptations for Escape in Herbivores

protective coloration and speedy, darting "escape plan"

Figure 11. Rabbit adaptation for speedy escape.



large ears

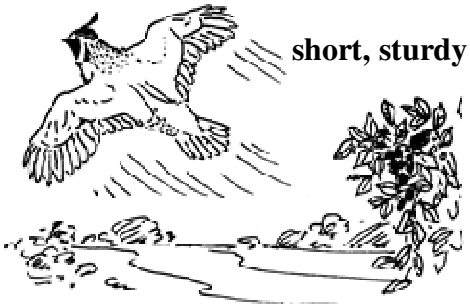
Figure 12. Rabbit adaptation for sensing danger.

The large ears of the rabbit detect sounds long before a would-be predator appears.

Protective Coloration, along with a speedy, erratic stop & go "escape plan" help the rabbit live longer.

more outstanding coloration of male

Figure 13. Special coloration for quail survival.



short, sturdy wings

Figure 14. Quail have sturdy wings for fast escape.

The California quail is a ground dweller with short, sturdy, powerful wings. It prefers to walk or run but can, if alarmed, use its wings for near-vertical takeoffs. Short flights usually end in the safety of a thicket of shrubs. The male quail has brighter, more outstanding colors which aid in leading away potential enemies from the more drab females and young. Warning calls are often used in advance of an approaching enemy.

Adaptations for Seed-eating in Birds

heavy, wedge-shaped beak

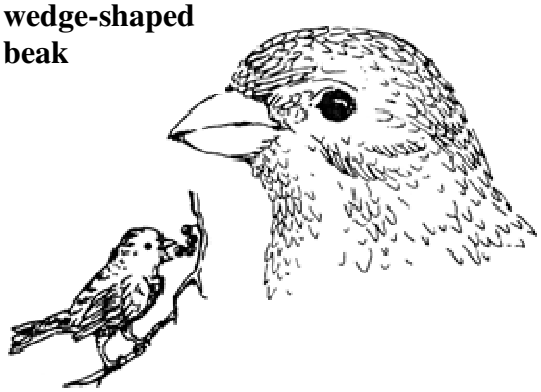


Figure 15. The house finch has a heavy wedge-shaped beak, which is used to break open the hard outer coatings of seeds.

delicate, needle-like beak

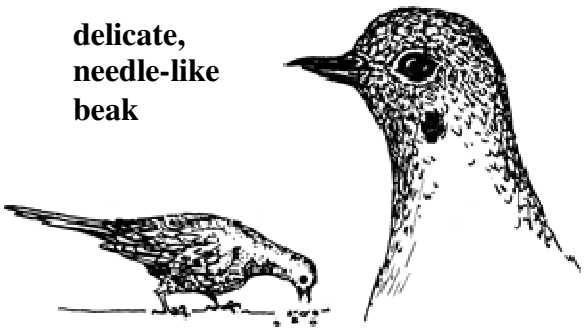
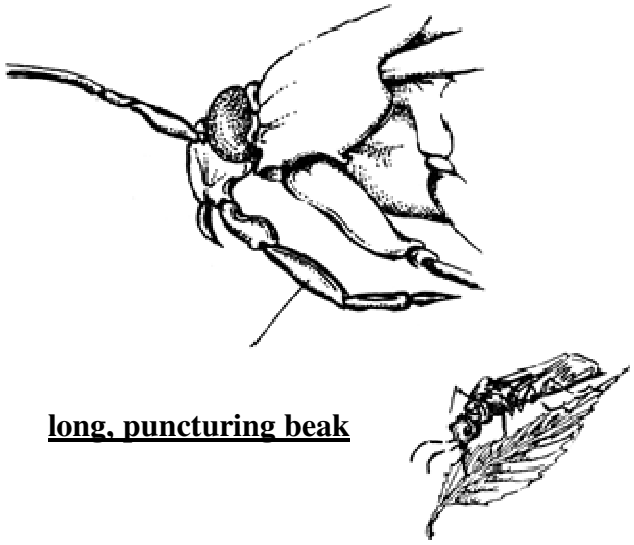


Figure 16. The mourning dove has a delicate needle- like beak. It merely picks up seeds, swallowing them whole.

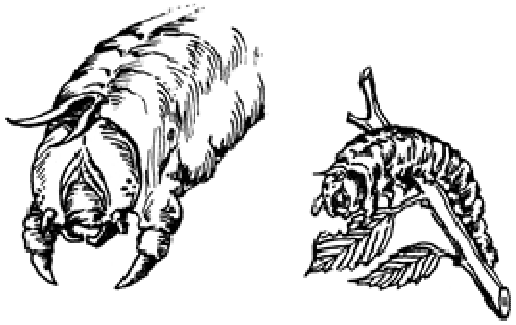
Adaptations for Plant-eating Insects

Plant-eating insects have evolved special ways of obtaining a variety of plant-based food.



long, puncturing beak

Figure 17. Certain true bugs (Hemiptera) have long beaks for puncturing the leaves and stems of plants to extract plant juice.



powerful jaws

Figure 18. Other insects, like butterfly larvae (Lepidoptera), chew leaves of plants with powerful jaws.

Adaptations for Plant-eating in Herbivores

Vocabulary words: **cellulose**, **rumen**, **browsing**

Animals have special "built-in tools" that fit their particular way of making a living.

Figure 19. Adaptations for plant-eating herbivores.

The mule deer has sharp-crowned molars for breaking down coarse cud. The rotating back-and-forth motion of these teeth makes the plant **cellulose** more digestible. There are no upper incisors; the deer must usually move the head up and away from the plant, using the lower incisors to nip the foliage off. It can eat quickly for a minimum exposure to enemies out in the open **browsing** areas, then retire to hiding to re-chew the food stored in the **rumen**.

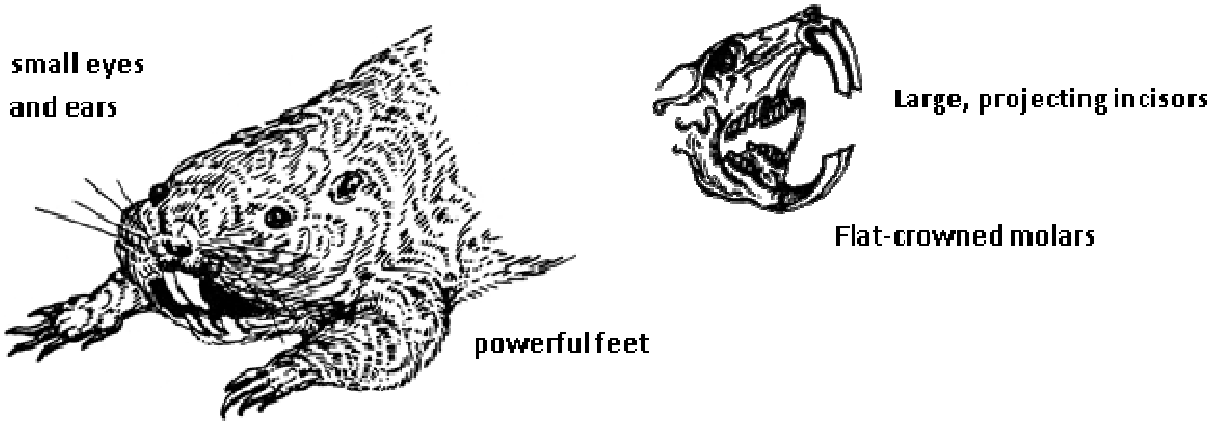


Figure 20. The gopher is well adapted for digging and eating roots underground.

In its underground tunnels, the pocket gopher is relatively safe from enemies, and finds a good food source in roots. It uses the large projecting incisors to tear away roots, soil and other objects when tunneling. The molars are flat-crowned for grinding plant material. The powerful feet are helpful in digging. It does not need very well-developed eyes and ears to escape detection in its underground habitat, so they are small and less cumbersome in the narrow dark tunnels.

Adaptations for Food Storage in Herbivores

Vocabulary words: **cache**, **nocturnal**

The seed-eating animals (granivores) usually store seeds in order to survive the lean seasons. The two mammals illustrated below collect vast quantities of toyon berries, coffeeberries, etc., when available during the summer and fall. They make large **caches** of food in their homes.

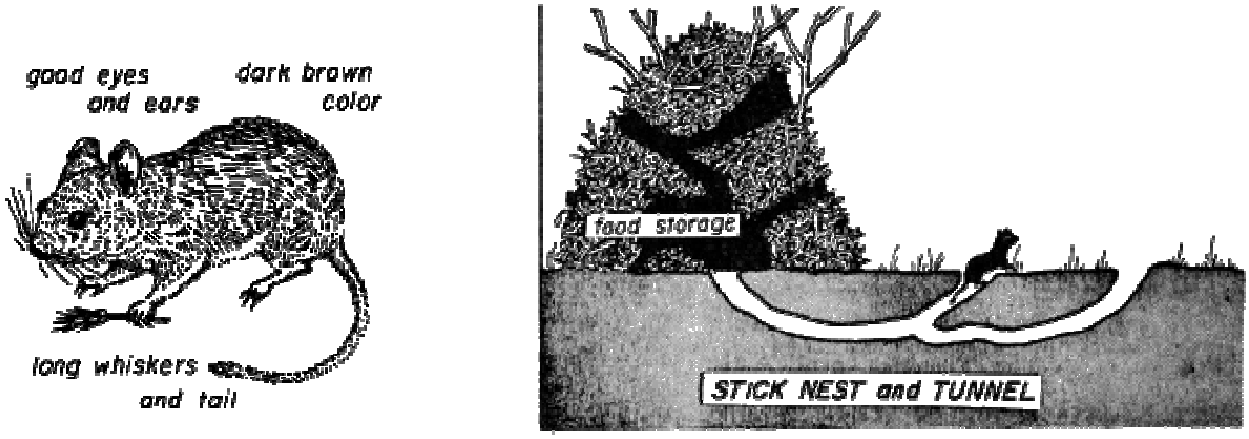


Figure 21. Dusky-footed wood rat.

The dusky-footed wood rat builds a unique stick-pile nest. The nest serves as an escape shelter and as a place to **cache** food. The wood rat can climb the branches of shrubs to harvest seeds before they can ripen, thereby avoiding direct competition with other seed-eaters. Its long whiskers and tail help him balance while climbing. Its keen eyes and ears and protective coloration help it evade enemies.

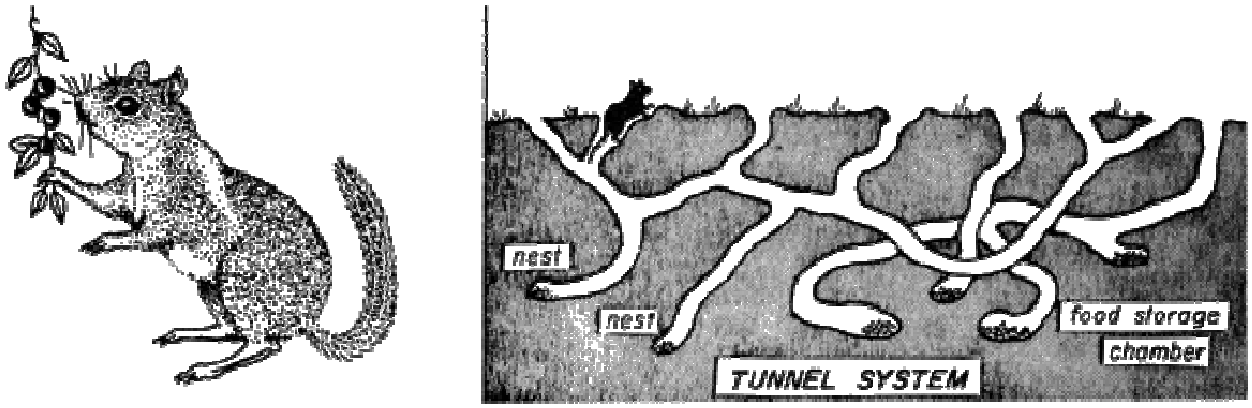


Figure 22. Beechey ground squirrel.

The Beechey ground squirrel builds a deep, extensive tunnel system which provides it with escape from enemies, protection from temperature extremes and a place to store quantities of seeds. Like the wood rat, the ground squirrel climbs trees to harvest its food. It is active during the day-time, thus escaping the many predators that **nocturnal** rodents have to contend with. Its sandy color blends in with its daytime surroundings. If any member of the colony detects danger, it gives a sharp warning "chirp," whereupon all the squirrels dive into the tunnels for safety.

Secondary Consumers

(Flesh-eaters)

Vocabulary words: carnivore, omnivore, overpopulation, herbivore, insectivore, raptor, niche

There are animals that eat other animals, and animals that eat a combination of plants and animals. We call them **carnivores** (predators) and **omnivores**, respectively. Sometimes the larger predators kill and consume smaller ones. An example of this would be a large, powerful great horned owl killing the weaker barn owl.

The carnivores are one of the many population controls that serve to maintain a wildlife community in what is often called a balance. This so-called balance is a dynamic, fluctuating system that goes through endless changes. One of these changes occurs in populations of carnivores and their prey and usually follows a cyclical pattern. Increases in herbivore populations, due to a large crop of green plants, will trigger an upsurge in the predator population. This **overpopulation** is followed by a natural decrease in herbivores, followed by a drop in the carnivore population.

Secondary consumers (carnivores, predators) have special physical adaptations for hunting and killing. They are usually stronger, faster and larger than their prey.

Adaptations for Flesh-eating in Carnivores

Figure 23. Coyote skull and Coyote.

The coyote, a relative of the dog, is a wide-ranging predator. Its long legs carry it many miles each night in search of rodents and rabbits to eat. Keen eyesight, a sensitive nose and acute hearing help it to locate its prey, and adaptive coloration is an aid in stalking without being seen. Sharp teeth are adaptations that are beneficial in killing and tearing flesh.

Adaptations for Flesh-eating Birds

There are large populations of flesh-consuming birds in the local ecosystem.

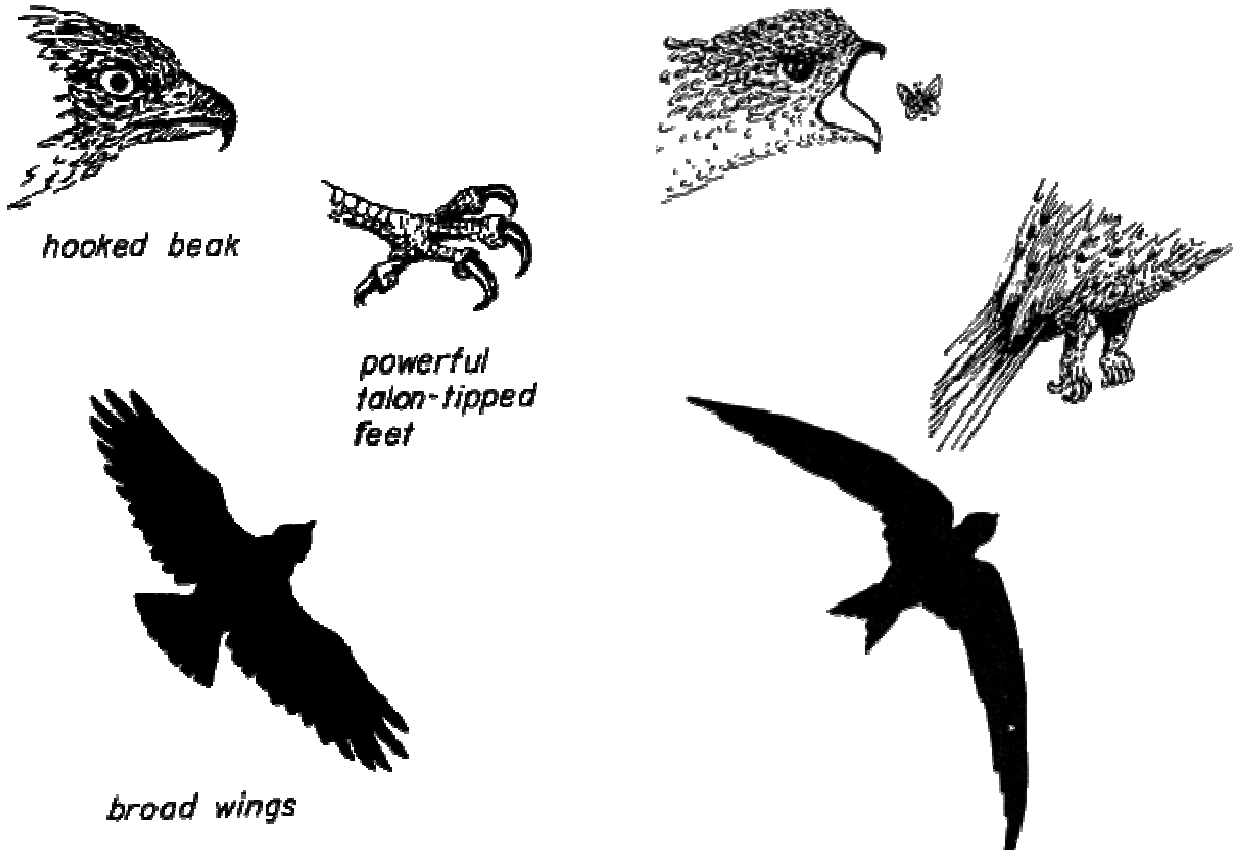


Figure 24. Raptors and insectivore birds have different adaptations in their beaks, talons and wings to insure efficient feeding.

The red-tailed hawk is a **raptor**. It feeds mainly on small mammals, insects and reptiles. It is active during the daylight hours, whereas owls, because of their nocturnal activity, feed on rodents and the night-active insects and arachnids. It captures such diurnal mammals such as the Beechey ground squirrel and the Audubon's cottontail rabbit. The broad wings are used for soaring and covering large areas of land in search of food, the muscular legs and talons are efficient for grasping prey, and the hooked beak is adapted for tearing flesh.

The white-throated swift is an airborne **insectivore**. Its wings are so long that the bird must spend its active daylight hours in the open air. The legs are small and weak and prevent it from walking on the ground. At night it sleeps in a high rock crevice, from which the bird can launch itself in the morning, without walking. The oversized wings are for sailing in open air at high speeds. The large net-like mouth is for scooping up insects in mid-air, for which it needs its excellent coordination and eyesight.

Adaptations for Insectivorous Mammals

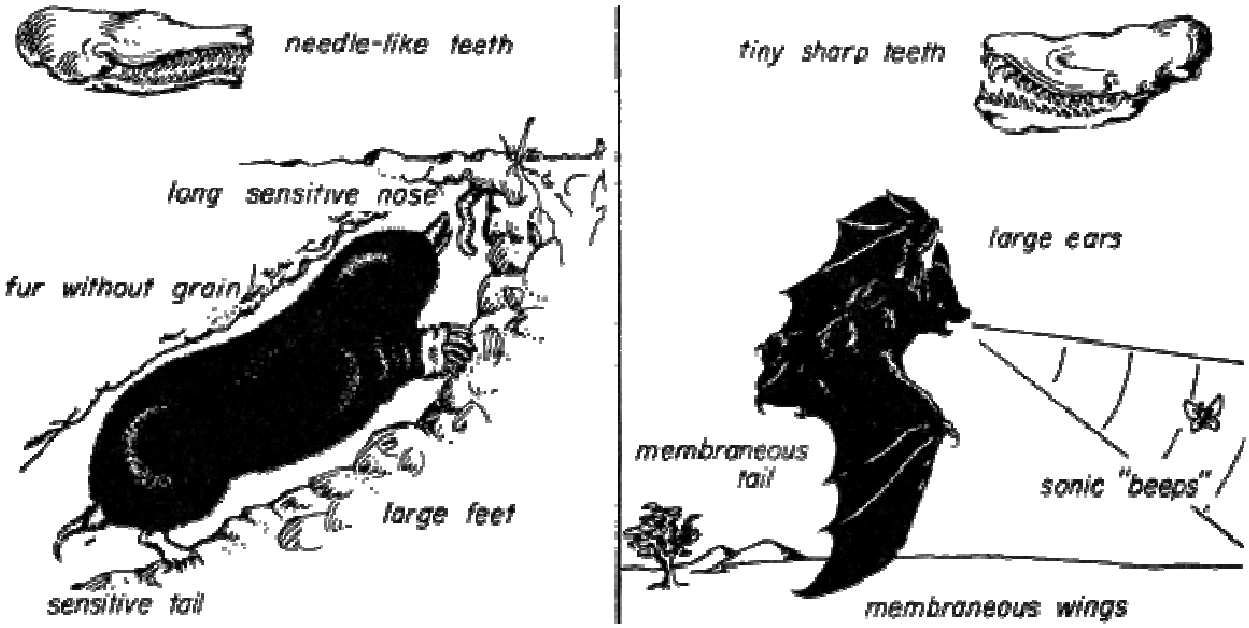


Figure 25. Insectivore mammals also need special adaptations for their particular living conditions.

The mole, an insectivore, represents an extreme form of adaptation. It has developed the ability to live underground in a world of darkness. By living in the soil, it has access to insect foods not available to other mammals and therefore has avoided direct competition with other secondary consumers. It has large feet for plowing through the soil, and its fur has no grain so dirt doesn't stick. The nose is long and sensitive and has an acute sense of smell, and the tail is also sensitive to help in going backwards through the burrow. The needle-like teeth can pierce insects' hard outer shells.

Bats are also insectivorous mammals. Possibly the most remarkable animal adaptations are found among the bats. The ability to fly has allowed them access to airborne insects. The unique sound-detection system permits nocturnal food-getting. By flying and feeding at night, the bat has avoided competition for food with both mammals and daytime air-feeding, insectivorous birds. The membranous tail holds food it has caught. The leathery wings enable quick, accurate flight. Its high-pitched call is a "radar" for finding insects; the large ears interpret the returning sound waves. It has tiny, sharp teeth for grinding up insects.

Adaptations for Reptiles and Amphibians That Eat Flesh

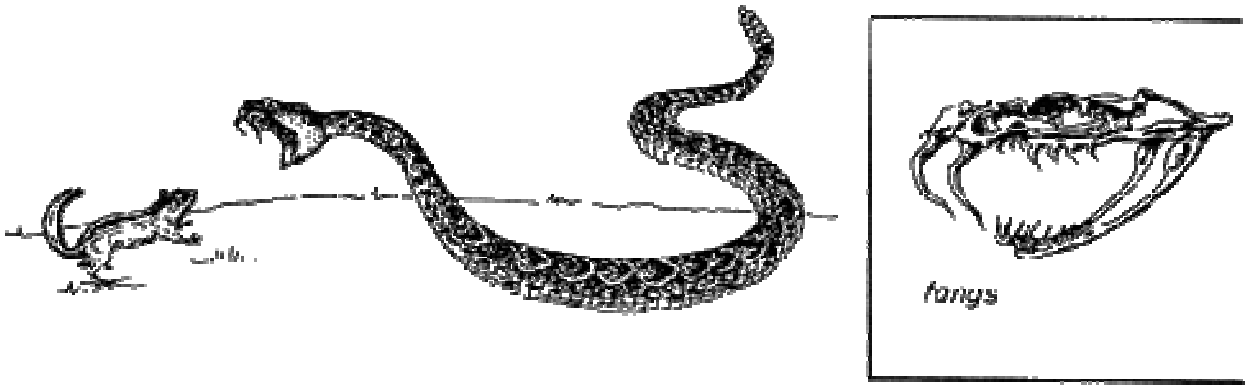


Figure 26. Rattlesnakes are well adapted to feeding on burrowing animals.

The rattlesnake occupies a rather specialized **niche**. Its long slender body allows it to procure food where most other carnivores cannot reach it, in the burrows of small mammals. Instead of constricting its prey to kill it, as many snakes do, the rattlesnake injects poison through its fangs. The poison not only kills the prey, it also begins the process of digestion by breaking down tissue. Snakes are valuable controls on rodent populations and should be protected.

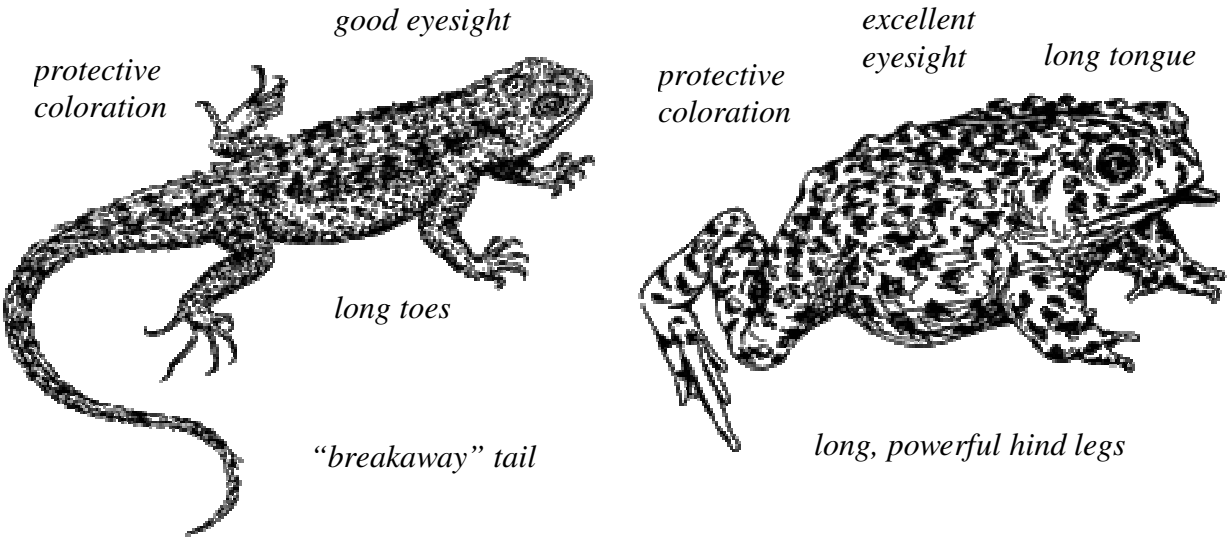


Figure 27. Lizards and toads have numerous features that insure their survival.

The western fence lizard has good eyesight for spotting its insect prey, and its long legs help it climb to better hunting areas. If a predator catches it by the tail, the tail breaks away, leaving the rest of the animal to escape.

The western toad hunts insects on the ground. Its long powerful legs help it hop, to evade its enemies. It is too awkward to take its prey by stalking it or running it down, and instead sits in one place and shoots out its long tongue to catch a meal of insects.

Adaptations of Predatory Invertebrates

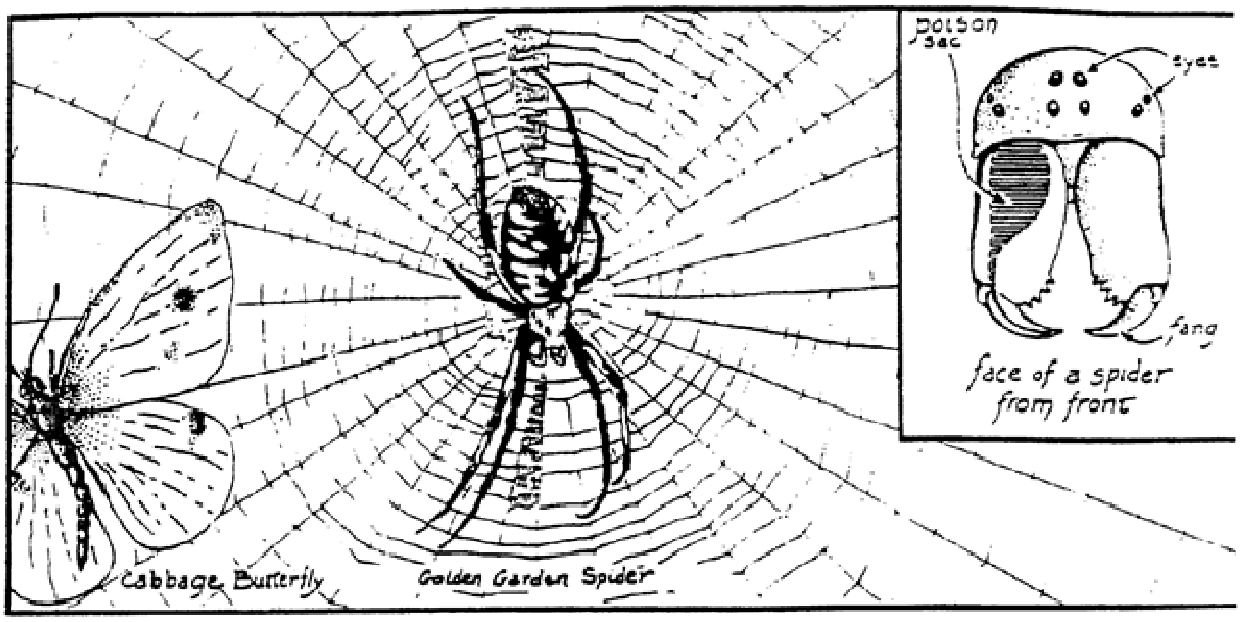


Figure 28. Spiders are uniquely adapted to capturing insects using webs.

Most insects are herbivores; however, some are carnivores. All spiders are carnivores. Small insects form the prey base for most of these tiny predators. Some, especially bloodsuckers like ticks and mosquitoes, feed on vertebrates.

Enlarged mouthparts, often coupled with and/or enlarged grasping front legs are structural adaptations for predation. Capture techniques, such as traps, can be seen in the webs of spiders (above) and the pitfall traps of antlions (below).

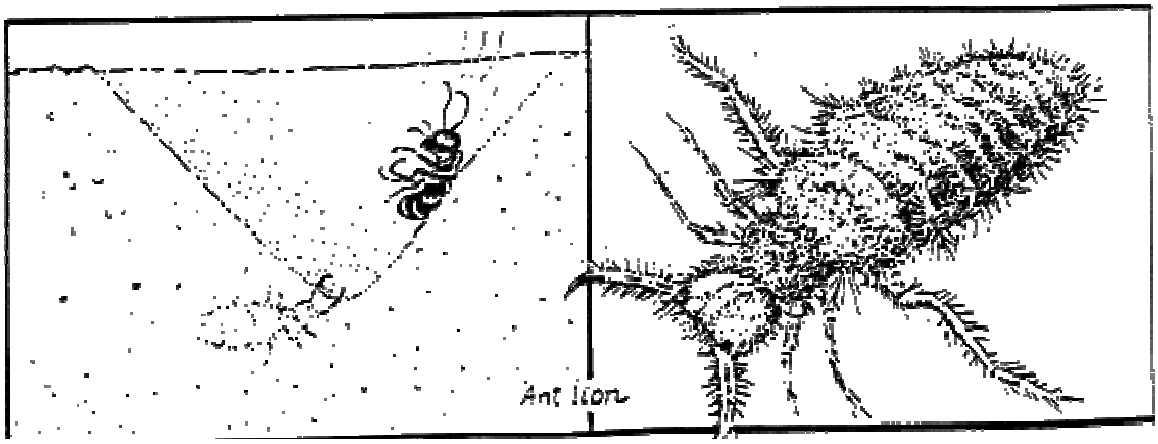


Figure 29. Ant lion insects use traps to capture their prey.

Decomposition

Vocabulary words: bacteria, fungi

A vital function to the maintenance of life in an ecosystem is that of decomposition. If the processes of decay were to cease, the surface of the land would soon be piled high with the bodies of dead plants and animals. The important nutrients locked up in the corpses would also be denied to future living organisms, causing life to gradually die out. We can thank such tiny creatures as bacteria and fungi and processes of oxidation such as fire, for our very existence on this planet.

Decomposition in Moist Areas

The breakdown of dead plant and animal tissues in moist places is carried out primarily by tiny organisms called **bacteria** and **fungi**. Bacteria eat dead animal flesh and, through digestion, break it down into inorganic chemicals. Fungi do the same for plants.

Decomposition in moist places takes place in or near the surface of the leaf litter and humus layers of the soil. The fungi, however, travel up the standing trunks of dying trees and begin breaking down the tree's woody structure. With the aid of insects called termites, the tree is toppled to the forest floor, where the billions of decomposers can destroy it.

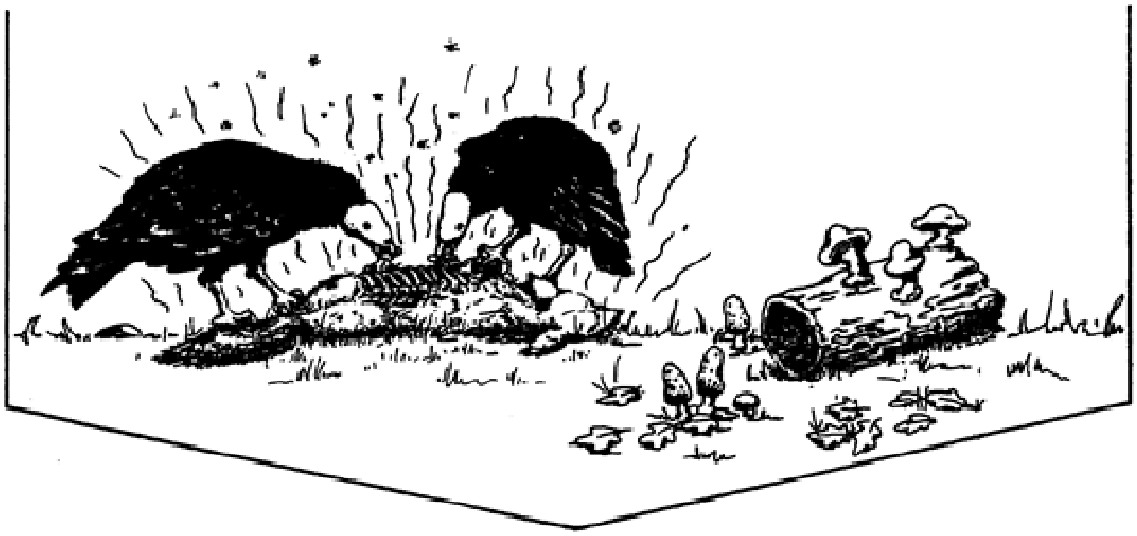


Figure 30. Numerous processes support the decomposition and recycling of organic material in nature.

Decomposition in Dry Areas

Vocabulary word: xeric

The local ecosystems that are dominated by chaparral and coastal sage scrub plant species are too dry for most soil bacteria and fungi to be active in the dry season. When plants die they decompose slowly, usually through the work of termites. It is in **xeric**, or dry, habitats that fire plays an important role as an agent of rapid decay. Fire burns the cellulose of the plants, converting it to ash, which is readily used as food by living plants. In our local plant communities the ashes of the burned plants make a seedbed rich in nutrients for future plants. The hard outer coatings of the seeds are cracked open so that germination can begin. The burning of the vegetation also opens up the dense brushy forests so that sunlight can reach the forest floor. Sun-seeking annual plants grow in abundance, producing food for increasing wildlife populations. If a fire burns the brushy hillsides about once every 29 years, the plants remain vigorous and healthy. When too many fires burn the same area, the brushy plant growth dies out and is replaced by grass. If the fires are not frequent enough, the brush dies of old age, and when the dead fuel is ignited, a holocaust erupts.

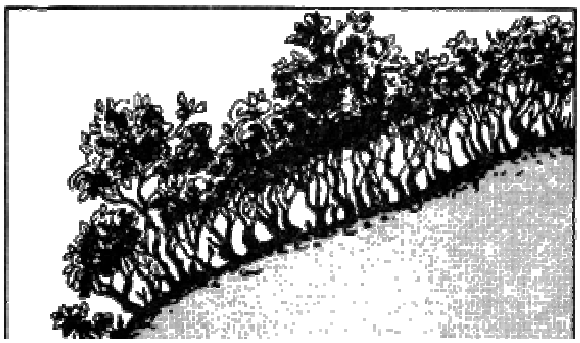


Figure 31. Excessively dense brush can limit the wildlife supported.

1. Old, decadent brushland supports very little wildlife. The old brush has become thick and chokes out ground cover, lowering the amount of food available to wildlife. It is now unpalatable, and has become impenetrable to larger animals such as deer.

2. Fire

The majority of wildfires do not burn clean. Patches of habitat are skipped over by the rapidly-burning fire. These islands of brush are havens for animals which have been displaced by the fire.

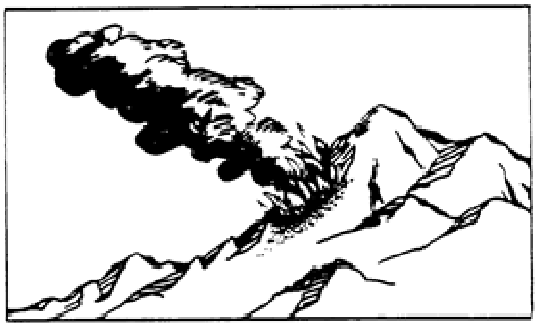


Figure 32. Wildfires can begin the renewal of habitat.

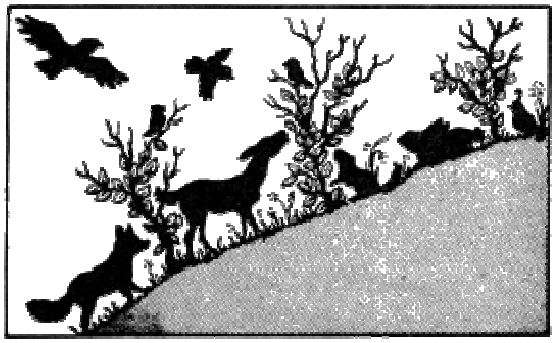


Figure 33. The burned out land regrows and supports more wildlife.

3. The fire has “pruned” the forest by destroying the old, thick vegetative cover, fertilizing the soil and providing new succulent resprouts from the root crowns of the shrubs. Annual plant growth is re-established, providing maximum food production for wildlife.

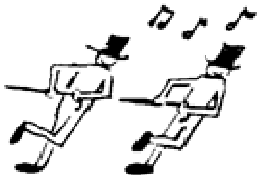
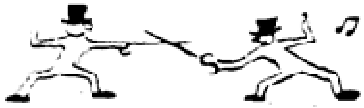
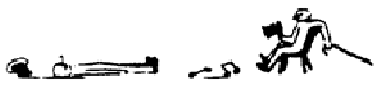
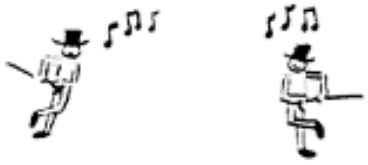
Symbiotic Relationships

Different Types of Two-Species Interaction – Symbiotic Relationships

+ Means that the population or individual is favored (increased) by the relationship.

- Means that the population or individual is inhibited (decreased) by the relationship.

0 Means that the population or individual is unaffected by the relationship.

Symbol & Meaning	Term for Relationship	Examples
++ both species favored 	**mutualism**	Lichens: an alga and fungus growing together (oblig.); yucca and yucca moth, each dependent upon the other; ground squirrel and oak, not oblig. but beneficial.
+0 one species favored one unaffected 	**commensalism**	Shark & remora, which shares the one unaffected kill but contributes little or nothing to shark; orchids, which grow on, but do not affect, trees.
+- one species favored one inhibited 	**predation or parasitism**	Mountain lion & deer; hawk & rabbit; snake & rodent (PRED.); mistletoe & sycamore; dodder & shrub; fleas & dog; vampire & victim; creosote & other plant.
-- both species inhibited 	**competition**	Deer & elk or sheep in same area; swifts & swallows over same pond, feeding together.
-0 one species inhibited one unaffected 	**amensalism**	Penicillin mold, which accidentally inhibits bacteria; large trees shading out smaller ones.
00 neither species significantly affected 	**neutralism**	Pelicans & cormorants feeding in ocean; spiders & mantis feeding on same bush on insects; crows & ravens in same cornfield; numerous songbirds feeding and nesting together in woodlands.

Symbiotic Relationships

Organisms interact with one another, forming relationships that will ensure a perpetuation of their own kind. As populations expand in an area the available food and living space become harder to find. Many organisms have developed very special relationships in order to live together, sometimes even as a single organism. This “living together” is called symbiosis and takes many strange and bizarre forms.

Commensalism

Commensals are organisms that secure food, shelter, mobility or some other essential from a second organism, but without harming it in any way.

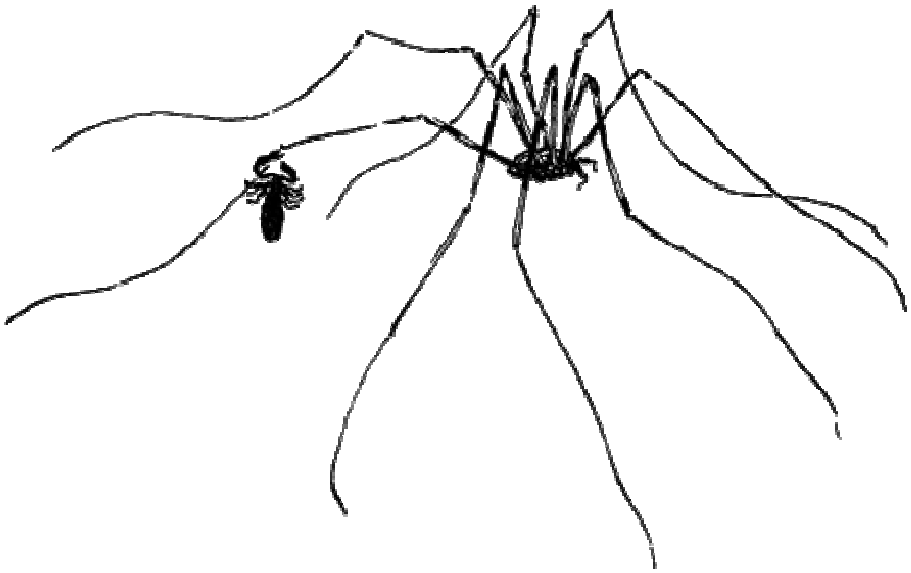


Figure 34. Pseudoscorpion grasping the leg of a daddy-long-legs.

Commensal Mobility

Arthropod commensals: certain gamasid mites, tiny predaceous arthropods, in their nymphal stage secure transportation on beetles. This hitch-hiking technique enables these tiny creatures to establish themselves in new areas. The daddy-long-legs (Phalangida) are sometimes found playing the same role as beetles when they tote around pseudoscorpions (small harmless arachnids). The pseudoscorpion uses its large pincers to grasp one of the spindly legs of the daddy-long-legs. The pseudoscorpion drops off when a new, suitable home is reached.

Parasitism

Vocabulary words: endoparasite, nutrient, ectoparasite

Parasitism is a population control with much the same effectiveness as predation by the flesh-eaters. It affects both plants and animals and takes many diverse forms.

Animal Parasites

Some examples of animal parasitism

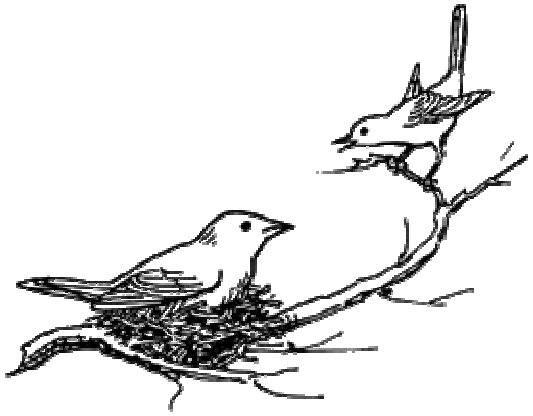


Figure 35. The cowbird's invasion of a nest is a form of parasitism.

The cowbird lays its egg in the nest of another bird and then disassociates itself from all responsibility for it. The foster mother accepts the new egg as her own and hatches the young bird, which responds by pushing all other babies and young birds from the nest. Then, when it is grown, it flies off to continue the parasitic cycle.

All wild mammals and birds have their **endoparasites**, as well as external mites, ticks, fleas, and lice (**ectoparasites**), and a variety of fungal diseases.

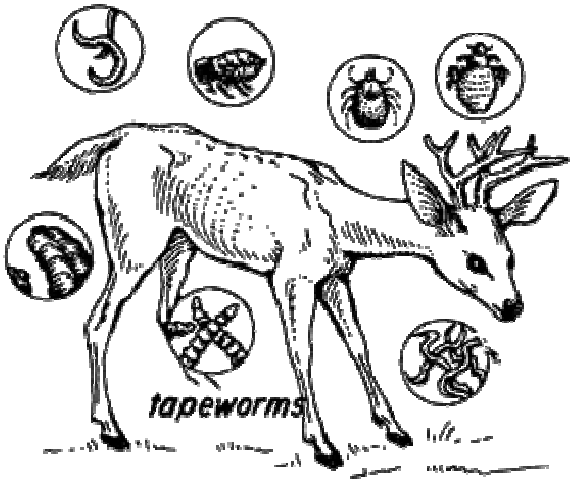


Figure 36. Examples of endo- and ectoparasites.

Plant Parasites

Dodder, the bright orange "witch's hair" which grows a dense network of stems over shrubs during the spring, lacks the chlorophyll to carry out photosynthesis. So it attaches itself in the **nutrient**-transporting layers of the host plant and absorbs some of its water, minerals, and carbohydrates.

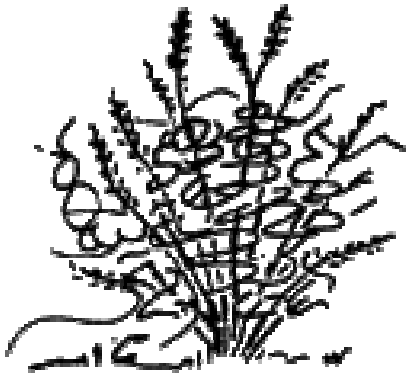


Figure 37. Dodder growing on another plant.

Figure 38. Mistletoe growing in an oak tree.

The seeds of mistletoe, which attacks the tops of oaks, cottonwoods and other trees, are a valuable food for many birds. Other plant parasites in the Park are the witch's broom, a multi-stemmed whitish growth on oak trees, and the multitudinous minute fungi, whose role is not fully understood.

Mutualism

Mutualism is a form of symbiosis in which both organisms benefit from a relationship. Many insects and flowering plants have formed mutualistic relationships. The plants are pollinated and insects receive food in the form of nectar, pollen, seeds, and leaves.

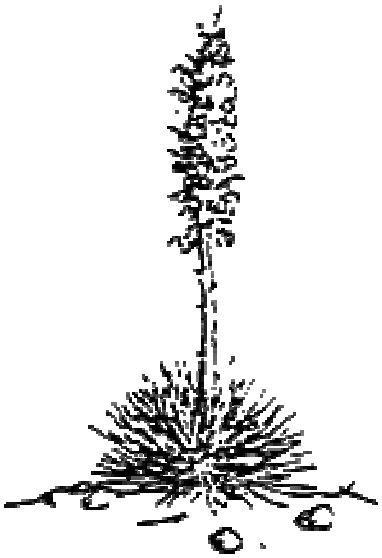


Figure 39. Yucca.

The yucca and the yucca moth are prime examples of mutualism. The yucca flowers are pollinated only by the yucca moths. The female of this moth will deposit eggs only in the ovary of the yucca flowers. The female moths have specially-modified mouthparts to scrape the sticky pollen from the stamens, forming it into a pellet which is carried to another yucca flower where it is deposited into the stigma. The moth then lays one egg in the ovary of the flower.

Figure 40. Yucca flower and yucca moth.

Following germination the fruits develop, enclosing the egg, and eventually seeds are developed. The yucca moth egg hatches and the caterpillar feeds on the developing seeds. Each yucca seed pod contains about 200 seeds and only about 25 are eaten by each caterpillar. This results in both organisms benefiting from this unusual relationship.

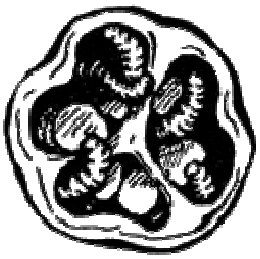
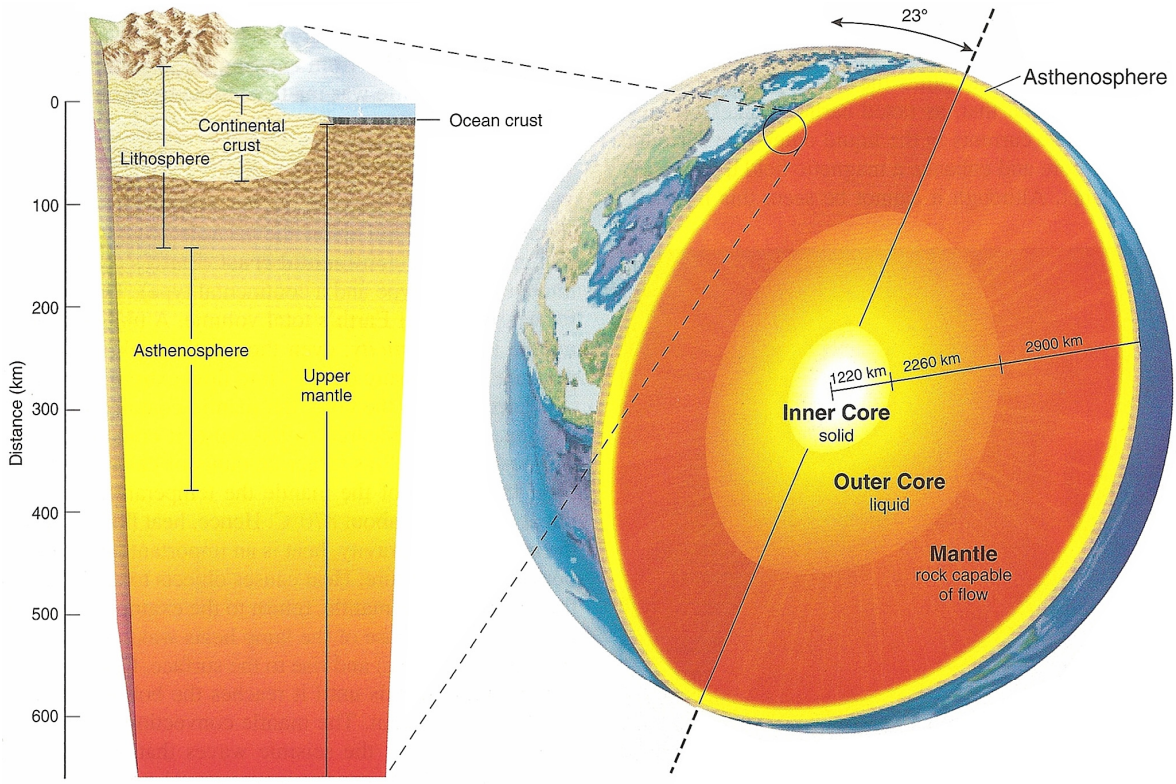


Figure 41. Cross section of a yucca seed pod with seeds and larva.

Geology

Geology: The scientific study of the Earth (from the Greek gê, "earth" and (-logia), "study of")



Evidence indicates that Earth's interior consists of the inner core, the outer core, the mantle, and the crust. The lithosphere consists of the crust (upper lithosphere) and the lower lithosphere, which is part of the upper mantle. The asthenosphere, also in the upper mantle, lies below the lithosphere.

Figure 42. The Earth.

The Earth is a layered sphere.

Core

Inner – solid

Outer – liquid

Mantle – layer above the core

Crust or outer layer – lithosphere consists of crust (skin) and upper mantle.

Continental crust – rocks rich in lighter elements or compounds made up of igneous, metamorphic and sedimentary rocks.

Oceanic crust – rocks enriched in basic elements or compounds made up of volcanic rocks.

The crust is made up of large plates that float on the mantle that can break up and/or move. Plates can and do interact.

Plate junctions or contacts are spreading zones or faults.

Spreading zones are divergent with plates moving away from each other and forming new crust.

Fault boundaries

Subduction (convergent) faults

Plates approach each other with one diving beneath the other.

Transform faults

Plates pass by each other, or connect spreading zones (e.g. San Andreas fault zone).

Fault types

Strike-slip fault, horizontal movement--right-lateral, left-lateral (e.g. San Andreas fault, Vasquez fault zone at Eaton Canyon, Raymond fault)

Normal fault, vertical movement, hanging-wall drops relative to foot-wall (e.g. Owens Valley fault)

Reverse fault, vertical movement, foot-wall drops relative to hanging-wall (e.g. Sierra Madre fault at Eaton Canyon)

Oblique-slip fault, movement has both horizontal and vertical components (perhaps the Sierra Madre fault)

Mountain Building

Caused by volcanism, faulting and folding generally along converging plate boundaries

Can get faulting and folding from both compression and extension

Minerals

Natural occurring non-organic, solid crystalline compounds with definite (but variable) chemical compositions

Chemicals (atoms) are arranged in a definite orderly fashion creating crystals

Mineral properties--used to identify minerals

Color – can vary

Definite crystal forms

Hardness – resistance measured on Mohs hardness scale

Cleavage – breakage along planes of weakness

Fracture

Luster – character of reflected light

Streak – color when powdered, obtained by rubbing on porcelain

Reaction to HCl (hydrochloric acid)

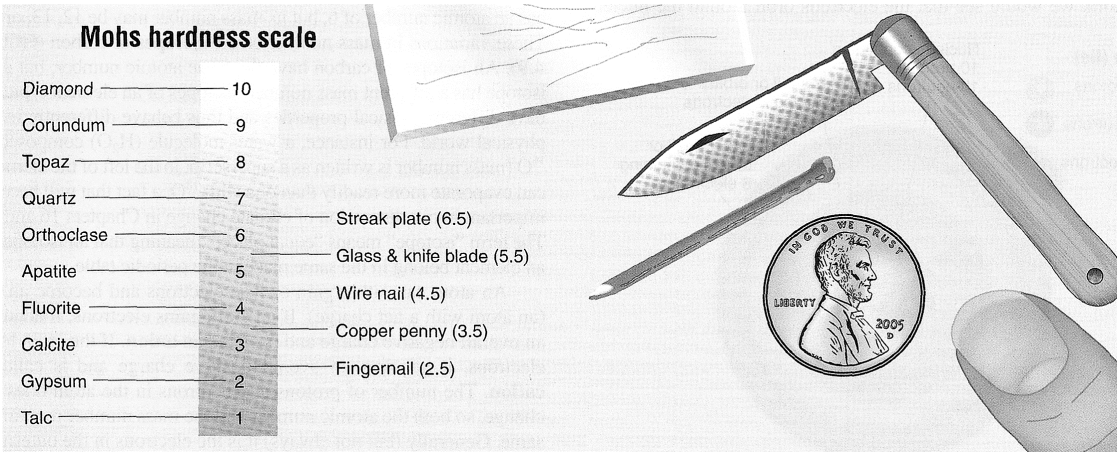


Figure 43. Mohs hardness scale. To test the hardness, scratch one mineral across the surface of another. A mineral that leaves a scratch on another is harder.

Common minerals found at Eaton Canyon

Quartz – clear to milky white, concoidal fracture, hardness 7,

Orthoclase – pink, cleavage, hardness 6

Plagioclase – white, cleavage, hardness 6

Hornblende – dark green to black, cleavage, hardness 5-6

Biotite – black to brown, shiny, platy, hardness 2

Muscovite – white to silvery, shiny, platy, hardness 2

Epidote – green, hardness 6-7

Rocks are a solid mass made up of one or more minerals. There are three types of rock.

Igneous rocks

Formed at depth from magma in the upper mantle or lower crust. Source of magma is mantle or melted surface rock in subduction zone

Most common igneous rock are granite, quartz monzonite, granodiorite, diorite and gabbro. All are found at Eaton Canyon. Volcanic equivalents of these rocks are rhyolite, andesite, dacite and basalt, some of which can be found at Eaton Canyon.

Special cases are pegmatite and quartz dikes. Both types contain quartz and/or feldspar and mica and are coarse to very coarse grained and found at Eaton Canyon.

Sedimentary rocks

Formed at the earth's surface from detritus derived from weathered rock from the crust that becomes consolidated by various processes.

Grain size of sedimentary rocks varies from clay size to massive blocks of rock.

Rivers and streams are the most common carriers of the detritus that form the largest deposits although wind can form dunes.

Common sedimentary rocks

Conglomerate

Sandstone

Shale (siltstone, mudstone, claystone)

Sedimentary rocks are not found at Eaton Canyon.

Metamorphic Rocks

Metamorphic rocks are composed of igneous, sedimentary and metamorphic minerals that have recrystallized in the crust under mid to high pressure and mid to high temperatures.

Common metamorphic rocks are gneiss, schist, slate and marble.

Gneiss – generally contains quartz, plagioclase, orthoclase, hornblende, biotite, muscovite epidote and sometimes garnet. It is usually medium to coarse grained, coarsely foliated and often banded due to mineral segregation.

Schist – generally contains mica, hornblende, plagioclase, orthoclase, chlorite, quartz and sometimes garnet. It is usually fine to coarse grained and strongly foliated with a shiny luster.

Slate – contains clay minerals, chlorite and muscovite. It is fine grained. Individual minerals are not visible.

Quartzite – contains only quartz. It is fine grained and massive.

Marble – consists of calcite. It is white, fine grained and massive.

Common rocks found at Eaton Canyon in outcrops or as clasts in alluvial deposits are :

Gneiss and schist ~ 1700 million years old

Lowe Granodiorite ~ 220 million years old

Echo Granite ~ 160 million years old

Wilson Diorite ~ 75-80 million years old

Quartz monzonite ~ 65-80 million years old

Weathering includes physical, chemical and biological processes that decompose rock.

Principle physical processes that weather rock:

Pressure relief – uplift and exposure-allows cracks and fractures to form.

Abrasion – running water and wind carrying particles causes chipping of small fragments from rock surfaces.

Freeze-thaw – wedges rock apart when water enters fractures and expands upon freezing.

Principle chemical processes are hydrolysis, oxidation and dissolution.

Hydrolysis – most common process, causes decomposition of silicate minerals. Hydrogen ions replace cations in minerals changing feldspars and dark minerals to clays.

Oxidation – causes decomposition in minerals containing iron. This is a form of rusting and source of red staining.

Dissolution – dissolving of minerals (primarily limestone and marble) by acidic water created by CO_2 mixing with precipitation in the atmosphere and in soil.

All weathering products are much more easily eroded than unweathered rock.

Rocks exposed in the Eaton Canyon area are notoriously weathered two main reasons:

The rock is highly fractured from the faulting along the Vasquez and Sierra Madre faults.

Much of the rock contains abundant dark (mafic) minerals.

Mass Wasting

Common types of mass wasting are creep, landslides, rock falls and debris flows.

Creep – is the slow downslope movement of soil under the influence of gravity over periods of days, months and years, often aided by precipitation and burrowing animals. Roots help mitigate creep.

Landslides – are relatively rapid downslope movement of masses of soil and/or rock along well defined slip planes.

Rotational slides have a curved surface, a head scarp and a bulged toe. The rock and soil mass between the head scarp and toe may be little disturbed.

Translational slides – move along planar surfaces and have head scarps.

Debris flows – fast moving slurries of water and rock and soil debris with a variety of grain sizes. Common on steeper slopes during and after heavy precipitation, especially after fires. Can move long distances.

Rock falls – rapid downslope movement of broken rock, generally caused by earthquakes. Common in Eaton Canyon area.

Alluvium

Alluvium consists of unconsolidated deposits of eroded debris containing the coarser grain sizes (fine sand to boulders). It forms valley fill and alluvial fans at mouths of canyons. They are fan shaped and may be incised by the stream that formed them. This can create stream terraces with surfaces below and parallel to the fan surface.

Earthquakes

Earthquakes are the result of the release of energy from the breaking of rock along faults.

Differential movements (stress) of very large masses of rock on either side of a fault build up strain in the locked fault. When the strain is sufficient the rock breaks and rebounds releasing energy.

The energy released produces four types of seismic waves:

P-waves – move parallel to direction of wave front, forward (compression) and back (dilation). Fastest kind of wave.

S-wave – moves up and down and side to side. Slower than P-wave.

Surface waves-- cause most damage from earthquake.

Love waves--move side to side.

Rayleigh waves--move up and down and backward and forward, generating a rolling motion.

An earthquake event may have foreshocks and will have aftershocks, all of a lower magnitude than the main shock.

After shocks decrease in magnitude with the passage of time.

Water

Hydrologic cycle – water in various forms (liquid, vapor and solid) moves continuously from the atmosphere as rain, snow, sleet and hail and falls to the surface.

On land the water either evaporates, infiltrates soil and/or rock, or runs off as stream, river or glacial flow, eventually ending up in the sea, where it evaporates and is recycled.

Watershed--area bounded by a line connecting the highest points of land within which all water flows to the trunk (ultimate) stream or river.

Surface water

Runoff – water is collected by a drainage system consisting of a network of small channels that join in a downhill direction joining a trunk stream that emerges from a watershed.

Runoff consists of precipitation that runs off the ground surface during precipitation as well as water that has infiltrated soil and/or rock and emerges at the base of the drainage. Runoff is rapid and occurs mostly during a rain event.

Ground water arrives at the surface after some delay of the precipitation event (days, months, or years) and can maintain stream runoff during limited periods of non-precipitation. Can control perennial or intermittent flow. The Eaton Canyon stream is usually perennial in the upper reaches and intermittent below the stream mouth.

Ground water

Ground water – exists in the subsurface in both the upper non-saturated, and in the lower saturated zone. Does not exist as underground pools or lakes but rather in pore spaces between grains in soils, sedimentary deposits and in fractures in bedrock. Ground water is important for the survival of plant life which can access it via roots.

Non-saturated zone – the water molecules cling to grain surfaces by capillary action. May be accessed by roots.

Saturated zone – below the water table surface where water fills all spaces between grains. The water table rises and lowers in step with wet and dry seasons, respectively.

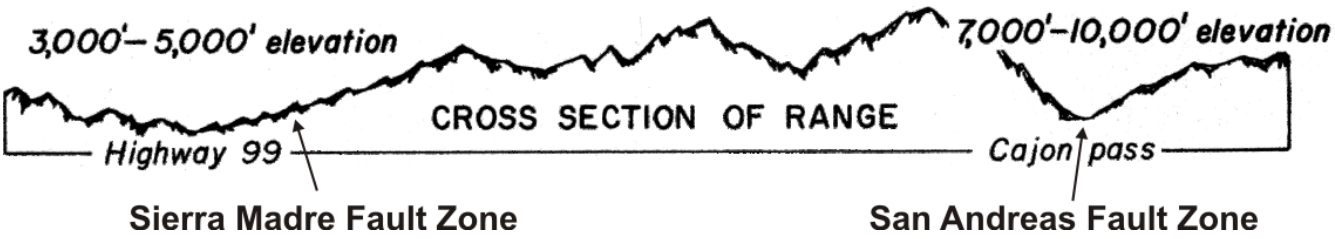


Figure 44. Cross section of the San Gabriel Mountains range.

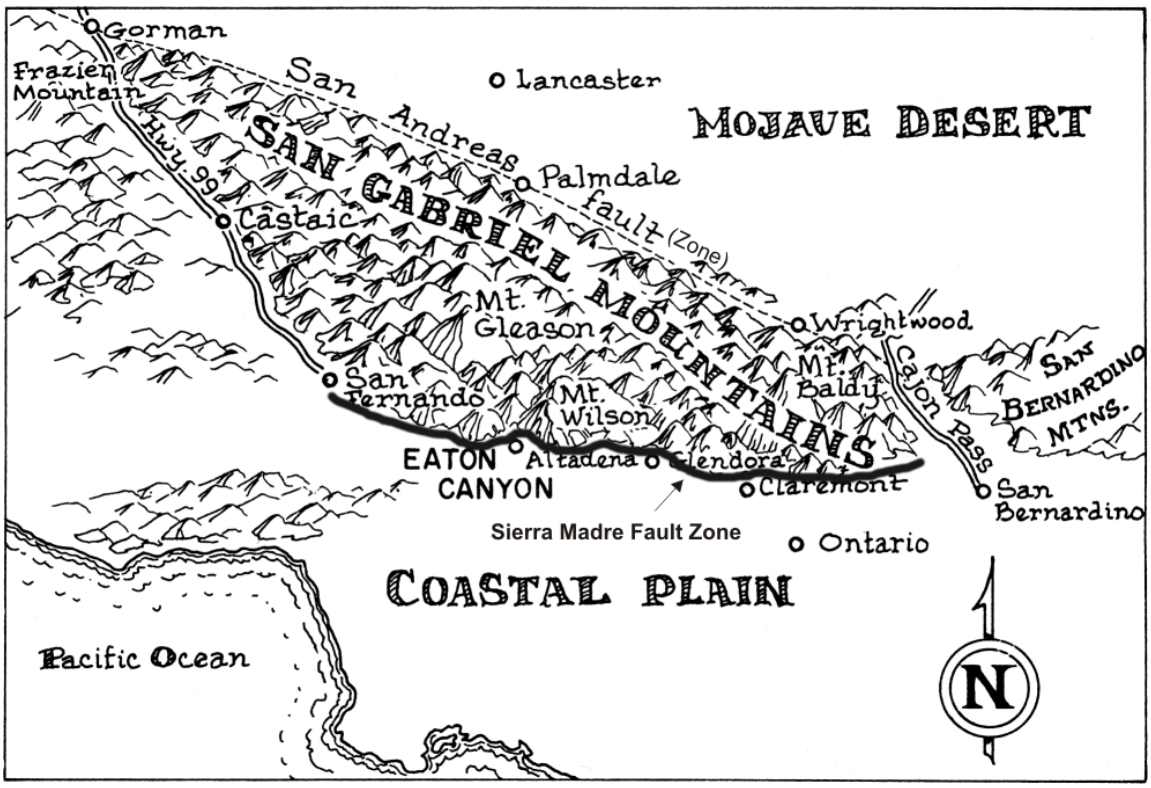


Figure 45. San Gabriel Mountains.

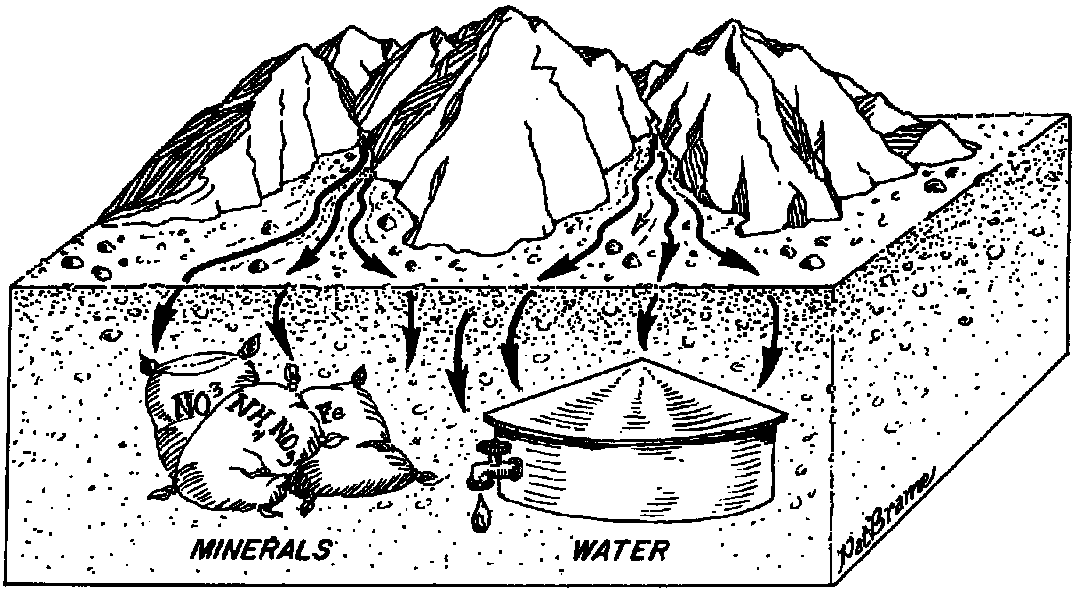


Figure 46. Soil ecosystem.

Some Common Rocks of the San Gabriel Mountain Foothills

The rocks found in the San Gabriel Mountains are primarily of two types, **igneous** and **metamorphic**. The predominant **minerals** are feldspars, micas, quartz and hornblendes. All minerals contain crystals and all rocks contain minerals.

Igneous Rocks

Figure 47. Wilson Quartz Diorite.

Wilson Quartz Diorite has a granite-like texture; the ground mineral is whitish with very small black crystals.

Figure 48. Lowe Granodiorite.

Lowe Granodiorite is an intermediate form between granite and diorite. The ground mineral is whitish, with very small black crystals, some clustered.

Figure 49. Hornblende Gabbro.

Hornblende Gabbro has a granitic texture. It is dark gray with whitish crystals deeply enmeshed.

Figure 50. Granite Pegmatite.

Granite Pegmatite is pinkish with white areas. It has a large angular crystal structure.

Figure 51. Milky Quartz.

Milky Quartz was formed by silica which was precipitated out of steam as the original magma was cooling. It is formed of very large crystals with flat planes and is white and almost translucent.

Metamorphic Rocks

Figure 52. Muscovite Mica.

Muscovite Mica is very silvery from the fine grains of mica oriented roughly parallel. It contains small, round, brown garnet crystals.

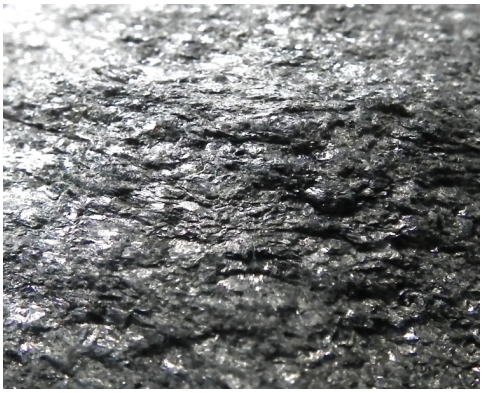


Figure 53. Biotite Mica Schist.

Biotite Mica Schist is similar to the above but is very dark and lustrous. Schists have the property of schistosity, or breaking in a wavy, uneven surface in thin layers.

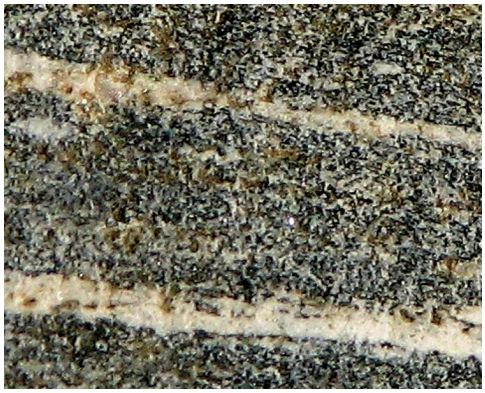


Figure 54. Gneiss.

Gneiss is a coarse-textured rock with the minerals in parallel streaks of light and dark grey.

Plants

Plants

Plants are members of the Plant Kingdom (Plantae), consisting of most of the green (and some non-green) organisms that we see. It does not include bacteria (Kingdom Monera), algae, molds, seaweeds, or kelp (Kingdom Protista), fungi (Kingdom Fungi) or lichens (combinations of fungi and algae).

Plants are distinguished from members of the other kingdoms by being multicellular, with cells that contain a nucleus and cell walls that contain cellulose. Most are capable of producing their own food through photosynthesis. Some botanists also include the green algae in the Plant Kingdom.

Because plants contain the green pigment, chlorophyll, they are able to generate their own food, and food for animals. They use carbon dioxide (CO_2) from the air, water from the soil, and energy from light to synthesize sugar, which can then be used for many other chemical processes in the plant.

While photosynthesis is a complex process, the general equation is:

$$6CO_2 + 12H_2O + \text{light energy} \longrightarrow C_6H_{12}O_6 + 6O_2 + 6H_20$$

That is to say:

6 carbon dioxide molecules + 12 water molecules + light energy
yields
1 sugar molecule + 6 oxygen molecules + 6 water molecules

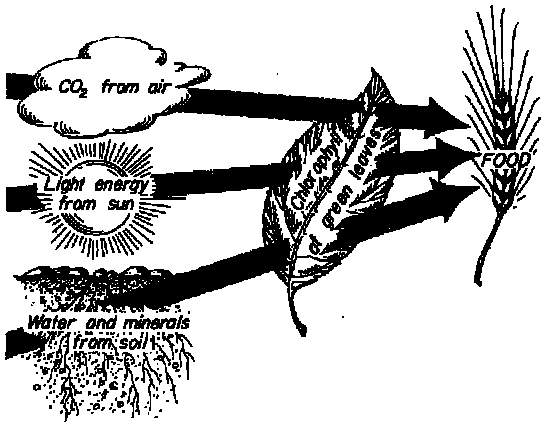


Figure 55. Photosynthesis.

All animals are dependent on the oxygen and food that are generated by photosynthesis in plants (and photosynthetic algae). Plants are, therefore, called the **producers** in ecological terms.

Plant Types (in part)

Some of the major categories of plants that are found in Los Angeles County are listed below, along with a brief summary of their characteristics and the approximate numbers of species, worldwide.

I. Non-vascular Plants

A. **Bryophytes** – Reproduction by spores; no water-conducting tissues
Mosses, Liverworts…
~23,000 species

II. Vascular Plants

A. **Ferns** and related species – Reproduction by spores; vascular tissues
Club Mosses, Spike Mosses, True Ferns, Horsetails
~10,000 species

B. **Gymnosperms** (Naked Seeds) – Reproduction by male pollen and female cones to produce seeds
Ephedra, Conifers
~1000 species

C. **Angiosperms** (Flowering plants, with fruits containing seeds)
>90% of all plants

1. **Magnoliids** – a small part of the former Dicots
3-merous flowers, net-veined leaves, 2 leaves in seed
Magnolia, Avocado, Bay Laurel…
~9000 species

2. **Eudicots** – most of the former Dicots
4- or 5-merous flowers, net-veined leaves, 2 leaves in seed
Oaks, Roses, Sunflowers, Peas, Mustards…
~200,000 species

3. **Monocots**
3-merous flowers, parallel veined leaves, 1 leaf in seed
Grasses, Lilies, Irises, Palms, Sedges, Orchids…
~60,000 species

Note: the group of flowering plants, called Dicots, has been split into two groups, because some of the plants (the Magnoliids) were found to be not as closely related to the others (Eudicots) as they were to the Monocots.

Parts of a Vascular Plant

Vascular plants are often referred to as "higher plants", meaning that they have more highly developed structures than do the non-vascular plants, like mosses and liverworts. Vascular plants have tissues (veins) that transport fluids through the plant: water and minerals from the roots to the leaves, and sugars – food – from the leaves to the roots, where they can be stored.

Vascular plants generally have four primary parts: roots, stems, leaves, and reproductive parts.

Leaves

Generally, most of the visible biomass of a plant consists of leaves. Leaves are usually green because they contain chlorophyll. A key characteristic of plants is the ability to make food through photosynthesis, for which chlorophyll is essential. In photosynthesis, water and carbon dioxide – with the help of sunlight – are converted into sugar, releasing oxygen in the process. All animals, including people, depend on this oxygen and on the food that is produced by plants (and algae).

Some plants have lost the ability to make food and depend on other plants to do it for them. These plants are parasites, which take their food from other plants, either directly or indirectly through the use of intermediate fungi. These parasites often do not have leaves and are usually not green, because they have no chlorophyll. An example of a parasitic plant in the San Gabriel Mountains is Dodder (*Cuscuta spp*.).

Roots

One of the major functions of roots is to anchor the plant in the soil. Roots provide a stable base to support the above-ground structure of the plant.

A second, vital function of roots is to absorb water and minerals from the soil and make them available to the rest of the plant. Roots are the only part of the plant that can do this. Usually, the take-up of water and nutrients is aided significantly by specialized soil fungi, called mycorrhizal fungi. The plants and the fungi form mutually beneficial, symbiotic relationships, called micorrhizae.

In plants that live for more than one year (perennial herbs, shrubs, and trees), roots are also used to store energy, in the form of starches. This is especially important for plants that must survive periods without the ability to produce food, such as during cold winters or dry summers, and after fires. When conditions are right again, the plant can use that stored energy to quickly produce leaves that can make food again.

Stems

Stems may be light and flexible, even hollow, or rigid and woody. In either case, the two primary functions are structural support to the leaves and flowers, and the transport of water and nutrients.

For most plants, it is important that the leaves be held where they can maximize their exposure to sunlight. Stems provide this support to the leaves. In addition, the stems hold flowers (or cones, in conifers) in positions that enhance the likelihood of being pollinated by the wind or by animals.

Stems contain veins that carry water and minerals from the roots to the leaves. They also move the food, which is produced in the leaves, to other parts of the plant for growth, and to the roots for storage. In

woody plants, such as trees, the transport tissues lie in the inner bark, between the woody part and the outer, protective bark. The wood is only for support.

Reproductive Parts

In flowering plants, the reproductive parts are contained within the flowers. In conifers, they are within the cones, and for ferns, they are the spore-producing sporangia, which are usually on the undersides of the leaves.

Flowering Plants

Flowering plants are vascular plants that have their reproductive parts in the form of flowers. The flowers may be large and showy, as in the Foothill Poppy (*Eschscholzia caespitosa*), or tiny and inconspicuous, as they are on the catkins of an oak tree or the spikelets of grasses, sedges, and rushes. Some shrubs also have small, hard-to-notice flowers, like the California Coffeeberry (*Frangula californica*).

Flowering plants, as a group, developed more recently than conifers, ferns, and mosses. Using a flower for reproduction has made flowering plants very successful, as evidenced by the vast number of different species and their distribution to virtually every corner of the earth. About 90 percent of all plant species are flowering plants. The extreme variability of flower forms demonstrates adaptation to different conditions, and contributes to the success of this form of reproduction.

In spite of the variability of form, all flowers follow the same basic structure and pattern of sepals, petals, stamens, and pistils. That structure is often readily apparent, but sometimes it requires significant magnification to recognize the parts, and sometimes some of the parts are missing.

There have traditionally been two major subdivisions of flowering plants: the dicots (dicotyledons) and the monocots (monocotyledons). Recently, because of greater understanding of the relationships among plants, the dicots have been split into two groups: the magnoliids and eudicots. Most of what were considered dicots are now called eudicots. One local exception is California Bay, which is a magnoliid.

All of the flower parts first appeared millions of years ago from modified leaves. They are arranged in a series of whorled structures. In nearly all botanical references, they are described from the bottom up or, equivalently, from the outside in. You can see the arrangement of parts in the adjacent diagrams.

Sepals

The outermost parts of an individual flower are called sepals. There are usually two to five sepals that cover the developing flower while it is in bud. They are usually green, but may be nearly any color, sometimes matching the petals. The term **calyx** refers to all of the sepals together.

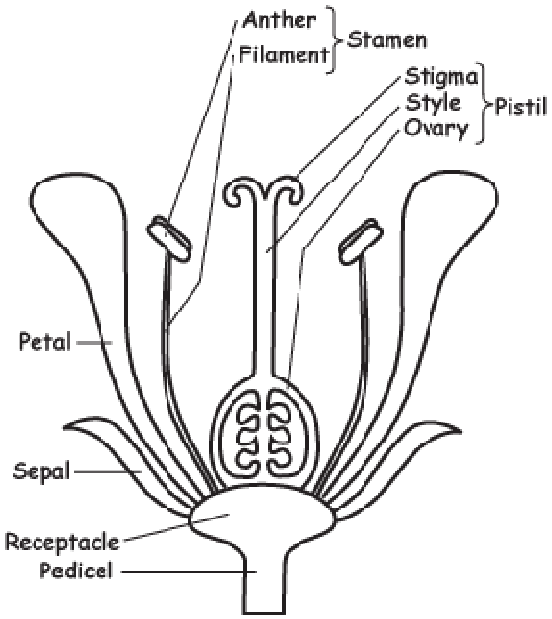


Figure 56. flowering plant parts.

Petals

Next come the petals, which are often colorful and showy, usually three to many per flower. Their primary function is to advertise the flower to insects and other animals that can pollinate it. Flowers need to offer a benefit to the pollinators. This is usually sugary nectar, which is often secreted by glands, called nectaries, at the bases of the petals. In some cases, the reward for pollination by animals is the pollen itself. This is especially true of bee-pollinated flowers.
Plants that are not animal-pollinated (wind-pollinated, for example) usually do not have colorful petals and they may not have any petals at all.

The term **corolla** refers to all of the petals together. The calyx and corolla together are called the **perianth**. Sometimes, especially in monocots, like Brodiaea, and some eudicots, like cacti, the sepals and petals are so similar that they are virtually indistinguishable. In this case, they are collectively called **tepals**.

Stamens

The next ring of parts consists of the stamens, which are the **male flower parts**. A stamen usually consists of a **filament** and one or two **anthers**. The anthers produce pollen and release these dust-sized particles when they are ripe. The filament is the stalk that holds the anthers in the best position for the wind or a pollinating animal to disperse the pollen. When a flower does not have any stamens – or the stamens are sterile and do not produce pollen – we speak of the flower as a female flower.

Pistils

Within the whorl of stamens, there are generally one or more pistils, the **female flower parts**. A pistil usually has three parts. The base of the pistil is the **ovary**. Inside the ovary are the ovules that will become the seeds after pollination. When the ovary is visible above the base of the petals, we speak of a **superior ovary**. When it is below the petals, it is called an **inferior ovary**. Some plants have ovaries that are part way in between. At the tip of the ovary is usually a stalk, called the **style**, that holds the stigma in the proper position for pollination. The **stigma** is the usually sticky part that will receive the pollen. In plants that have separate male and female flowers, the male flowers generally do not have a pistil.

Adaptations to Our Mediterranean Climate in Coastal Sage Scrub and Chaparral

In Southern California's Mediterranean Climate, nearly all of the rain comes in winter and early spring, while almost none falls through late spring, all summer, and fall. Local plants need to survive six to eight months with virtually no rain. Our native plants have developed several adaptations to this challenge.

The primary issue is to prevent as much loss of water through the leaves as possible. For most plants, pores, called stomata, on the undersides of the leaf, through which the plants exchange gasses. Carbon dioxide is taken in to permit photosynthesis, and oxygen and water are released. This release of water vapor is called transpiration.

Here are some of the adaptations that are common in our local flora:

1. Minimize exposed surfaces
Many plants have leaves that are very small, to minimize the stomata through which they can lose water. Examples are Flat-topped Buckwheat, Pine Goldenbush, and Scale Broom, which takes this approach to the maximum.

2. Seal in the moisture
Most of the shrubs of chaparral and some trees have hard, waxy-feeling leaves to prevent as much moisture loss as possible. Examples are Sugar Bush, Coast Live Oak, and Hollyleaf Cherry.

3. Reflect the sunlight
Many plants, especially those of Coastal Sage Scrub, have whitish or gray-green leaves. The lighter color reflects the light so that the leaves stay cooler and evaporate less water. White Sage and California Fuchsia are good examples. Mugwort has the white on the undersides of the leaves, which it turns toward the sun on hot days. The waxy leaves of chaparral shrubs will also reflect some of the light.

4. Keep the air next to the leaf still
When you touch the leaves, you will feel that many of them have short hairs that give them a soft, fuzzy feel, especially on the undersides where the stomata are. These hairs reduce the movement of drying air in that thin layer right next to the leaf, reducing moisture loss. Indian Milkweed and Thickleaf Yerba Santa are examples.

5. Store your own water
Succulents, like Coastal Prickly Pear are famous for storing water within their fleshy pads, which are their stems. Others, like Canyon Liveforever, use their leaves.

6. Go dormant in the summer
The hills of Southern California can look pretty dry and dead in the heat of summer and fall. Many of the plants do not try to keep the above-ground parts active. Instead, they withdraw water into their roots and let their leaves dry up and fall off, in what is called drought dormancy. With the first rains of winter, their leaves begin to grow again on the existing stems, like California Sagebrush and Deerweed, or from their root crown, like Wild Cucumber. All of the plants that grow from bulbs, like Soap Plant and Blue Dicks, naturally wait out the summer underground.

7. Grow in the shade
The plants that grow in the understory of Oaks, do not need to conserve water as much as those that grow in full sun. The oaks (and to a lesser extent, shrubs) provide an environment that is not as challenging;

where water does not evaporate as quickly. Examples are Coastal Wood Fern, Golden Currant, and Hummingbird Sage.

8. Grow only where water is available
While not exactly an adaptation to summer drought, this strategy works well for Willows, Mule Fat, Sycamores, and Stinging Nettle.

9. Develop an effective root system
Western Sycamores develop roots that grow deep into the gravelly soil near washes, whose water flows on the surface only part of the year. The roots need to reach the water that still flows deep below the surface. Coast Live Oaks have deep roots, but also have wide-spreading roots near the surface to capture water from fog or drizzle near the coast.

10. Don't even try to survive the summer
Annual herbs, are those whose life-cycle completes in only one year don't need to survive through a drought. But they must germinate, grow, flower, and set their seeds before they get too dry. Their seeds, which are already dry, easily survive though the summer and germinate when water from the winter rains soak through the seed coats. Southern Suncup, Fiddleneck, and California Poppy are annuals.

A number of plants of the Coastal Sage Scrub and Chaparral plant communities combine two or more of these strategies. Felt-leaf Everlasting is white from a dense coat of white hairs, so it reflects light and stills the air. California Sagebrush has tiny, gray-white leaves that drop in late summer. Flat-topped Buckwheat has tiny leaves that are also waxy.

Adaptations to Periodic Fires in Coastal Sage Scrub and Chaparral

In Southern California, because of the summers and falls that have little or no rain, the plants of Coastal Sage Scrub and Chaparral get very dry and can burn easily. As a result, they are periodically subjected to large, often wind-driven fires. If a plant species is to exist here for very long, it needs to be prepared to survive occasional fires. Our local native plant species have developed a number of adaptations that have been successful for them.

Here are some of the adaptations that are common in our local flora:

1. Don't try to survive the fire
Annual herbs live their entire lives within one year. They are not expected to survive a fire, but their seeds can. Their seeds need only to wait until the rainy season comes to germinate and grow, often in more abundance and with greater size than before the fire, as a result of the extra space and nutrients in the soil from the ash.

Some annuals are fire specialists. Their seeds do not germinate in a season without a fire. Their seeds can lie dormant in the soil until they receive a cue from the fire; for some it is the heat, for others it is chemicals in the ash or charred wood. The fire cue conditions the seed coat to allow entry by water, so that it germinates with the first rains. After a fire, these fire-followers, like Stinging Lupine and Large-flowered Phacelia, can grow and flower in amazing abundance. Some, like Yellow-throated Phacelia and Fire Poppy, will not be seen again until the next fire.

2. Withdraw before a fire
A number of perennial herbs finish their reproductive cycle prior to the time of high fire risk and let their above-ground leaves and stems dry up and drop off. Their roots have stored food with which they will

grow new stems and leaves the following year – with or without a fire. Species that grow from bulbs, corms or rhizomes are in this category. Mariposa Lilies, Soap Plant, and Wild Cucumber are examples.

3. Insulate yourself
Some of the larger trees, like Coast Live Oak, have very thick bark that insulates the important inner bark, this permits the tree to survive low ground fires with little damage.

4. Allow the top to burn
A high percentage of chaparral shrubs have the ability to grow new trunks and branches from the root crowns, in a process called "crown sprouting". While the entire above-ground parts may be burned, the roots are protected by the soil. Special buds in the crown can take advantage of food stored in the roots to quickly grow new stems and leaves, without even waiting for the first rain. New growth of Chamise and Scrub Oaks can be seen very soon after a fire. These shrubs are called "resprouters". A variation on this adaptation, used by Coast Live Oak, is to be ready to sprout new growth from the trunks and branches.

5. Use the fire to prepare seeds for germination
In mature chaparral, it is not productive for seeds to germinate when seedlings cannot thrive for lack of light and space. So, the seeds of many shrubs, like Hoaryleaf Ceanothus and Bigberry Manzanita, will not germinate until a fire creates openings and provides the cues for germination (heat or chemicals in ash or charred wood). Plants that grow from seeds after a fire are called "seeders". Some species, like Deerweed, produces two types of seeds – some that need fire cues and some that don't.

Some perennials and short-lived shrubs are strict fire-followers. Their seeds may lie dormant until they receive the fire cues and then germinate. Because they do not flower in the first season, they do not get attention until the second or third year after the fire. They live only until the chaparral cover closes once again and they are not seen again until the next fire.

6. Reseed from outside the burned area
Some plants have no mechanism to survive fires. However, burned areas may be revegetated by seed from nearby unburned areas. These may be plants with wind-blown seeds, like those of some grasses and many members of the sunflower family, carried on animal fur, or deposited in the scat of birds and mammals.

Risk of Too Frequent Fires

Chaparral is often said to be adapted to fire. Some even say that chaparral "needs fire". However, chaparral and coastal sage scrub plant communities are adapted to survive occasional fires. They are not able to survive fires that occur too frequently. To say that chaparral needs fire is similar to saying that because you have fire insurance on your house, your house needs to burn.

The problem is that, with over 17 million people living in the five-county Greater Los Angeles Area, people have come to cause a number of fires that far exceeds the natural fire frequency, or that caused by the Native Americans.

Resprouting from the root crown is very effective in regenerating the plant communities, and does it rather quickly by using energy stored in the roots as starch. To prepare for the next fire, resprouters must grow new stems and leaves, which consumes much of the stored energy. It must then create new food to replenish the energy in the roots that was lost. This may take several years. If another fire comes too soon, the shrub may not have enough stored energy to resprout again and may not survive.

Similarly, seeders need time to recover. The seeds must germinate, grow into a mature shrub, flower, fruit, and set new seeds. This will usually take longer than resprouting. If the next fire comes before the cycle is completed, the species will be lost to that location.

Either type of shrub is placed at significant risk from fires that come too often. The result of fires that occur without sufficient recovery time is that the plant communities will be converted to a totally different plant community, usually that of introduced, invasive grasses and other weedy plants. This process is called “type conversion”. Besides the loss of the natural communities that support the native fauna, the weedy grasslands are even more fire prone and do not support the local animals nearly as well.

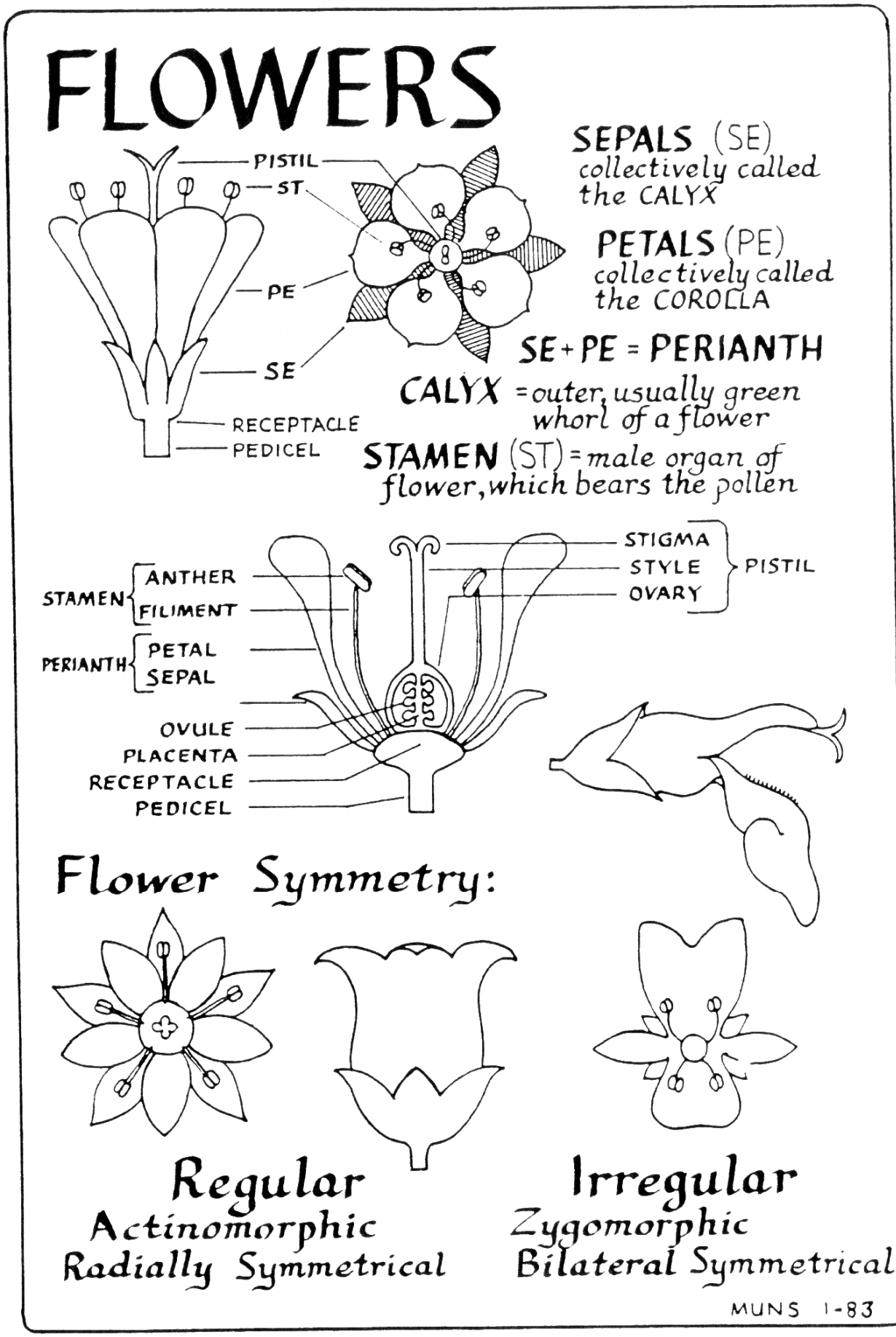


Figure 57. Parts of a flower and flower symmetry.

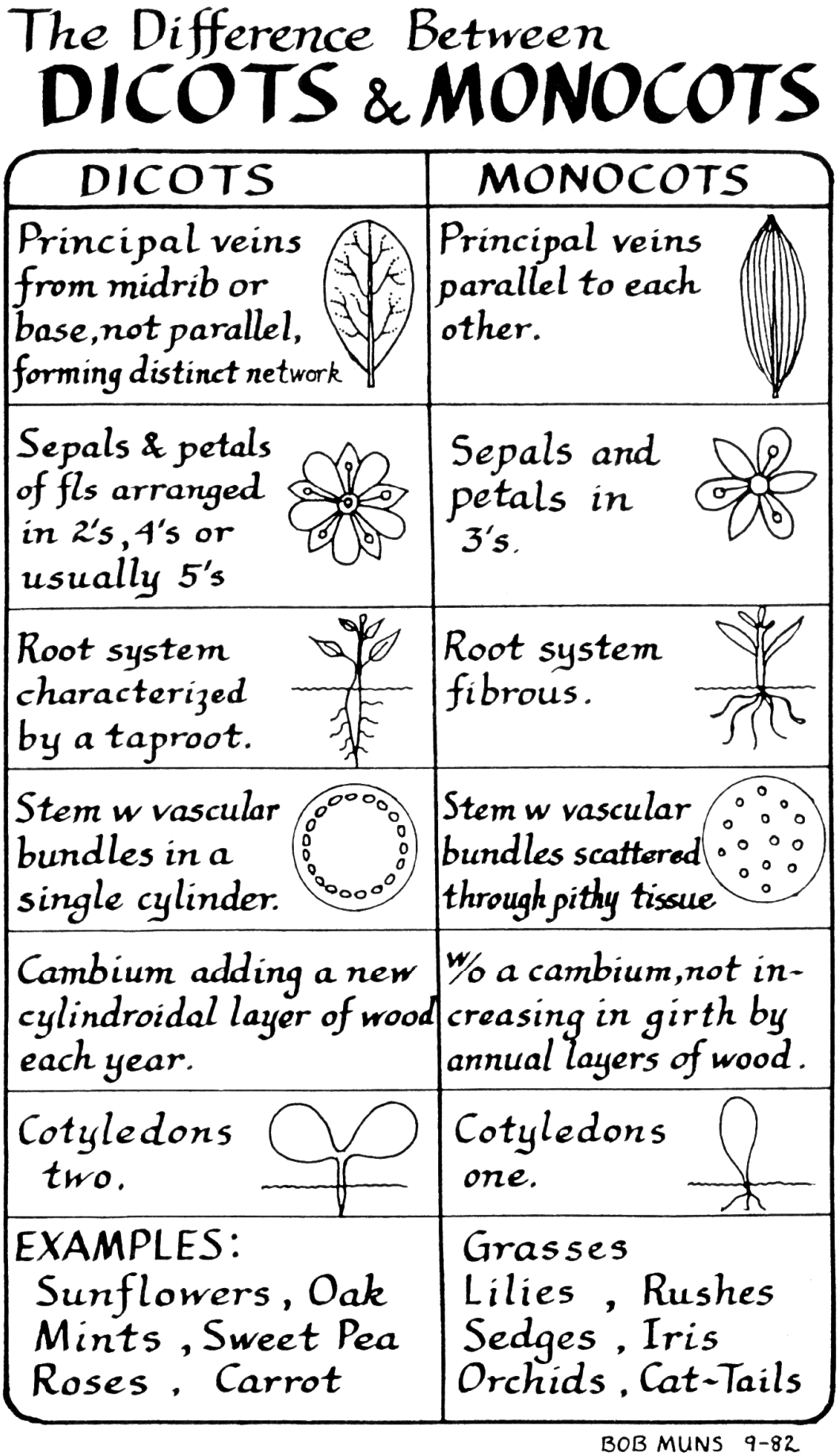


Figure 58. Comparison of dicot and monocot characteristics.

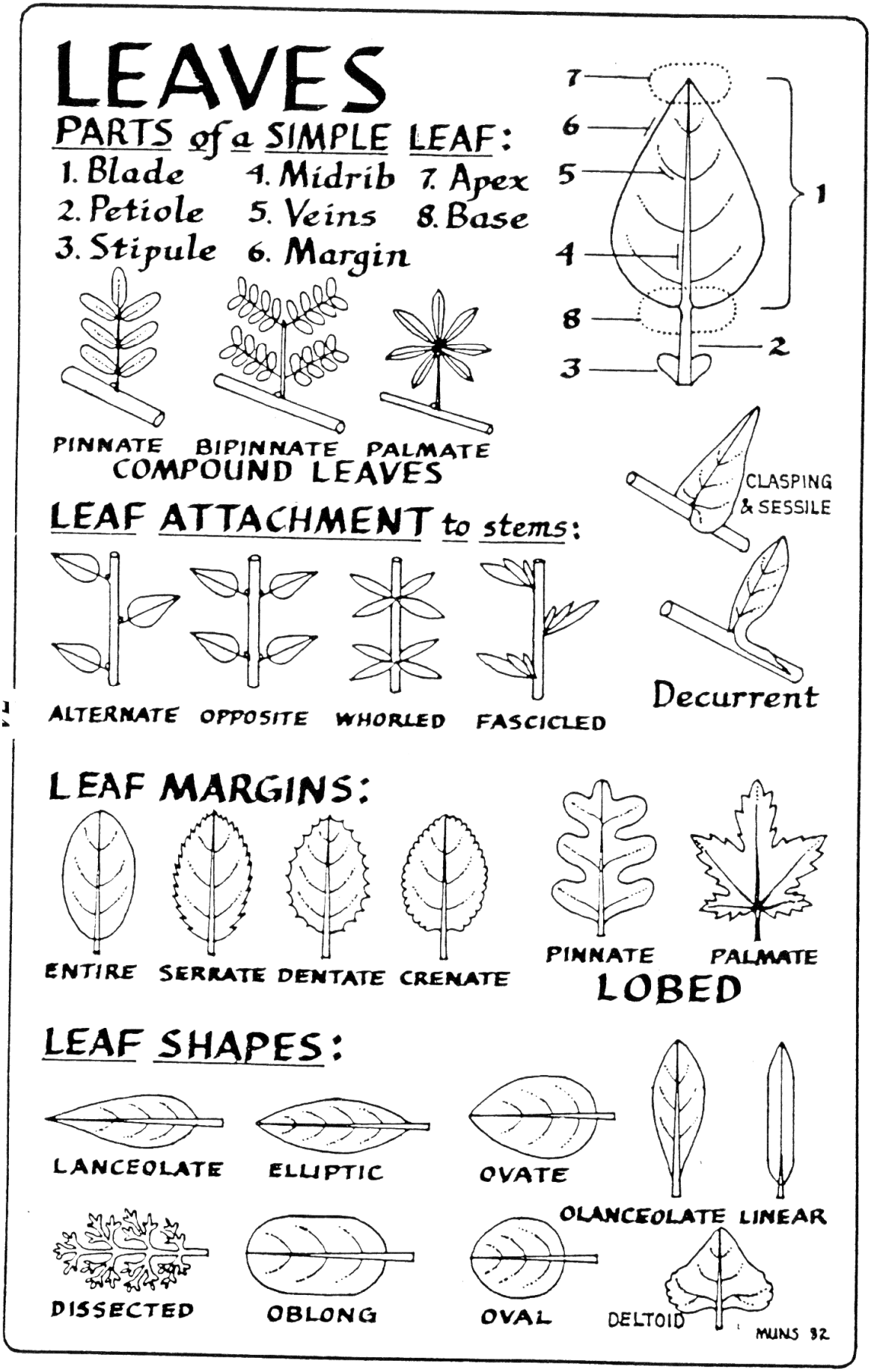


Figure 59. Illustration of leaf types.

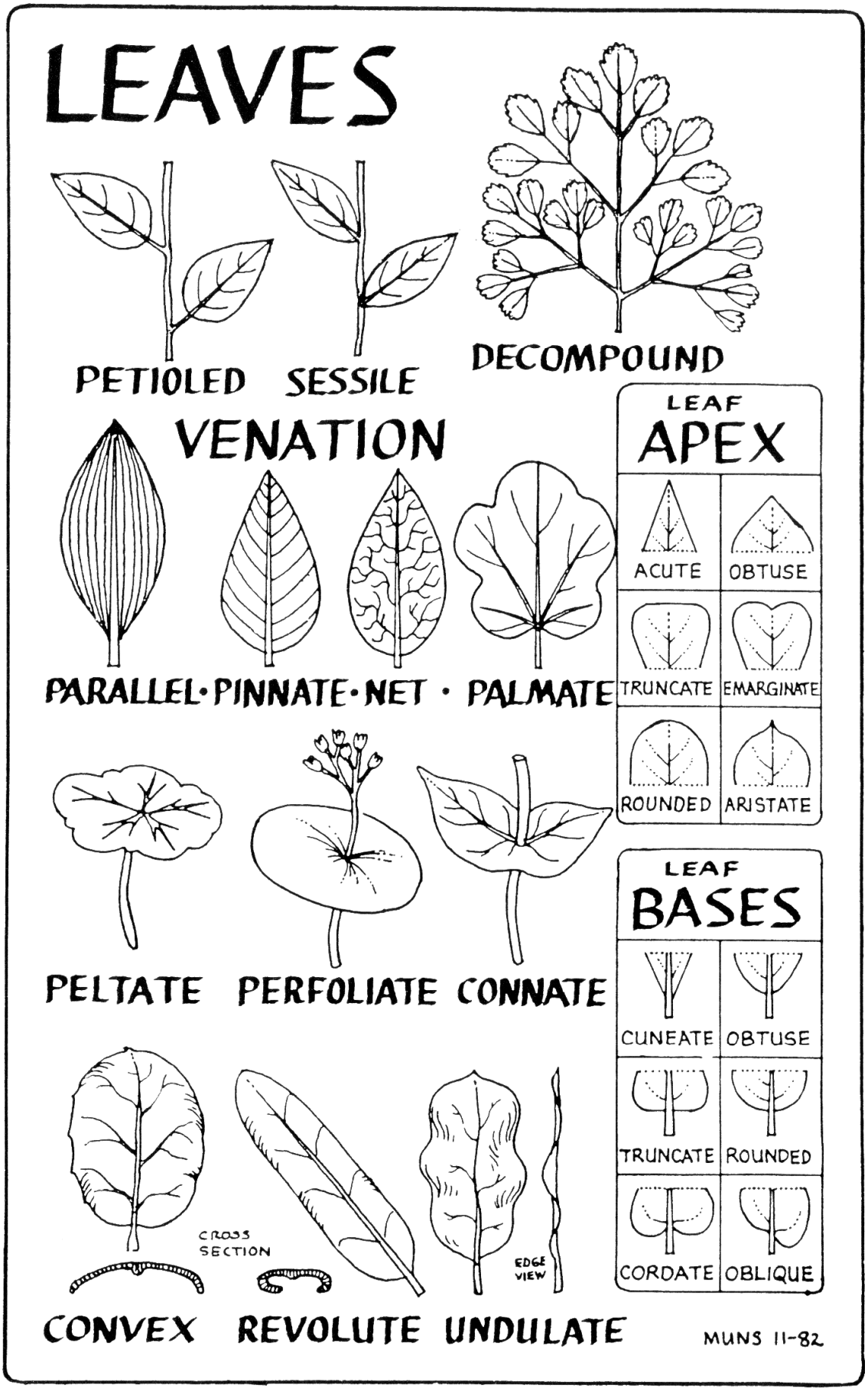


Figure 60. Illustration of leaf types.

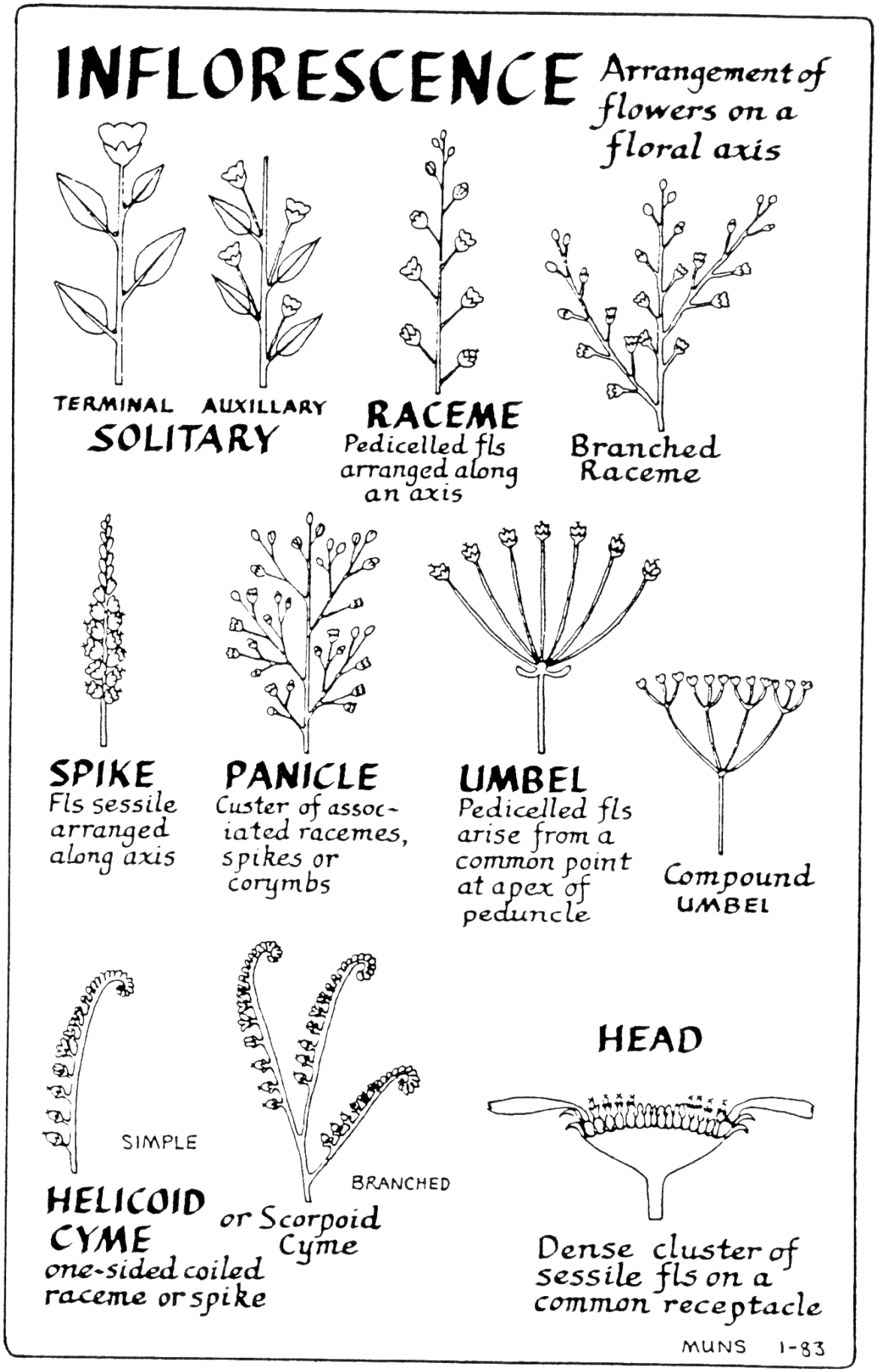


Figure 61. Arrangement of flowers on a floral axis.

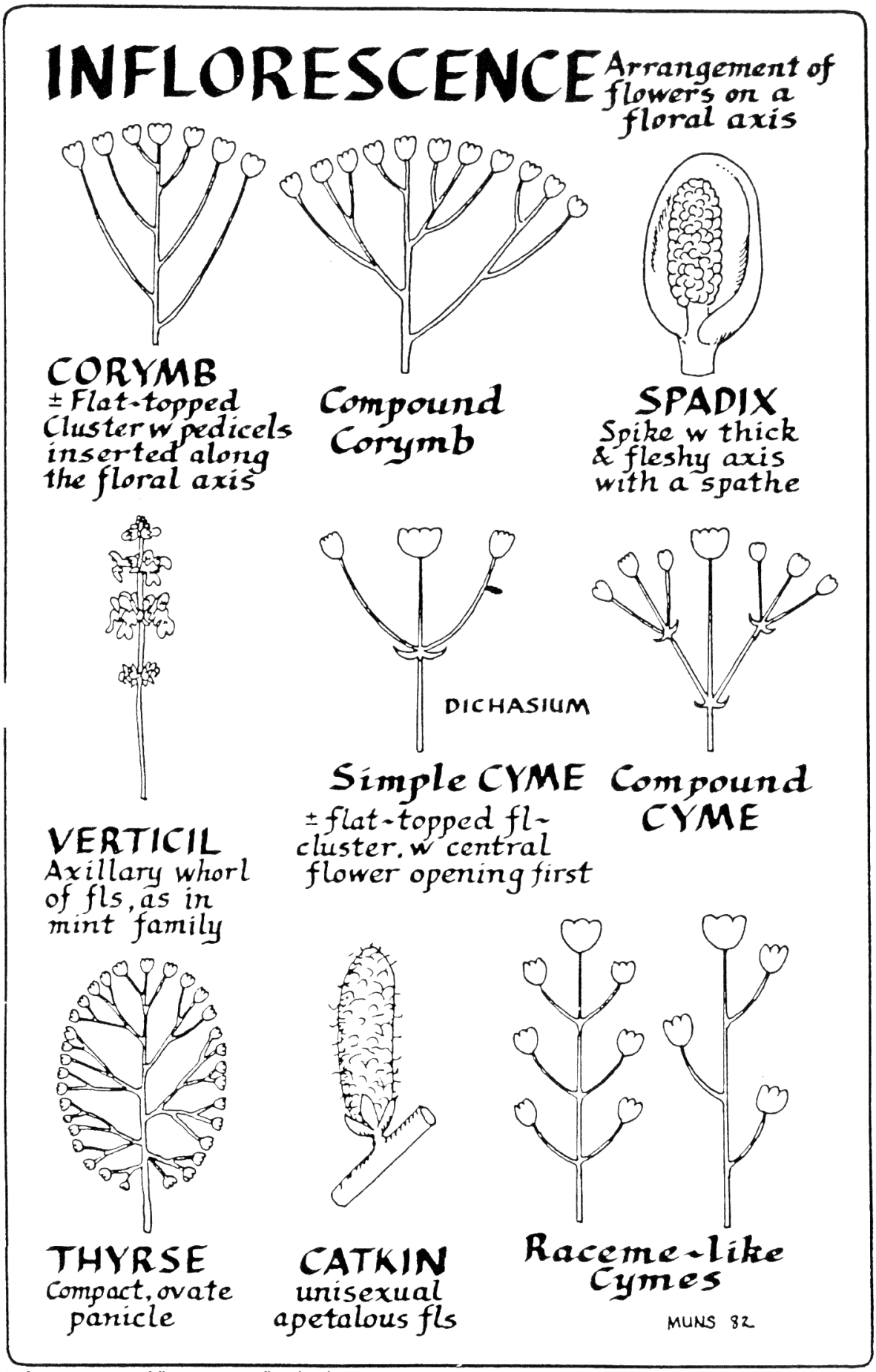


Figure 62. Arrangement of flowers on a floral axis.

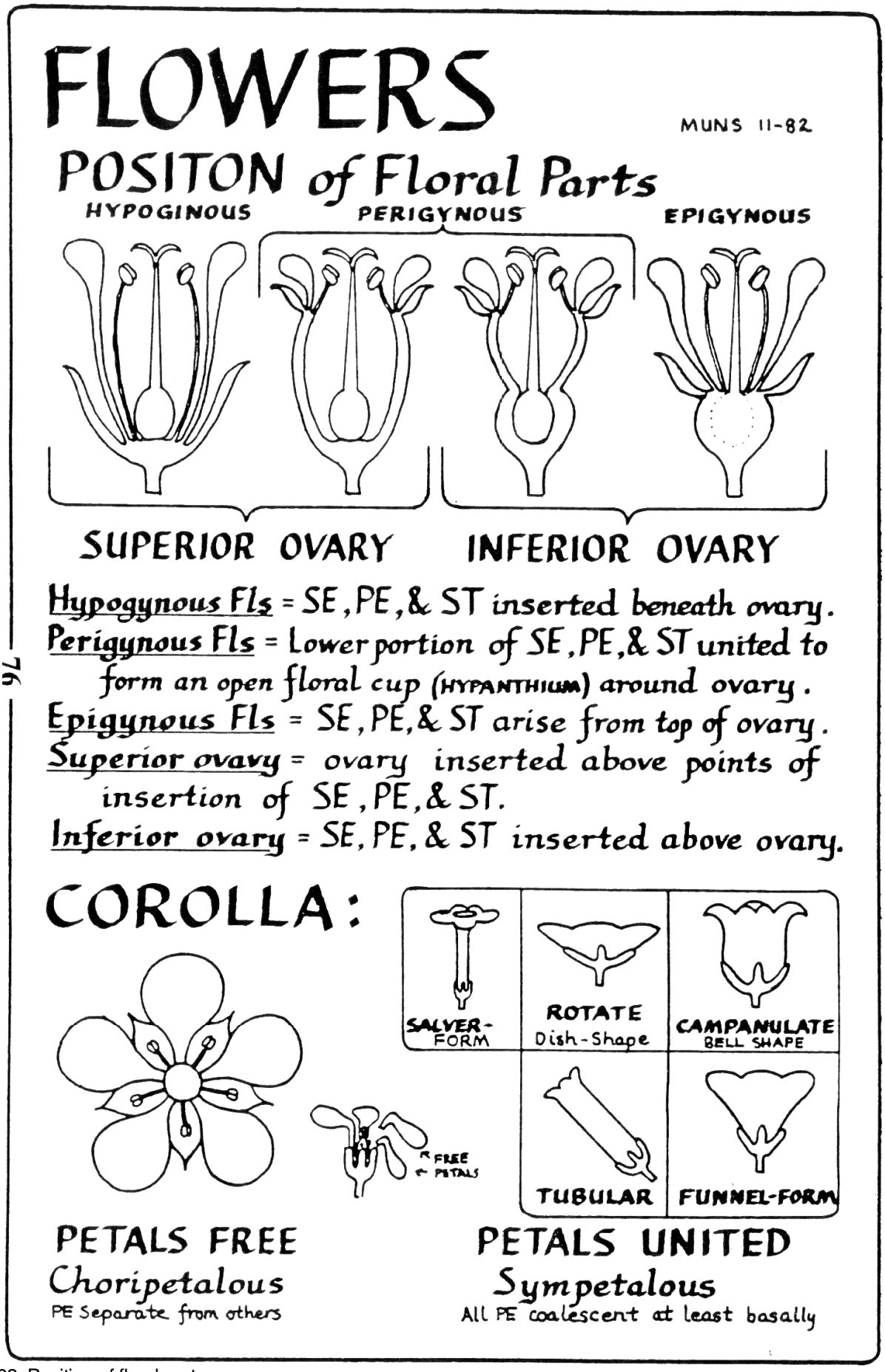
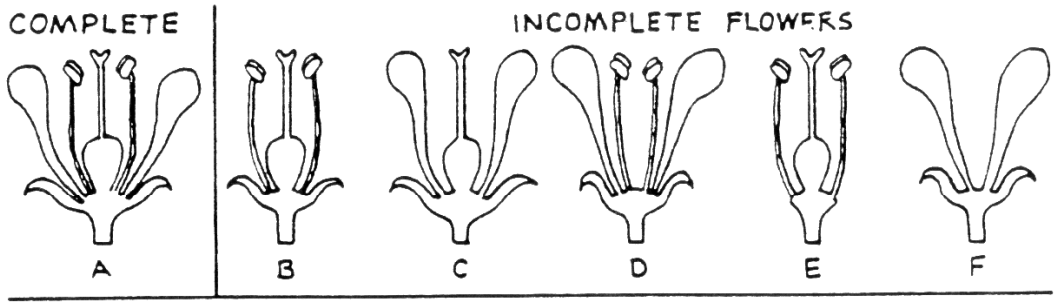


Figure 63. Position of floral parts.

FLOWERS

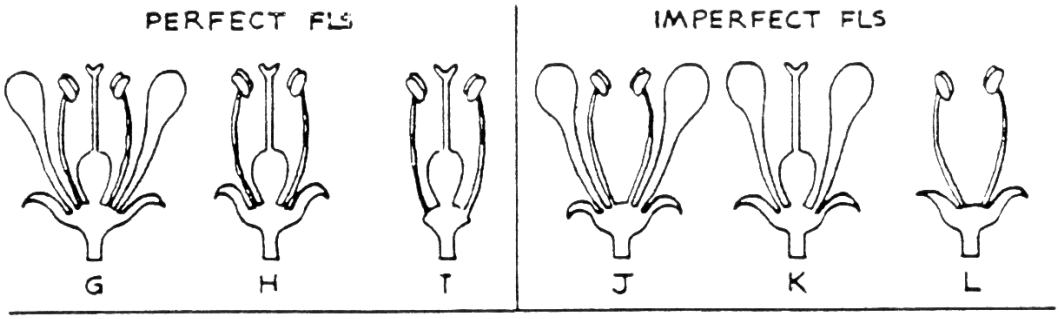
COMPLETE Fl: Fl has sepals (SE), petal (PE), & stamen (ST) and pistil (Pl)

INCOMPLETE Fl: Fl lacking one or more of the above flower parts.



PERFECT Fl (Bisexual fls): Fl has both ST & Pl.

IMPERFECT Fl (Unisexual fls): has only ST or only Pl.



Staminate Fls: Fls w ST, but w/o Pl. (D, J & , L above)

Pistillate Fls: Fls w Pl, but w/o ST. (C & K above)

MONOECIOUS Plants: with imperfect (unisexual) fls, staminate & pistillate occurring on the same individual plant.

DIOECIOUS Plants: w imperfect fls, staminate fls only on one individual plants, pistillate on another.

POLYGAMOUS Plants: w perfect (bisexual) and imperfic flowers on the same individual plant.

MUNS 11-82

Figure 64. Flower types.

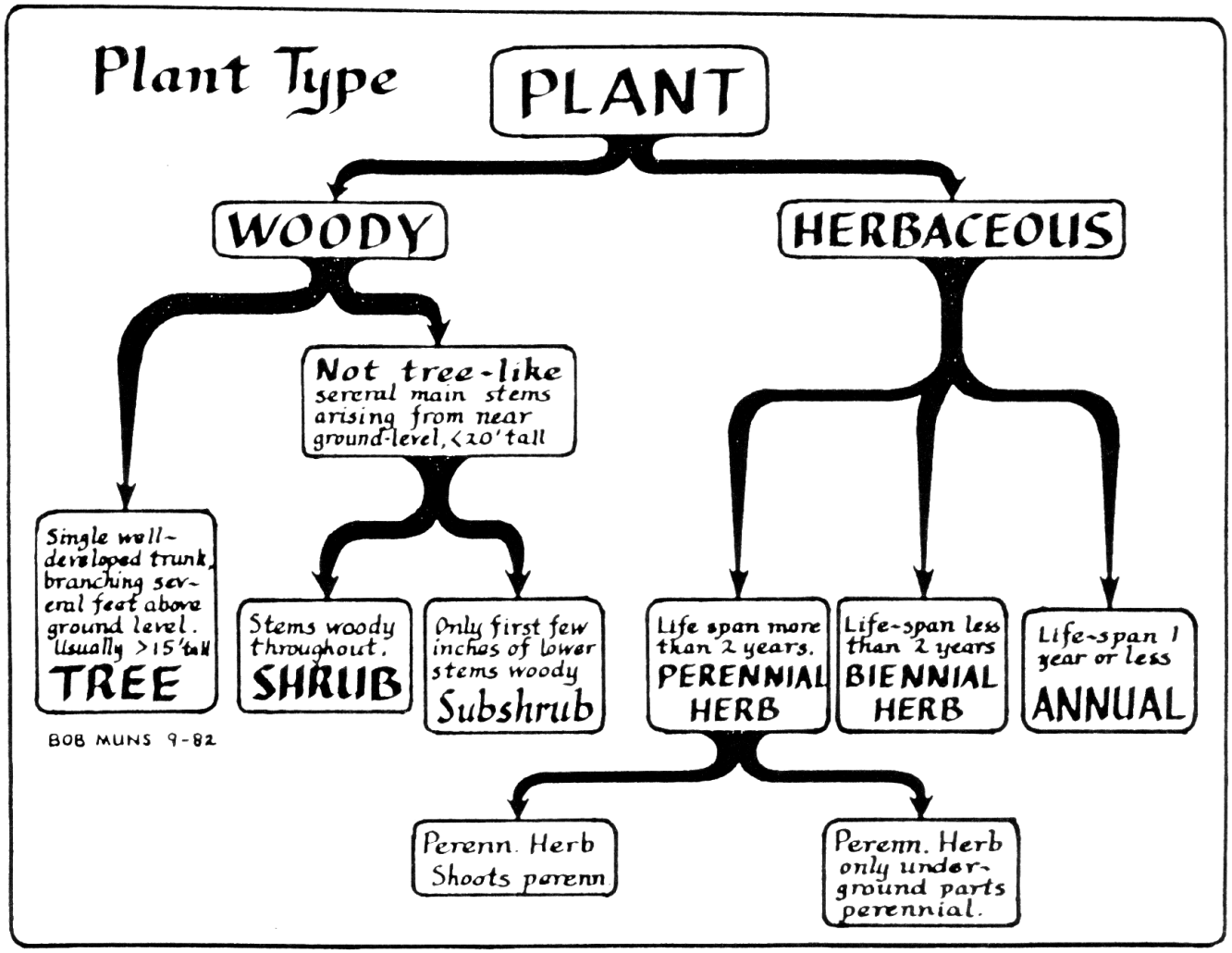


Figure 65. A system of classification of plant types.

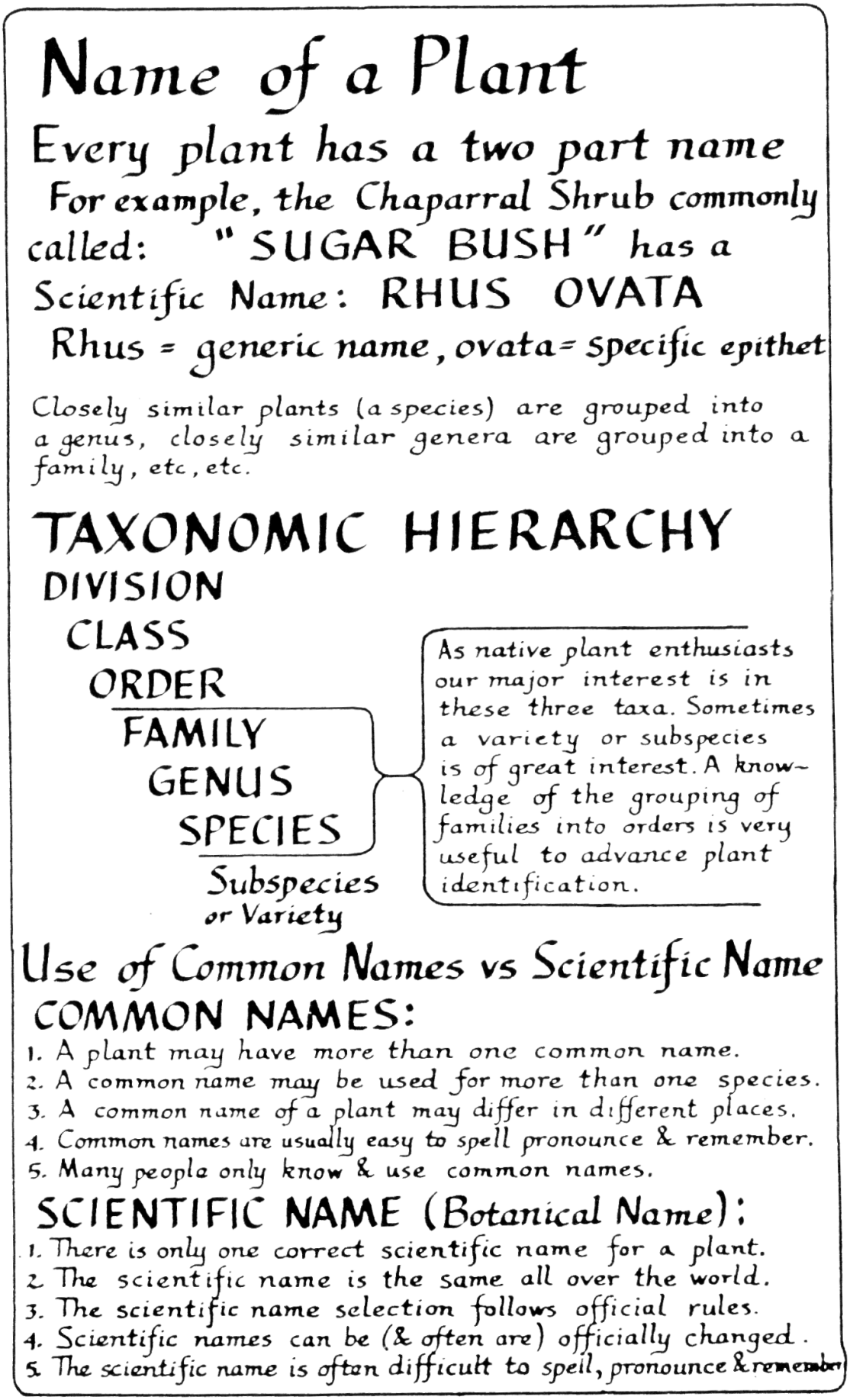


Figure 66. The taxonomic system for plant names.

Plant Communities

Vocabulary words: **indicator species**, **ecotone**, **pioneer community**, **drought deciduous**

A plant community is a grouping of plants which have similar tolerances to a given physical environment. These tolerances are of temperature, rainfall, soil, solar radiation, and wind. A plant community may vary somewhat in different geographical locations, but will be characterized by certain indicator species wherever it occurs.

Important Plant Communities of County Natural Areas

The following plant communities are present to varying degrees at Eaton Canyon, Placerita Canyon, San Dimas Canyon and Whittier Narrows natural areas. Plant communities rarely have distinct boundaries, often merging one into another to form an ecotone or transitional zone of vegetation. Thus, Coastal Sage Scrub often intermingles with adjacent Chaparral and Southern Oak Woodland with adjacent Riparian vegetation. The diversity of plants brought about by this transition zone situation allows for large and varied animal populations.

A. The Coastal Sage Scrub Plant Community

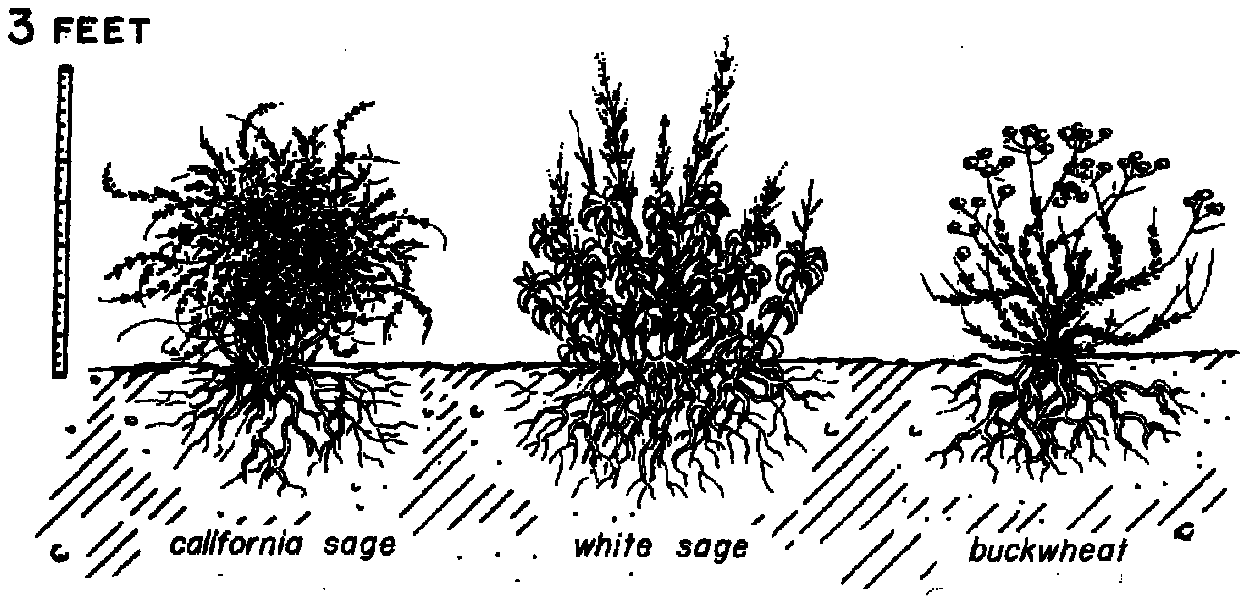


Figure 67. Coastal Sage Scrub indicator species.

The indicator species are California sagebrush, white sage, black sage, and lemonade berry. This community is usually found on gravelly slopes below 3,000 feet elevation. It is found below the Chaparral where there is a border between the two communities. It occurs in the rocky wash areas and the lower slopes of the foothills. Where the Chaparral has been disturbed by fire, bulldozers, etc., the Coastal Sage Scrub is the first plant community to appear. For this reason, it is called a pioneer community.

The species of this community are adapted to a hot, dry environment by having very small leaves and by drought-deciduous dormancy, which means that the plant loses its leaves during the hot, dry periods of the year. The root systems are shallow so that they can absorb the surface water as it percolates through the sandy soils in which they grow.

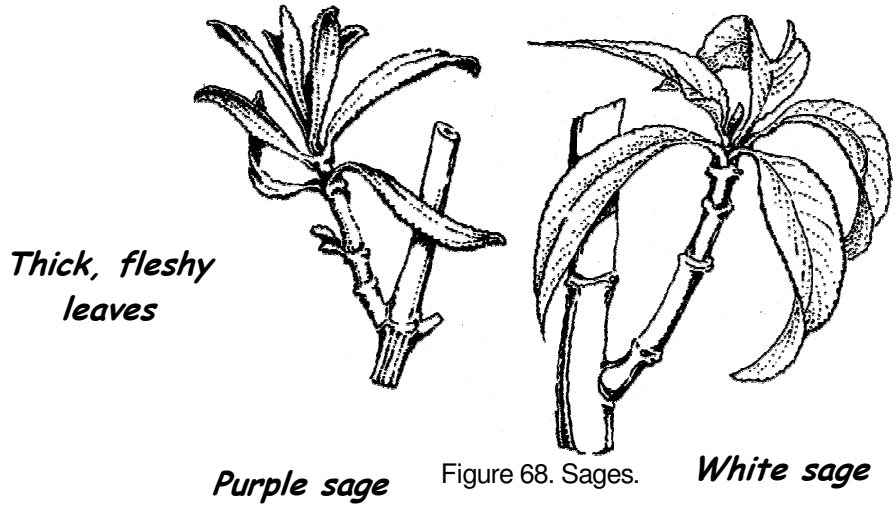


Figure 68. Sages.

B. The Chaparral Plant Community

Vocabulary word: **cuticle**

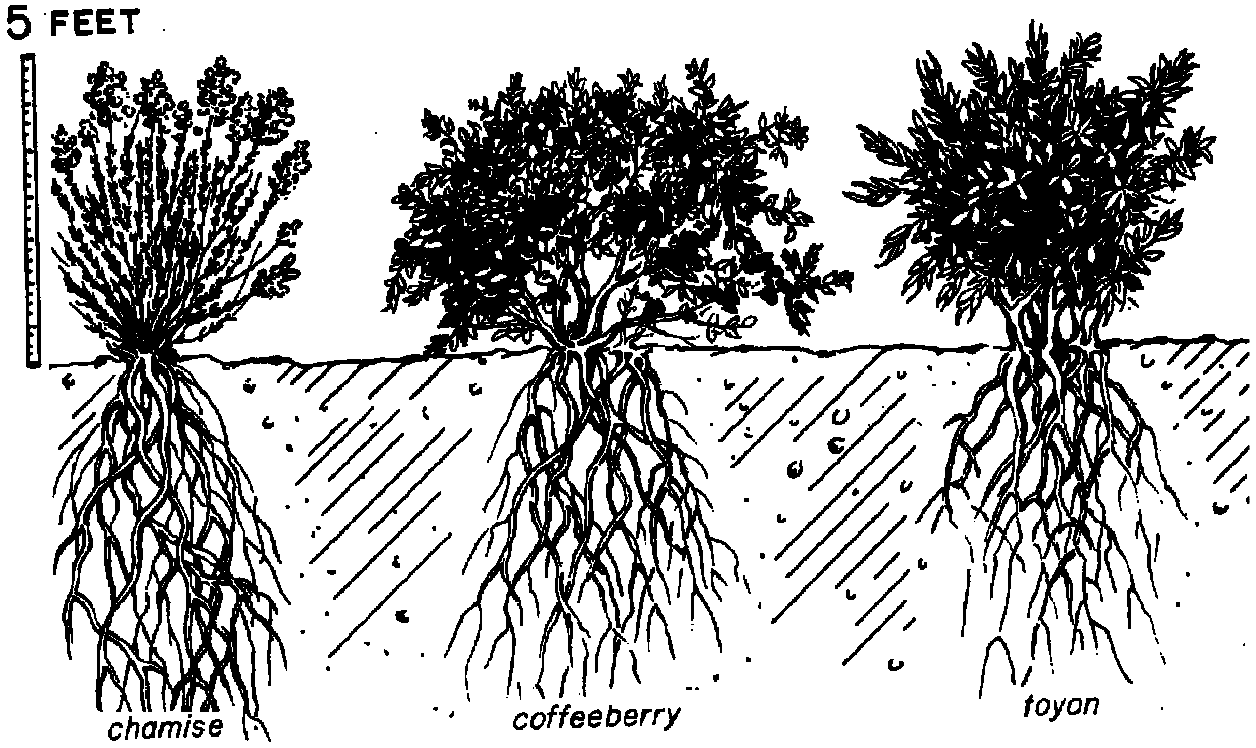


Figure 69. Chaparral plant community indicator species.

The **indicator species** are chamise, toyon, coffeeberry, redberry, scrub oak, mountain mahogany, Whipple yucca, mountain lilac, and manzanita. Chaparral is found from about 1,000 to 5,000 feet elevation. This community provides ground cover for the steep foothills and canyon walls.

These plants have unique leaf adaptations to help reduce water loss; the leaves are thick and leathery, with a heavy waxy **cuticle**, or outer skin, or else they are hairy or fuzzy. They have deeper root systems and can tap the deep year-round water supplies, too. These two adaptations enable them to stay green and active the year round.

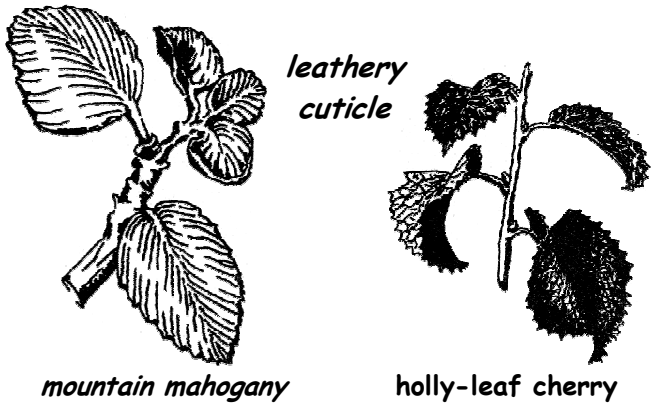


Figure 70. Leathery leaves.

These plants store water in their thick, fleshy leaves, like a cactus; the whitish "bloom" or coating helps hold water in by slowing down transpiration

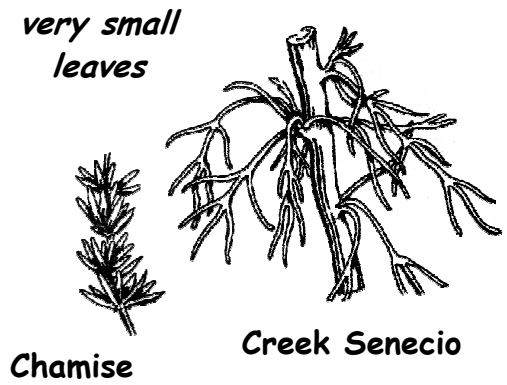


Figure 71. Very small leaves.

The leaves of these plants are reduced or very small, thereby presenting a smaller area to the hot, dry air which carries away precious water.

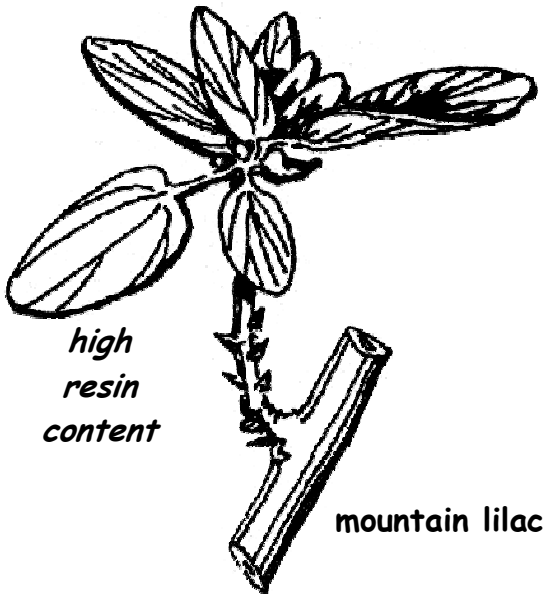


Figure 72. Mountain Lilac.

There is a tough, glossy coating on the surface of these leaves, giving them a leathery appearance and slowing down water loss. These broad-leaved sclerophyll ("hard leaf") plants usually have a high resin content as well, making their juices thick and resistant to evaporation.

C. The Southern Oak Woodland Plant Community

Indicator species are the coast live oak, golden currant, and poison oak. The trees provide shade, modifying the environment so that plants with no special adaptations to a hot, dry climate can survive. The mulch of oak leaves acts as a sponge to hold moisture and develop a rich topsoil through the gradual decay of the leaves.

Figure 73. Southern Oak Woodland.

D. The Riparian Woodland

The term **riparian** comes from the Latin word for bank or streamside, and refers to the vegetation along rivers, creeks and around edges of lakes and ponds. The primary **indicator** species in Southern California are sycamore, white alder, black cottonwood and/or Fremont cottonwood, willow (many species) and often mulefat. The presence of permanent surface or subsurface water provides for growth of these broad-leaved deciduous trees or shrubs. This community is usually subjected to periodic severe winter flooding and the plant species are adapted to regrowth after flooding. The often linear arrangement of riparian growth, forming narrow strips along streams or around ponds, is an excellent example of the "edge effect" or the tendency for increased numbers and species of organisms at the junction of two communities. The presence of water attracts a large number of wildlife and is ideal breeding habitat for many birds.

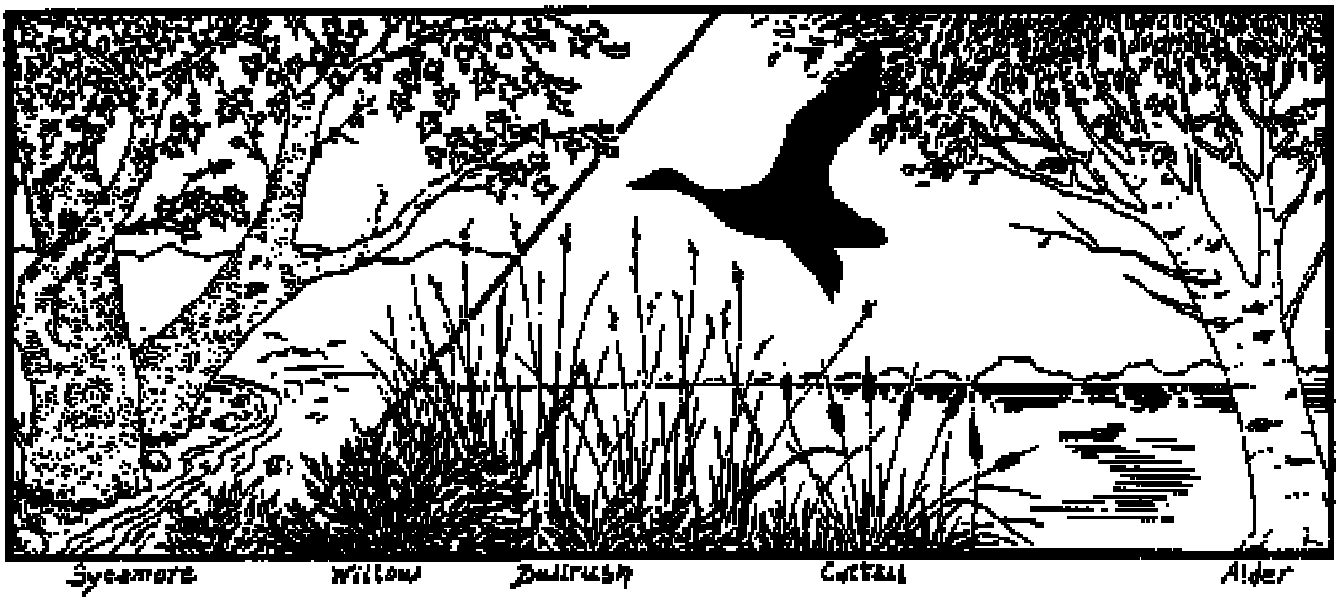


Figure 74. Riparian Woodland.

Major Plant Communities of Southern California

Coastal Dune Sand Plant – Sea level to a few feet above. Shifting sands with high salt content, fog, strong winds, intense sunlight = harsh environment. Sand Verbena (*Abronia spp.*), silver beachweed (*Ambrosia chamissonis*), beach primrose (*Camissoniopsis cheirranthifolia*), bush lupine (*Lupinus arboreus*).

Coastal Salt Marsh – Near sea level. Inundated regularly by tidal action or storms with salt water. Plants are halophytes ("salt plants") often with succulent stems, leaves. Salt grass (*Distichlis spicata*), cord grass (*Spartina foliosa*), Frankenia (*Frankenia salina*), sea blite (*Suaeda calceoliformis*).

Freshwater Aquatic – Low elevation to high mountain lakes, ponds, marshes, reservoirs. Plants submergent and emergent. Pond weed (*Potamogeton spp.*), cattails (*Typha latifolia*), bulrush (*Scirpus spp.*).

Riparian Woodland – Lowlands to about 5000 ft. Riparian means "riverbank" or "streamside." Willow (*Salix spp.*), white alder (*Alnus rhombifolia*), cottonwood (*Populus spp.*), sycamore (*Platanus racemosa*), mulefat (*Baccharis salicifolia*).

Valley Grassland – Formerly on low elevation flats and hills; now very rare and largely replaced by European grasses and "weeds." Bunch grasses (*Poa spp.*), needle grass (*Stipa spp.*), brome grass (*Bromus spp.*), fescues (*Festuca spp.*).

Southern Oak Woodland – Low elevation "benches" and foothills. Sometimes coexists with riparian woodland in moist, shady canyons. Dominant = Coast live oak (*Quercus agrifolia*), often with California black walnut (*Juglans californica*), poison oak (*Toxicodendron diversilobum*), coffeeberry (*Frangula californica*).

Coastal Sage Scrub – Near sea level to 1500 ft. Low, semi-woody, drought-deciduous shrubs. Dominant = California sage-brush (*Artemisia californica*), with white sage (*Salvia apiana*), black sage (*Salvia mellifera*), wild buckwheat (*Eriogonum fasciculatum*), California encelia (*Encelia californica*), etc.

Chaparral – Foothills and mountain slopes, 1000 to 5000 ft. Dominant plant community in California making up over 7% of native ground cover. Fire-adapted community with many shrubs "stump-sprouting" from burned root crowns. Chamise (*Adenostoma fasciculatum*), manzanita (*Arctostaphylos spp.*), wild lilac (*Ceanothus spp.*), scrub oak (*Quercus durata* var. *gabrielensis*), Whipple yucca (*Hesperoyucca whipplei*).

Yellow Pine Forest – Mountains from 4500 to 7000 ft. The dominant cone-bearing forest type for Southern California. Ponderosa pine (*Pinus ponderosa*), Jeffrey pine (*Pinus jeffreyi*), Coulter pine (*Pinus coulteri*), incense cedar (*Calocedrus decurrens*), white fir (*Abies concolor*), sugar pine (*Pinus lambertiana*).

Subalpine Forest – Mountains from 7000 to 10500 ft. The high mountain conifer forest above Yellow Pine zone and reaching to timberline. Lodgepole pine (*Pinus contorta ssp. murrayana*), limber pine (*Pinus flexilis*), western juniper (*Juniperus occidentalis*). Trees stunted at timberline.

Alpine Fell-field – Peaks of highest Southern California mountains (Mt. San Gorgonio, Mt. Baldy) above 10000 ft. Plants mostly perennials, low mats or cushion-form. Cling to rocky substrate; winds, snow, cold. Buckwheats (*Eriogonum spp.*), oceanspray (*Holodiscus discolor*), Oreonana (*Oreonana vestita*), Lomatium (*Lomatium nevadense*).

Pinyon-Juniper Woodland – Desert slopes of mountains, 5000 to 8000 ft. Open woodland of pinyon pine (*Pinus monophylla*) and/or California juniper (*Juniperus californica*). Also present are desert scrub oak (*Quercus turbinella*), antelope bush (*Purshia spp.*) and mountain mahogany (*Cercocarpus ledifolius*).

Joshua Tree Woodland – Lower desert slopes below Pinyon-Juniper Woodland and above Creosote Bush Scrub; 2500 to 4000 ft. Open, arid community dominated by tree-like Joshua tree (*Yucca brevifolia*). Also present may be California juniper, cottonthorn (*Tetradymia axillaris*), Mormon tea (Ephedra spp.), goldenbush (*Ericameria spp.*).

Sagebrush Scrub – Desert and semi-arid mountain slopes, 4000 to 9000 ft. Low shrubs; grayish color. Dominant = basin sagebrush (*Artemisia tridentata*). Others include rabbit brush (*Ericameria nauseosa*), antelope bush, saltbush (*Atriplex spp.*), cottonthorn (*Tetradyia comosa*).

Creosote Bush Scrub – Extensive community of desert floor and lower slopes to 5000 ft. Dominated by creosote (*Larrea tridentata*) and burro weed (*Ambrosia dumosa*). Also brittlebush (*Encelia farinosa*), ocotillo (*Fouquieria spendens*), cheese bush (*Ambrosia salsola*), cholla (*Cylindropuntia spp.*), prickly pear (*Opuntia spp.*).

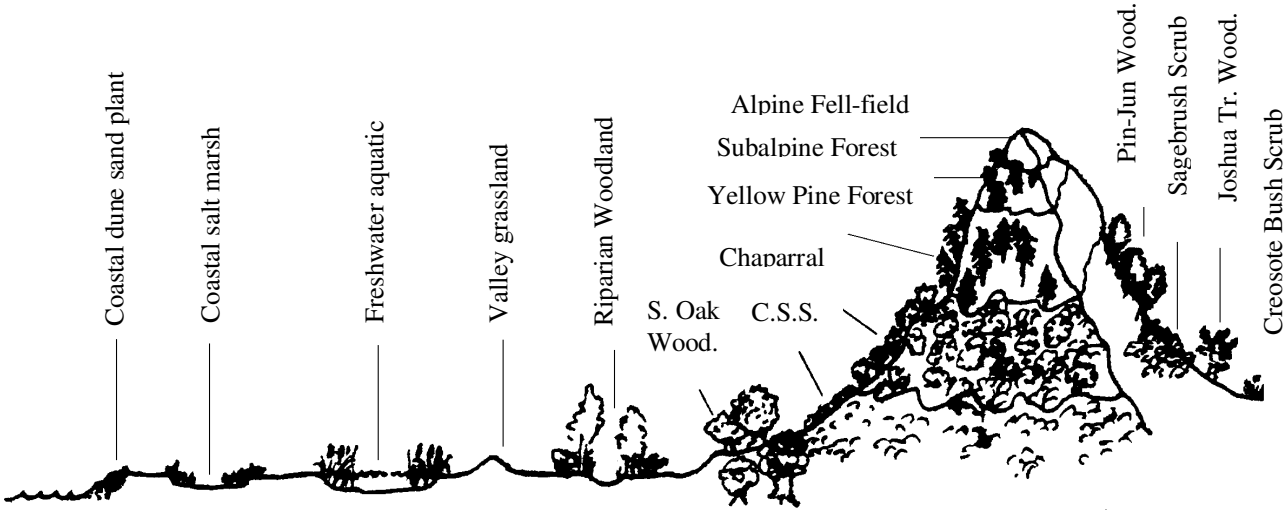
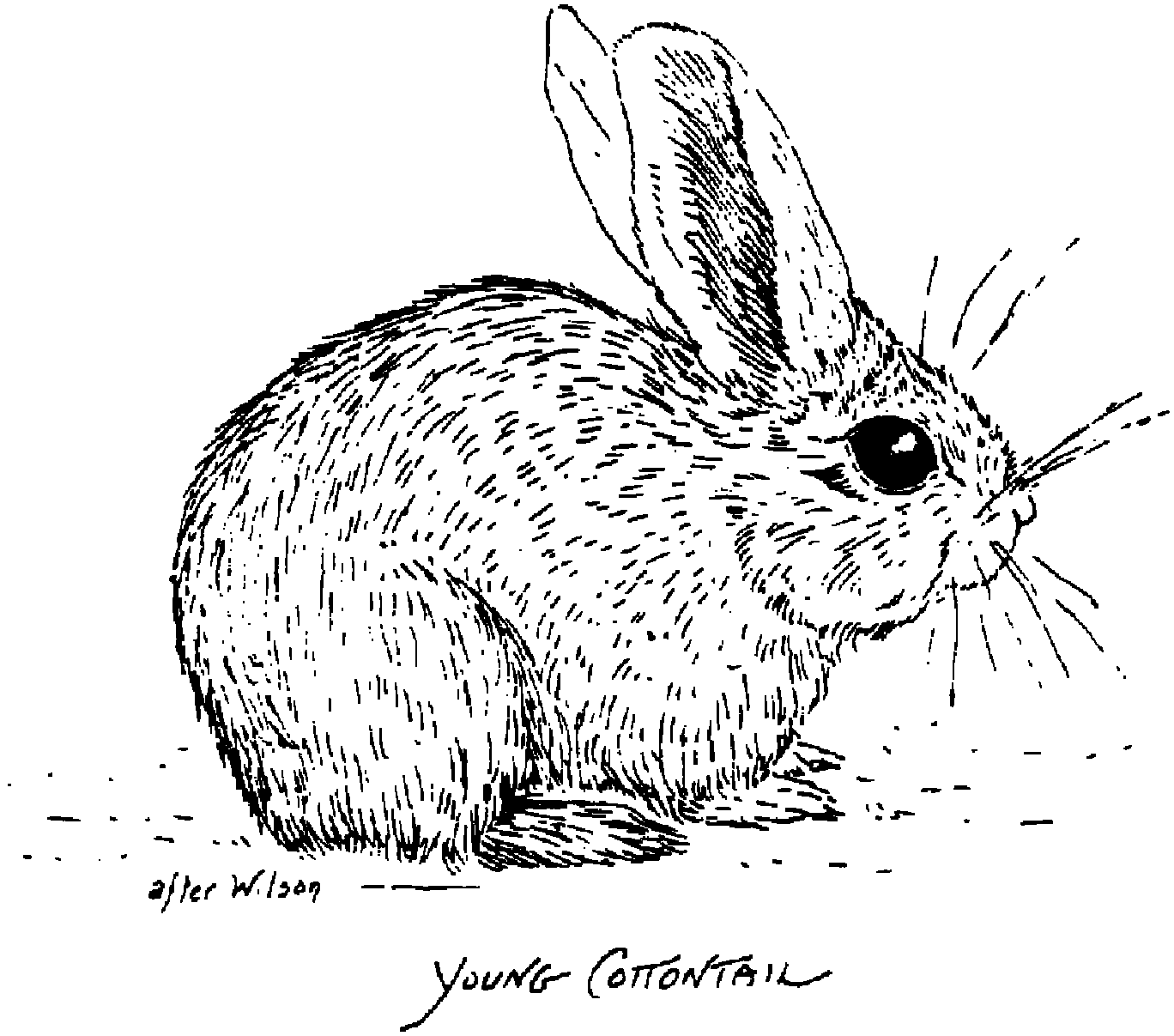


Figure 75. Changes in plant communities with elevation.

<——————south north——————>

Animals



Introduction to Animals

Tips for Locating Animals in the Field

1. Be quiet and stay on trails.
2. Be alert to small noises all around you which may indicate movement of small animals or birds.
3. Watch for signs or movement in bushes, grass, or trees, as well as in open areas of trails, sky and meadow.
4. Search for insects on bark, dead wood, under logs and stones (being sure to replace them when finished). Take time to look on flowers and leaves. Some insects live in ponds and streams.
5. Choose an ecotone area, which is the border of two plant communities (such as between a forest and meadow) where animals can come out of hiding to feed.
6. Take your time. Move slowly, and sit in one place for a while.
7. Choose the proper time of day to see animals. Very early morning and very late afternoon are best for general viewing.
8. Watch for tracks of animals which indicate their presence even if they are not seen.
9. Most animals are brown or camouflaged. Look for motionless animals in grass or along trails.
10. Look at holes, small trails and tunnels for signs of recent activity.
11. Check patches of sunlight for sunning reptiles such as lizards.
12. Look in trees and on the ground for birds. Some stay mainly in one location, while others fly from tree to tree.

Arthropods

Arthropods comprise the largest group of animals in our natural areas. They are predators, herbivores, scavengers, and many form symbiotic relationships with other organisms.

Arthropods have an external skeleton, or **exoskeleton**, made of a tough cellulose-like material called **chitin**, which completely covers their bodies. Their bodies and appendages are also **segmented**. Growth requires the animal to make a new larger exoskeleton on the inside of the old one, and then shed or **molt** the smaller, old exoskeleton.

Insects are the major group of terrestrial arthropods.

Arachnids include spiders, scorpions, mites, and harvestmen.

Crustaceans are primarily aquatic or marine. Some, like isopods (e.g. pill bugs, sow bugs) and amphipods, are found in moist terrestrial habitats.

Spiders and insects are most commonly encountered arthropods in our parks.

Insects

The Importance of Insects

Wood boring beetles, fly maggots, and termites feed upon and ***recycle*** dead animals and plants.

Bees, flies, butterflies and moths, and beetles for example **pollinate** flowering plants including many of our food crops

Insects constitute the ***food*** for two-thirds of world's birds (e.g. young song birds, flycatchers, and woodpeckers), as well as many mammals, amphibians, freshwater fish and reptiles.

Cutworms, flour moths, and bark beetles many other kinds of insects are ***pests*** of crops, stored products and timber.

Insects may transmit or cause ***disease*** in plants, animals and people. (e.g. rusts, wilts, bubonic plague, typhus and malaria)

The ***aesthetic value*** of insects has been appreciated by people for millennia and is reflected in art, clothing and jewelry. Appreciation of their beauty as well as the value of insects is increased the more one knows about them.

The Anatomy of Insects

The **body** of insects is divided into three parts: head, thorax with legs and wings, and abdomen.

The **wings** are used for flight, protection, and communication. Most insects have ***two pairs*** of wings as adults, which are attached to the second and third segments of the thorax. Some like the true flies have ***one pair*** of wings. Some insects have ***no wings***, as in the worker casts of ants and termites, fleas, lice, and silverfish and some immature insects.

The **antennae** are tactile organs and may also detect odor, sound, heat, wind speed, and water vapor.

Their three pairs of **legs** may be used for walking, running, jumping, digging, catching prey, carrying food, defense, swimming and sound production. Some larvae lack legs.

The **mouth parts** may be adapted for a variety of foods as are the bills of birds and the teeth of mammals. The major types are: 1) Chewing in grasshoppers, beetles, and caterpillars. 2) Chewing-lapping as in bees and wasps. 3) Sponging in some flies. 4) Cutting-sponging as in horseflies. 5) Piercing-sucking in fleas, mosquitoes, plant bugs, and predaceous bugs. 6) Siphon-tube as in butterflies and moths.

Both the simple **eyes**, also called ocelli, and compound eyes are found in most insects. Compound eyes usually have from hundreds to thousands of facets. Some insects, like dragonflies and wasps, have excellent eyesight. Some wasps can even recognize each other's faces.

The **spiracles** open on thorax and abdomen allow for gas exchange through tubes called trachea which branch throughout the body of the insect.

Metamorphosis is the change in body form during development after the insect hatches from its egg.

In **gradual**, **simple**, or **incomplete metamorphosis** the immature stages resemble adults and usually feed on the same foods. (e.g. Aphids, true bugs, grasshoppers, termites, and dragonflies)

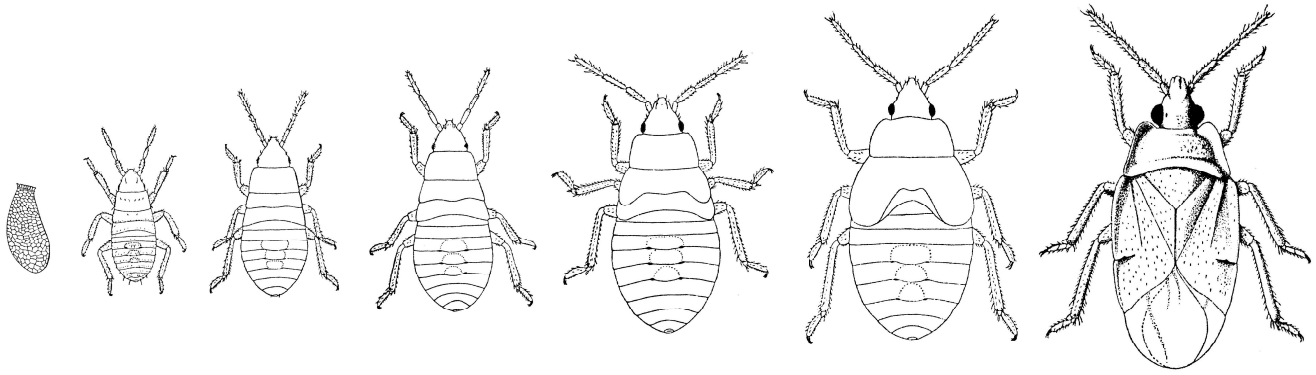


Figure 76. Incomplete metamorphosis of hemiptera (a true bug).

In **complete metamorphosis** the larvae do not resemble adults and usually feed on different foods. (e.g. Butterflies and moths, beetles, bees, wasps, ants, 2-winged flies, and fleas)

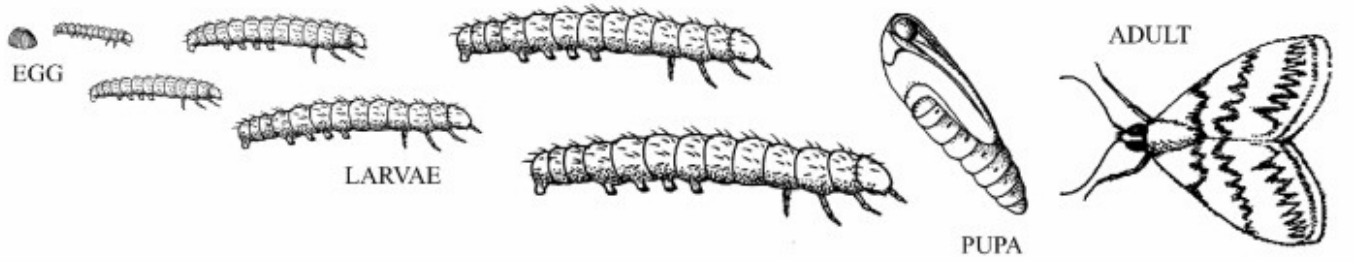


Figure 77. Complete metamorphosis of a moth.

There are also some intermediate forms of metamorphosis.

Spiders

The Importance of Spiders

Spiders are one of the main predators of insects and help regulate insect populations.

Hummingbirds use spider silk to line their nests.

Many wasps use spiders as food for their larvae.

Spider webs also add to the beauty of our landscapes.

The **body** of a spider is divided into two parts: the **cephalothorax,** with 8 legs and 2 **pedipalps**, and the **abdomen** with **spinnerets**.

The **eyes** of spiders number from two to eight. All are simple eyes. However, jumping spiders and wolf spiders, with large forward-facing eyes, have excellent eyesight.

The **pedipalps** are used as tactile organs, for food manipulation, and for mating by males.

The **book lungs** of spiders open on the ventral side of the abdomen.

Silk is released from the silk glands through the spinnerets which are located at the tip of the abdomen. Silk is a very strong elastic protein that solidifies when extruded. Several silk types are produced by the spinnerets depending on the use. Silk is used by spiders for making egg cases, webs, draglines, ballooning, protective shelters and trapdoors.

Immature spiders resemble the adults but feed on smaller prey.

Sexual dimorphism is common in spiders. Females are usually larger than males, and often attempt to eat the male spider after mating. Males have enlarged pedipalps, which makes them easy to identify. Males may also differ from females in color.

The **life span** of most spiders is one or two seasons, but female tarantulas may live for 20 years.

Comparison of Insect and Spider Anatomy

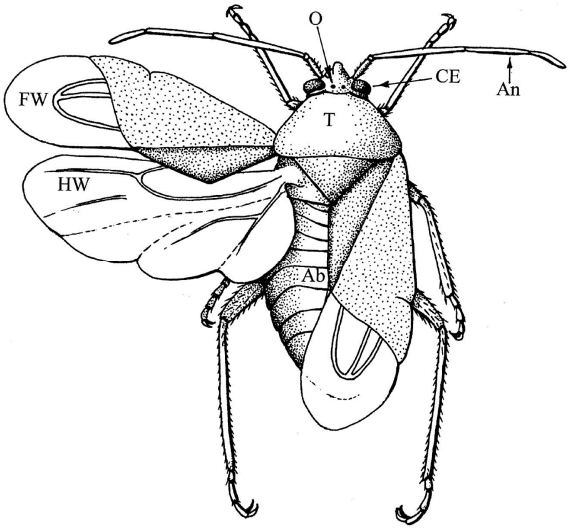


Figure 78. Insect diagram.

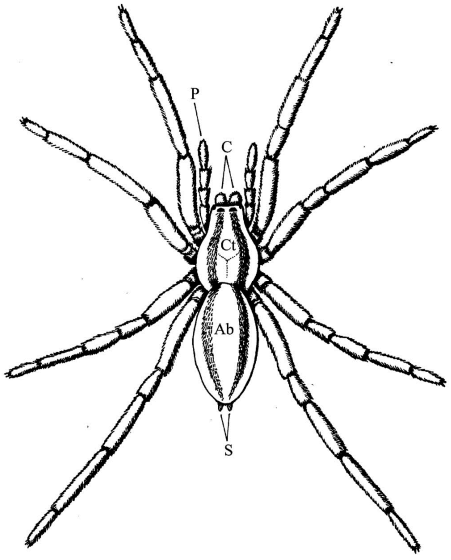


Figure 79. Spider diagram.

	Insects	Spiders
Body Divisions	Head, Thorax (T), Abdomen (Ab)	Cephalothorax (Ct), Abdomen
Antennae (An)		None
Eyes (CE, O)	2 compound, 3 simple usually	8 simple usually
Mouth Parts	Mandibles and maxillae	Chelicerae (C)
Legs	6	8
Wings	4, 2, or none Fore wings(FW), Hind wings (HW)	None
Pedipalps (P)	None	2
Spinnerets (S)	None*	6 usually

* Some insects, like moth larvae and webspinners make silk but do not have spinnerets like spiders.

Finding Insects and Spiders

With a few rare exceptions, insects and spiders are terrestrial or aquatic. While searching for insects and other animals, avoid damaging their habitat.

Do NOT turn over rocks and logs because this practice destroys microhabitats and often causes small animals to run to less safe places. Also, they may be crushed when the rock or log is returned to its original position.

Watch where you walk. Insects may often be seen crossing trails or sitting on rocks.

On leaves and branches, look for irregularities, such as differences in colors, bumps on stems, and movement. Many insects and spiders are textured and/or colored to match plants they frequent.

Flowers offer good opportunities to find insects that feed on pollen and nectar. Crab spiders and assassin bugs frequent flowers to capture insect visitors.

Streams and ponds provide habitat for a variety of insects specialized for living in freshwater.

Lights on porches attract a wide variety of nocturnal insects during warm weather.

Fish

Ichthyology: The scientific study of fish. (from Greek: ikhthus, "fish"; and (- logia), "study of").

Classification: Fishes are separated into three classes

Kingdom – Animalia (animals)
Phylum – Chordata (nerve cord present)
Subphylum – Vertebrata (animals with bony or cartilaginous skeletons)
Class – Agnatha (jawless fishes) – Examples: hagfish, lamprey [50 species]
Class – Chondrichthyes (cartilaginous fishes) – Examples: sharks, rays, 625 spp.
Class – Osteichthyes (bony fishes) – majority of fresh- and salt-water species; – Examples: bass, bluegill, etc., 30,000 species

Characteristics:

1. Fish are "cold-blooded" (ectothermic = outside heat source), aquatic vertebrates.
2. Their skin is generally covered with scales.
3. Their limbs are modified into fins for swimming.

Perhaps the most commonly seen small fish at the nature centers are mosquito fish (*Gambusia affinis*). In the same family with guppies, and resembling them somewhat, these fish reach a maximum size of about 2 inches, give live birth to 10-30 young, and have been introduced widely in California since 1922 for mosquito control.

Other common fish of Los Angeles County lowland ponds, lakes and streams (mostly introduced) – to be seen at Whittier Narrows Nature Center:

Brown Bullhead (catfish)
Black Bullhead (catfish)
Common Carp
Black Crappie
Largemouth Bass
Green Sunfish
Bluegill

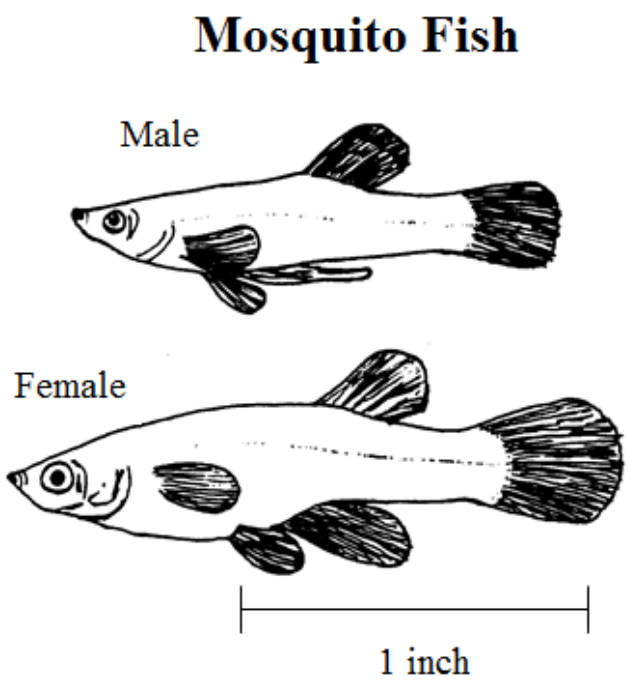


Figure 80. Mosquito fish.

Amphibians and Reptiles

Herpetology: derived from the Greek "herpeton" for "a crawling animal". Herpetology is the scientific study of amphibians and reptiles.

Classification: Includes two separate Classes of vertebrates.
Amphibians belong to the class Amphibia
Reptiles belong to the class Reptilia

Kingdom – Animalia (animals)
Phylum – Chordata (nerve cord present)
Subphylum – Vertebrata (animals with bony or cartilaginous skeletons)

Class – Amphibia (amphibians)
Order – Example: Anura (frogs)
Family – Example: Hylidae (tree frogs and their allies)
Genus – Example: *Pseudacris*
Species – Example: *regilla* = Pacific tree frog

….
Class – Reptilia (reptiles)
Order – Example: Squamata (scaled reptiles)
Family – Example: Phrynosomatidae (lizards)
Genus – Example: *Sceloporus* (spiny lizards)
Species – Example: *occidentalis* = western fence lizard

Amphibians and reptiles play an important role in the ecosystem as both predators and prey.

Amphibians were the first terrestrial vertebrates as they crawled out on land from lobefin fish ancestors. This occurred during the Devonian approximately 360 million years ago. With their thin, water-permeable skin, amphibians are susceptible to environmental contaminants and are declining worldwide.

Reptiles (evolved from amphibians) were the first vertebrates to develop the amniotic egg, with an extra membrane (the amnion) to protect the embryo from desiccation, allowing eggs to be laid on land.

Characteristics: The class Amphibia and class Reptilia share several characteristics which separate them from other animal groups:

1. They are "cold-blooded" (ectothermic = outside heat source) and for the most part terrestrial vertebrates.
2. Their skin is devoid of hair and feathers.
3. They have a three-chambered heart (except crocodiles & alligators with a four-chambered heart).

Amphibians	**Reptiles**
Skin is thin, smooth (usually), and lacking scales, hair, feathers	Skin with scales
Dependent upon moisture; highly susceptible to desiccation; moist skin functions in respiration	Not dependent upon externally moist skin
Lack claws on toes	Those with legs have claws
Paired occipital condyle on rear of skull	Single occipital condyle on rear of skull (Of note: birds also have a single condyle)

Common Species to Know

Locations: Eaton Canyon (E.C.)
Placerita Canyon (P.C.)
San Dimas (S.D.)
Vasquez Rocks (V.R.) is not indicated in this list at this time

Black-bellied Slender Salamander (*Batrachoseps nigriventris*) E.C., P.C., S.D.
Fairly common in winter and spring under logs, rocks, in shady, moist leaf litter of oak woodlands, riparian areas. Very slender, worm-like with tiny legs; dark body and tail with lighter reddish or beige dorsal stripe. Total length to 4 inches.

Toads:

California Toad (*Anaxyrus boreas halophilus*) also known as *Bufo boreas halophilus* All
Common toad of coastal California living by day under rocks, logs and in rodent burrows; hunting for insects and other arthropods at night. Adults to 5 inches. Grayish or greenish above with white stripe down back. Many habitats.

Chorus Frogs
Northern Pacific Treefrog (*Pseudacris regilla*) All

California Treefrog (*Pseudacris cadaverina*; formerly *Hyla cadaverina*) E.C., P.C., S.D.
Two common small treefrogs (also known as chorus frogs) with toe pads (lacking in true frogs – *Rana*). The Pacific is grayish, green or sometimes bronze color with distinct black mask through eye. The California Treefrog is generally paler grayish, with blotches matching gray of granitic boulders along streams, upon which they often rest. Both reach about 1-1/2 inches long.

Western Fence Lizard (*Sceloporus occidentalis*) All
Very common lizard in most habitats, seen on ground, rocks and logs in all but coldest winter months. Light gray to almost black above with spiny scales; brilliant metallic blue throat and sides of belly in male, paler in female. Active lizard, feeding on small arthropods and basking. Interesting "push-up" behavior of males for courtship and defense posture. Total length to about 6 inches.

Western Side-blotched Lizard (*Uta stansburiana elegans*) All
Very common small lizard, to about 5 inches total, usually on ground or rocks in dry, open areas. Pale grayish-brown above with blotches or stripes. Dark spot on side behind front leg. Short life span with most living only one year.

Whiptail lizard (*Aspidoscelis tigris*) E.C., P.C., S.D.
A very active, "nervous" lizard of sandy, gravelly flats and open areas in chaparral. Long and slender with very long tail and narrow, pointed snout. Body rich orange-brown with darker stripes and spots. Excellent sense of smell, this lizard "sniffs" the ground and digs up buried insects and larvae.

Southern Alligator Lizard (*Elgaria multicarinata*) All

The largest lizard in our area, reaching about a foot in total length in some individuals. Scales smooth and somewhat shiny; body light brown, grayish or dull yellow with darker narrow crossbars. A secretive lizard of somewhat cooler, damp areas sometimes seen basking on trails.

California Kingsnake (*Lampropeltis californiae*) All

A medium-sized snake, averaging 2 to 3 feet long, with alternating rings of dark brown and yellow (or black and white in desert form). Fairly common in lowlands and foothills, feeding on rodents, lizards, birds and other snakes, including rattlesnakes. Primarily nocturnal.

Striped Racer (*Coluber lateralis*) = (*Masticophis lateralis*) E.C., P.C., S.D.

Common in chaparral, oak woodland and washes, this snake is dark olive to almost black with a pale yellow stripe along each side. A very fast snake seen often as it disappears into a bush or grassy area. Common foods include lizards, rodents and birds, sometimes taken from nest in shrub.

Gopher Snake (*Pituophis catenifer*) All

One of the commonest and most widespread snakes of the West (with subspecies in the East), the gopher snake occurs in most habitats. Beige to brown ground color with dark blotches down the body; reaching 7 or 8 feet in rare individuals, average usually 3 to 4 feet. Feeds on rodents, birds, lizards.

Two-striped Gartersnake (*Thamnophis hammondii*) All

Olive to dark gray above with a whitish stripe on each side (sometimes faint). Averaging 1-1/2 to 2 feet long, these snakes are primarily confined to the vicinity of water, feeding on frogs, fish and tadpoles. Populations declining. Garter Snakes release a foul, musky fluid upon capture.

Western Rattlesnake (*Crotalus oreganus*) E.C., P.C., S.D.

Ranging in color from pale gray to dark brown and black, the Pacific Rattlesnake has somewhat diamond-shaped blotches down the back, each outlined in lighter scales. Easily identified by the presence of a rattle of hollow scales on a blunt tail and broad head with narrow neck. Adds one “segment” to rattle each time it sheds, about 4 times per year. The only dangerously venomous snake in coastal L.A. County. Averages 3 to 4 feet long; some to 5 feet.

Birds

Ornithology: from the Greek "ornis" for bird. The scientific study of birds.

Classification: Birds belong to the class Aves

Kingdom – Animalia (animals)
Phylum – Chordata (nerve cord present)
Subphylum – Vertebrata (animals with bony or cartilaginous skeletons)
Class – Aves (birds)
Order – Example: Passeriformes (perching birds)
Family – Example: Corvidae (Crows, Jays, Ravens, Magpies)
Genus – Example: *Aphelocoma*
Species – Example: *californica* = Western Scrub-Jay

Birds are descended from reptiles.
Earliest known fossil is Archeopteryx (ancient wing). 6 specimens. Late Jurassic (140-150 million y ago).
Archeopteryx had feathers, also claws on wing. Probably not a flyer – no keel breastbone.

Bird Numbers:

Worldwide, about 10,000 species
North America (North of Mexico) – about 700 regular breeders, many more have been seen
California: 644 recorded
LA County: 504 recorded

Characteristics:

1. They are warm-blooded (endothermic = inside heat source) vertebrates.

2. They have a four-chambered heart.

3. They lay eggs (oviparous).

4. Most birds fly.

5. One of the few absolutes in nature – all birds and only birds have feathers

Adaptations for Flight

Light weight.

Prominent keel bone for muscle attachment

Their forelimbs are modified as wings.

They lay eggs.

Lungs are relatively small but air sacs allow unidirectional flow.
Birds get much more oxygen with each breath than mammals do.

Tight center of gravity

Their skin is covered with feathers.

Feathers

Evolved from scales

Feather microstructure varies with location on bird and function.

Functions are:

Thermoregulation

Protection

Promote flight

Show – may be cryptic or bright and showy

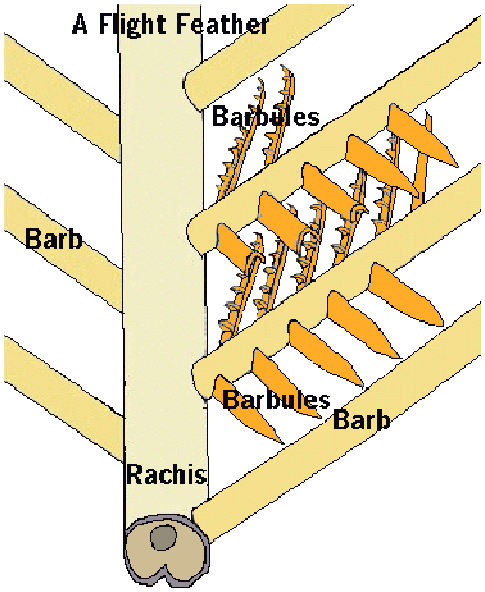


Figure 81. Anatomy of a feather.

Molt

Feathers wear out. All birds molt, i.e., lose and replace all their feathers at least once/year.

Some birds molt more often for specific reasons:

Insulation – Some northern birds need more feathers in winter for insulation.

Camouflage – Ptarmigans are white in winter, brown in summer

Breeding – some have brighter plumage in breeding season, esp. males.

Younger birds – less color, often streaked or spotted – cryptic.

Most birds molt gradually in a regular pattern.

Not all color changes are due to molt.

How Do Birds Perceive The World?

Information is inferred from studying the size of various parts of the brain, and from behavior.

Taste – poorly developed.

Smell – probably good in some species, but not in most.

Vision is excellent, best of all vertebrates.

Hearing is excellent. Songs and other vocalizations are very important.

Call vs. song.

Why do birds call?

Why do they sing?

Not all sounds are vocal.

Food and Eating Habits

Birds could be called carnivore, herbivore, etc., but usually those terms aren't used.
Most birds prefer one type (animal or vegetable) but can vary if necessary. If it's edible, some bird will eat it. Many seed eaters switch to insects during breeding season for extra protein for themselves & young.

Vegetable: Roots, bulbs, fruit, seeds, flowers, sap, nectar, stems.

Animal: insects, fish, worms, shellfish, other birds, mammals.

Birds' beaks are often specialized for different foods.

Birds must eat a lot – "eat like a bird" is a misnomer. Hummingbirds may eat twice their weight in nectar daily. They often eat, perch to digest, then eat again. Larger birds may skip a day, but most must eat daily.

Sexual dimorphism and feeding - typically the female raptor is larger than the male of the species. This allows the female to hunt larger prey so there is less territorial competition

Foot and Bill Adaptations in Birds

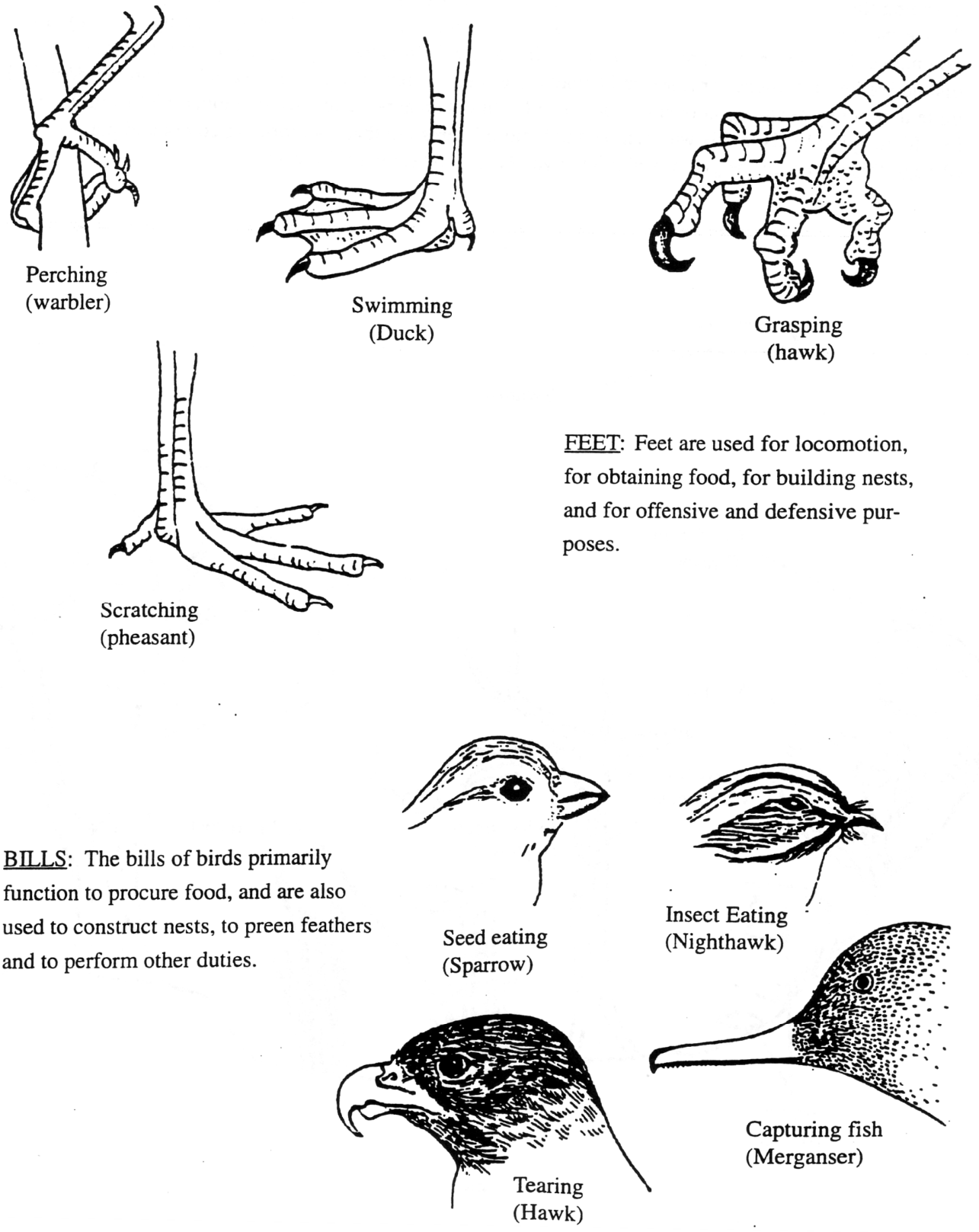


Figure 82. Foot and bill adaptations in birds.

Seasonal Distribution and Migration

About 80% of North American birds migrate.

Most migration is north/south, but there are exceptions.

Why do birds migrate? What triggers migration to begin?

Common migration routes – "Flyways".

Breeding

Most small birds breed the first spring after birth (10 months). Larger birds may take several years – eagles 3-5, Wandering Albatross 9-11 years.

Territory: That portion of home range defended during nesting season. Territory size varies from several miles in raptors to length of bill in colonial birds. Most small passerines defend about 1 acre – territory may grow or shrink with abundance of food.

Courtship & pair bonding: Most spp. (90%) monogamous, at least for 1 breeding season. Geese, swans, raptors, many seabirds may mate for life.

Precocial birds – larger egg, more yolk. Hatchling is covered with down, able to walk and feed itself.

Altricial – smaller eggs. Young are naked, blind, helpless.

Conservation Issues

Loss of habitat
Clearing forest for farms & housing creates smaller forest parcels with more edge.

More parasites (brown-headed cowbird) and predators get into forest taking eggs & birds.

Migrants are more crowded on wintering than breeding grounds, so more vulnerable to loss of tropical forests.

Loss of staging areas makes migration more hazardous. Wetlands especially a problem – over 90% of wetlands in California have been lost.

Climate change

Disease

Toxins

Some Common Birds of Los Angeles County

Chaparral Habitat:

California Towhee – often on ground beneath shrubs; seed eater; "sloppy" flight over short distances; rusty patch under tail and on throat.

Spotted Towhee – more secretive than the California Towhee; distinctive call from shrubs; scratches on ground in leaves.

California Thrasher – Mockingbird-like calls from bush tops, especially in spring; medium-sized brown bird, curved bill for "thrashing" leaves on ground for insect food; long, cocked tail.

Wrentit – heard much more often than seen; "voice of the chaparral" with call like bounding ping-pong ball; truly a chaparral resident in dense shrubs; said to not cross large clearings, firebreaks.

Bewick's Wren (pronounced "buick's") – another small bird of dense brush, jumping from branch to branch; gleans insects from shrubs; white eyebrow and underparts distinctive.

Oak Woodland Habitat:

Bushtit – tiny, "nervous" birdlets just larger than a hummingbird; move through trees and shrubs in loose flocks, rarely seen alone; high, rapid lisping calls.

Oak Titmouse – small, all grey bird with crest; works through oak branches; keeps moving; insect eater.

Western Scrub-Jay – well-known jay (erroneously called "Blue Jay," eastern U.S.); obvious and noisy resident of oaks and chaparral; very vocal; "plants" acorns under leaves.

Yellow-rumped (Audubon's) Warbler – actually widespread winter visitor in many habitats; small, slender insect eater in trees and large shrubs; often in small groups; often "flycatches," when distinctive yellow rump, throat and shoulder patches may be seen.

Riparian Habitat:

Red-shouldered Hawk – relatively uncommon hawk breeding in riparian and streamside oak communities; a "striped" hawk with black and white wing and tail stripes; distinctive cry repeated rapidly; on Audubon Society Blue List, declining due to declining habitat.

Black Phoebe – almost a sure indicator of standing water; typically perched over water; flies out to grab insects, returns to same perch or perch nearby; black back and hood with distinct white belly.

Red-winged Blackbird – flocking birds of bulrush, cattail, willow habitat; brilliant red shoulder "epaulets" used as territorial and courtship signals; musical, metallic calls.

Common Yellowthroat – a small yellow warbler of aquatic habitat; remains hidden deep in bulrush or cattails, occasionally appearing and disappearing; male with distinct black mask.

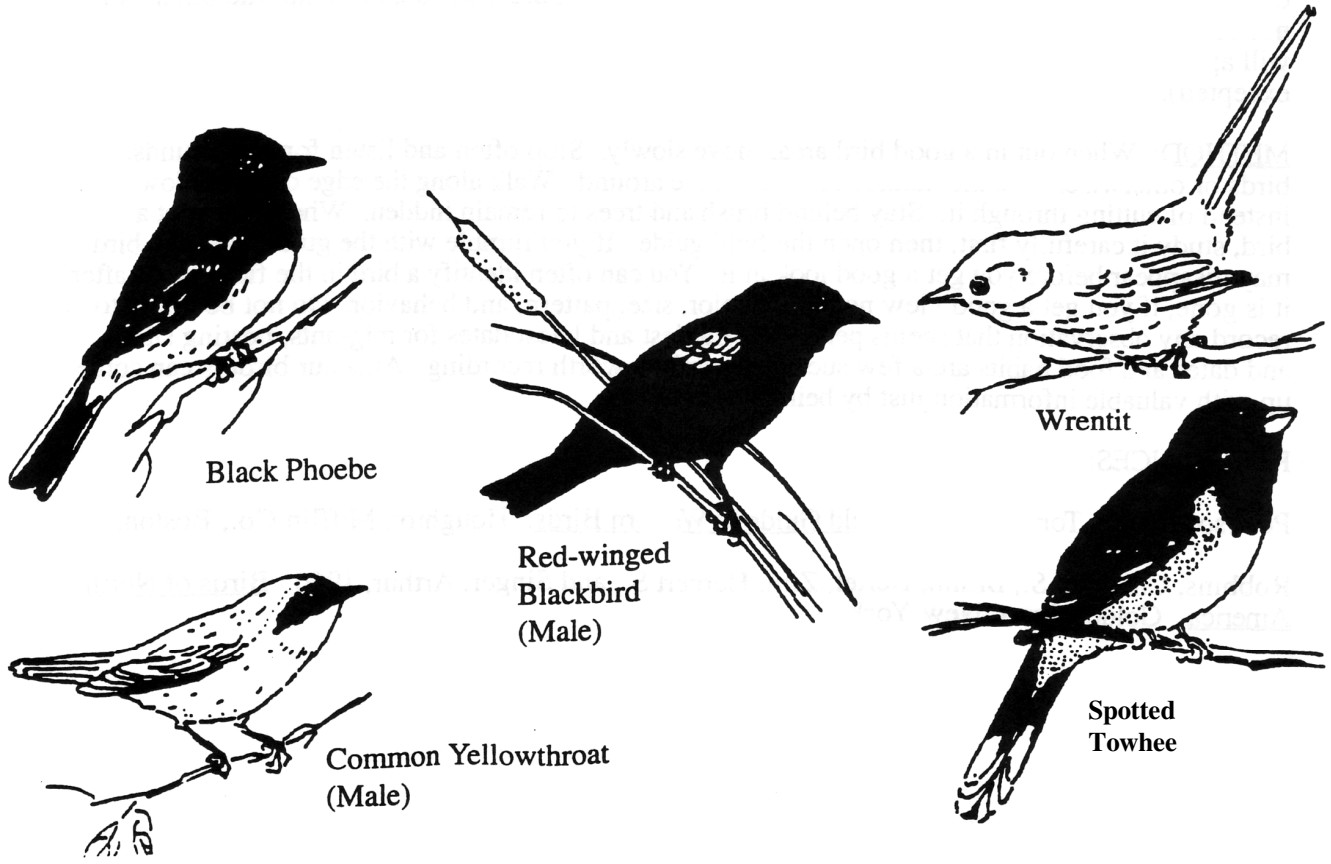


Figure 83. Common birds of the Riparian Habitat.

Techniques for Birding

Watching birds may sound like a very simple and natural thing to do, and it is. But if you are really interested in seeing and identifying as many species as possible or want to study behavior in a particular bird, there are some techniques to learn to greatly improve your chances.

Time: the best general time for birding is early morning while it is still cool and birds are feeding after resting all night. If you are rugged enough to get out in the field at sunrise you will be rewarded with species you might not see later in the day. The second best time for birding is late afternoon to just before dusk, when birds are feeding again before the long night's rest. A few species such as owls, poorwills and others are nocturnal and must be sought with flashlights or car headlights after dark.

Equipment: binoculars are almost an absolute necessity to identify birds at a distance. Most commonly used are 7 to 10 power, and 35 to 50 mm objective lens diameter (written "7x35" or "7x50", etc.). If you are inexperienced with binoculars the lower power and wider objective lens is probably better since it is easier to find the subject with the wider field of view. The 10 power is much better, however, for detailed views of the subject. Some birders carry a 15 to 45 power spotting scope mounted on a tripod for long-range identification but this is not a necessity for the average naturalist. A notebook for recording species and field observations is important and a good bird field guide is really the last piece of necessary equipment.

Clothing: no special clothing is required for watching birds except that it should be comfortable, warm (if it is cold out) and functional. Do not dress up to go birding; the birds will not be impressed. Also avoid bright colors; try to look like a forest, desert or mountain. Birds will approach much closer to a drab object than they will to a brilliant red shirt (hummingbirds excepted).

Method: when out in a good bird area, move slowly. Stop often and listen for any sounds, birds or otherwise. Use the natural cover to move around. Walk along the edge of a meadow instead of cutting through it. Stay behind brush and trees to remain hidden. When you spot a bird, study it carefully first, then open the field guide. If you fumble with the guide first, the bird may disappear before you get a good look at it. You can often identify a bird in the field guide after it is gone, if you get a good view noting its color, size, pattern and behavior. Do not be afraid to record any observation that seems pertinent. Earliest and latest dates for migrants, nesting sites and dates and food habits are a few such observations worth recording. Amateur birders can come up with valuable information just by being observant.

Habitat and Behavior Guide to Birds

Beginning birders are often discouraged by the bewildering numbers and variety of birds noted upon scanning the field guides. Equally discouraging are the strong similarities with certain groups which "make them all look alike." As you begin to observe birds regularly in a favorite locality, not only do you notice that each species really does have distinctive field marks or song, but most all species have a distinctive habitat, niche (or role), and behavior, as well. After some practice each bird can be identified quite quickly by forming an overall "picture" of it based on appearance, song, habitat, niche and behavior. Identifying birds in this way can be much more interesting than memorizing colors and patterns (though this is part of the game) and might even be called "ecological birding."

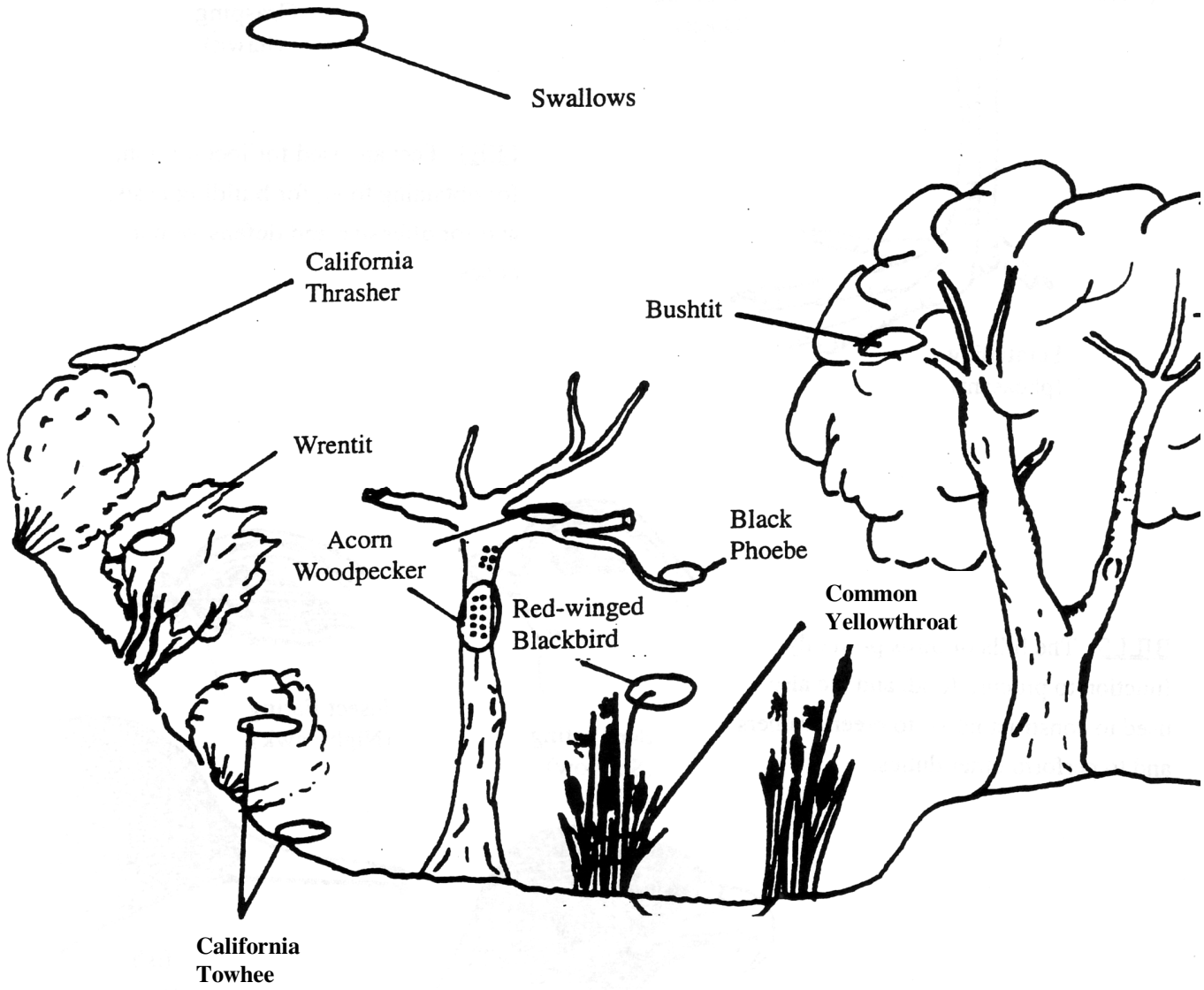


Figure 84. Locations birds are often spotted in their habitat.

Bird Facts and Fancies

-- People have been watching birds for a long time. The earliest depictions of birds, from 16,000 B.C., have been found on cave walls in France and Spain.

-- An anonymous 1703 essay written in England asserted that swallows hibernated on the moon, taking 60 days for the journey.

-- Feathers are unique to birds, but they vary in number per bird based on an individual species' needs. A Ruby-throated Hummingbird has over 1,500; a Meadowlark 4,600; a Mallard 12,000; the much larger Bald Eagle only 7,100, and one Tundra Swan had 25,216!

-- The Peregrine Falcon, when diving after prey, has been clocked at 175 miles an hour.

-- A hovering hummingbird beats its wings 50 times a second with its heart beating 1,200 times a minute. To supply all this energy hummingbirds eat about 50 meals a day of insects and nectar.

-- The largest known flying bird, living between 5 and 8 million years ago, was unearthed in Argentina in 1980. It weighed 200 pounds, would have stood 6 feet tall and had a 25-foot wingspan! Today the largest flying bird is the Wandering Albatross, with 11.5-foot wingspan, while the North American record, the California Condor, has wings spanning 9.5 feet.

-- The world's smallest bird is the Cuban Bee Hummingbird with a 2-1/4 inch body, under 4 inch wingspan and a weight of 2 grams.

-- Pigeons were the first air mail carriers. In 1894, the first air mail route was started in the United States between Los Angeles and Catalina Island using pigeons as carriers.

-- Robin fledglings are known to sometimes eat more than 10 feet of earthworms a day.

-- Some animals other than birds can fly, and some birds cannot fly, but only birds have feathers.

-- Birds may digest their food entirely in 1-1/2 hours! Birds are always hungry: they need plenty of calories to grow feathers, to fly, and to feed.

Mammals

Classification: Mammals belong to the class Mammalia, from the Latin mamillaris (of the breast).

Kingdom – Animalia (animals)
Phylum – Chordata (nerve cord present)
Subphylum – Vertebrata (animals with bony or cartilaginous skeletons)
Class – Mammalia (mammals)
Order – Examples: Carnivora (mountain lions, coyotes, etc.), Chiroptera (bats)
Family – Examples: Felidae (cats), Canidae (dogs)
Genus – Example: *Canis* (domestic dogs, coyotes, foxes)
Species – Example: *latrans* (coyote)

Characteristics:

1. Endothermic ("warm-blooded") vertebrates
2. Mammary glands[1]
3. Live birth[2]
4. Hair (varies greatly)[1, 3]
5. Heterodont ("different teeth") dentition[1, 4]
6. Sudoriferous (sweat) glands[1]
7. Sebaceous (fat-secreting) glands[1]
8. Diaphragm[1]

[1]These features are unique to mammals.
[2]The platypus and echidna are the only mammals that do not give live birth—they lay eggs.
[3]Not all have hair (e.g., some whales and dolphins have little or no hair as adults).
[4]Not all have teeth (e.g., anteaters).

Mammals are the most recent class of vertebrates in the evolutionary chain, following—in order—fish, amphibians, reptiles, and birds. They can be found on every continent and in every environment, from water to land to forest and jungle canopies, and even in the air.

Which mammals can you reasonably expect to see on a morning or afternoon walk in the natural areas, other than horses, dogs, and humans? Because most of them are nocturnal, sightings will usually be limited to squirrels, rabbits, deer, and perhaps a bobcat or coyote, depending upon which park you're visiting. Rats and mice, bats, shrews, voles, opossums, skunks, raccoons, and most others seldom appear during daylight hours. Although bears and mountain lions may be roaming during that time, they normally try to avoid encounters with humans.

Often, the only way to determine whether certain mammals are present is to be aware of signs such as scat (droppings), tracks, holes, hair, scratches, and odors.

Endothermic Vertebrates

The term "endothermic" is used for mammals rather than the common "warm-blooded" because warm and cold are relative terms. For example, some "cold-blooded" reptiles have body temperatures far above those of most mammals. Endotherms use an internal system of maintaining a fairly constant body temperature, which means they must eat enough food to accomplish that as well as provide energy to function physically. Some, such as shrews, may eat their body weight in food daily!

Mammary Glands

All mammals have the eponymous mammary glands (they are actually modified sweat glands) with which to feed milk to their young, but there is a wide variation in the methods of their use. The platypus and echidna lay eggs. When the young hatch, they climb to their mother's breast and drink milk that runs down the hairs, rather than attaching to themselves to nipples. Marsupials, such as opossums and koalas, are born prematurely, then climb into the mother's pouch and suckle from nipples there. Whales and dolphins, because of their inflexible mouth parts, cannot create a suction, so the milk is actually forced into the young's mouths when activated by pressure from them.

Reproduction

Prototherians, or Monotremes: egg-laying; platypus & echidna

Metatherians, or Marsupials: incomplete placenta; young born prematurely and spend early days in pouch (*marsupium*); e.g., opossum, koala, kangaroo

Eutherians: complete placenta; all other mammals

Altricial: born helpless, or nearly so; e.g., humans, dogs, cats, mice, rabbits

Precocial: born mostly ready to fend for themselves; e.g., horses, deer, hares

Hair

Mammals are the only living things that have true hair. The "hairs" on plants are actually **Trichomes**, and the "hairs" on tarantulas, for example, are **Setae** (singular: seta). Many sea mammals have little or none, since it would create drag in the water and it is not needed for insulation because the large amount of body fat takes care of that.

Hair is made up of dead epidermal cells strengthened by keratin, the same material in fingernails. There are three layers: the outside, or cuticle; the middle, or cortex, and the inner, or medulla. The cuticle is usually clear and scaly, so hair color comes from either the cortex or medulla.

There are several very important functions of hair. Among them are: camouflage; insulation; mate attraction; protection from abrasion, snakes, bees, and parasites; warning (skunk); distraction (the "cotton" on a cottontail may distract a predator long enough for the prey to escape); and communication.

According to experts, there are two differences between hair and fur: fur (a.k.a. "pelage") is thicker than hair and it stops growing. By thicker, it is meant that the hairs are closer together, not of greater individual breadth.

Teeth

Teeth are made up of four parts: enamel, the outer coating and the hardest substance in the human body; dentine, the next layer, pulp, the softer inside and the one with all the nerves, and cementum, to hold the teeth in the jaws.

Mammals are not the only animals with teeth. For example, some fish (sharks) and reptiles (snakes) have them. However, only mammals can have more than one type—in fact, as many as four of them. The four types are: incisors, for cutting and slicing; canines, for grabbing and piercing, and premolars (or

bicuspids) and molars, usually for grinding. Mountain lions and other cats have sharp premolars and molars to aid in cutting instead of grinding.

Humans, dogs, bears, raccoons, opossums, and many others have all four types of teeth. Our local mule deer lacks incisors on the upper jaw (maxilla) and lacks canines, and anteaters have no teeth at all. Lagomorphs (rabbits and hares) lack canines, but have an extra set of upper incisors immediately behind the front ones. Many herbivores, including horses and cows, have extra-long molars because of the excessive amount of grinding of tough plant material.

Figure 85. Rabbit skull.

Sudoriferous Glands

Unique to mammals, sudoriferous (sweat) glands can serve many different purposes. They're used mostly for cooling the body through evaporation, but also excretion of toxins from the body and, in the case of skunks, defense. As with other bodily fluids, they can additionally be used to mark territories.

Sebaceous Glands

Also unique to mammals are sebaceous (fat-secreting) glands, the main purpose of which is to keep the hair and skin moist and soft. There can be a slight odor involved, which might be picked up by some animals and, when occurring in excess, is the main source of acne in teenagers.

Adaptations

Mammals, like almost all other living things, have had to adapt to their environments in order to avoid extinction. These adaptations take many forms.

Bats are the only mammals capable of true flight. They can locate their prey through echolocation, similar to a submarine's sonar. They also close their auditory canals when sending an outgoing tone, then open them to receive the incoming tone, avoiding misinterpretation. Another great feature is the disconnection between their ear bones and those of their bodies, which greatly reduces the interference between body movement noises and incoming sounds. Imagine being able to hear others clearly while munching on potato chips!

Many nocturnal mammals have developed highly sensitive eyes to magnify available light. Cats are notable examples.

Some have resorted to a life almost entirely underground, such as moles, gophers, and naked mole rats. Many of those subterranean dwellers have poor eyesight, choosing to find food and navigate using other senses, such as touch, smell, and hearing.

Predators generally have front-facing eyes, while those who are constantly on the lookout for danger have eyes placed more on the sides of their heads. A good mnemonic is “Eyes to the front, likes to hunt”; “Eyes to the side, needs to hide”

Some mammals change fur color to match the changing seasons. The coats of mink and artic foxes, for example, turn white in winter to camouflage them against the snow.

Desert kangaroo rats have coiled nasal passages, dry fecal pellets, and concentrated urine to greatly reduce water loss. They also have the ability to convert starch from seeds into water.

Extinction & Extirpation

The difference between extinction and extirpation is one of totality. For example, four mammals that are **extirpated** from California in historic times are the jaguar, grizzly bear, bison, and wolf. They used to exist in the wild here, but no longer do. Examples of **extinct** California mammals are the saber-toothed cat, dire wolf, ground sloth, and mammoth. No live specimens exist anywhere on earth.

Lifespan and Reproductive Habits

Common Name	Life Span	Mating Season	Gestation Period	Litter Size	Litters per Year
Opossum	7 + yrs	Jan – Oct	13 days	5 – 14	two
Raccoon	14 yrs*	Feb – Mar	63 days	2 – 7	one
Ringtail	8 yrs*			3 – 4	one
Longtail Weasel	5 yrs*	Jul – Aug	205-337 days	4 – 8	one
Badger	12 yrs*	Aug – Sep	~42 days	2 – 5	one – two
Spotted Skunk	8 – 10 yrs*	Jan. – Feb	~120 days	6 – 7	one – two
Striped Skunk	8 – 10 yrs*	Feb – Mar	63 days	4 – 10	
Coyote	14.5 yrs*	Feb – Mar	63 – 65 days	6 – 7 average	one
Gray Fox	10 yrs*	Feb – Mar	~51 days	3 – 5	one
Mountain Lion	18 yrs*	Any time	88 – 97 days	2 – 4	<1 a year
Bobcat	25 yrs*	Spring	50 – 60 days	3 average	three
Black Bear	30 + yrs	Jun – Jul	7 – 7.5 mos.	2 normally	<1 a year
Beechey Ground Squirrel	~ 10 yrs*	early spring	1 month	7 average	one
Western Grey Squirrel	~10 yrs*	Nov – Mar	44 days	3 – 5	two
Merriam's Chipmunk				2 – 8	two
Valley Pocket Gopher	3 yrs	any time	18 – 19 days	5 – 6 average	three
California Pocket Mouse	7.5 yrs			1 – 8 (4 avg)	several
California Mouse	1 – 2 yrs	Mar – Oct	21 – 25 days	1 – 3	several
Dusky-footed Woodrat	4 yrs	Nov – Mar	23 -38 days	usually 1 – 3	several
Desert Woodrat	5 – 6 yrs*		30 -36 days	usually 2 – 3	4 or more
California Vole	~1 yr	All year	21 days	4 – 8	1 or more
Blacktail Jackrabbit		Promiscuous	43 days	3 – 4	several per year
Audubon's Cottontail	~5 yrs*	Promiscuous	30 days	2 – 6	several
Brush Rabbit		Promiscuous	28 – 30 days	2 – 5	several
Mule Deer	25 yrs*	October	195-212 days	usually 2	one

* In captivity

Mammal Checklist – Los Angeles County

KEY: X = confirmed
O = formerly occurred; no recent record
? = possible or probable

		Placerita Canyon	Eaton Canyon	Whittier Narrows
Opossum	*Didelphis virginiana*	X	X	X
Ornate Shrew	*Sorex ornatus*	X	X	
Crawford's Desert Shrew	*Notiosorex crawfordi*			
Broad-footed Mole	*Scapanus latimanus*	X	X	X
California Leaf-nosed Bat	*Macrotus waterhousii*	X		
Little Brown Myotis	*Myotis lucifungus*			
Yuma Myotis	*Myotis yumanensis*			
Long-eared Myotis	*Myotis evotis*	X		
Fringed Myotis	*Myotis thysanodes*			X
Long-legged Myotis	*Myotis volans*			
California Myotis	*Myotis californicus*	X	?	X
Small-footed Myotis	*Myotis subulatus*			
Western Pipistrelle	*Pipistrellus hesperus*	X	X	X
Big Brown Bat	*Eptesicus fuscus*	X	?	X
Red Bat	*Lasiurus borealis*	X	X	
Hoary Bat	*Lasiurus cinereus*	X	X	
Spotted Bat	*Euderma maculatum*			
Townsend's Big-eared Bat	*Plecotus townsendii*			
Pallid Bat	*Anthrozous pallidus*	X		
Brazilian Free-tailed Bat	*Tadarida brasiliensis*			
Greater Mastiff Bat	*Eumops perotis*			
Brush Rabbit	*Sylvilagus bachmani*	X	X	
Desert Cottontail	*Sylvilagus audubonii*	X	X	X
Black-tailed Jack Rabbit	*Lepus californicus*	X		X
Merriam's Chipmunk	*Eutamias merriami*	X	X	
Lodgepole Chipmunk	*Eutamias speciosus*			
White-tailed Antelope Squirrel	*Ammospermophilus leucurus*			
California Ground Squirrel	*Spermophilus beecheyi*	X	X	X
Mohave Ground Squirrel	*Spermophilus mohavensis*			
Golden-mantled Ground Squirrel	*Spermophilus lateralis*			
Gray Squirrel	*Sciurus griseus*	O	O	
Fox Squirrel	*Sciurus niger*			
Northern Flying Squirrel	*Glaucomys sabrinus*			
Botta's Pocket Gopher	*Thomomys bottae*	X	X	X
Little Pocket Mouse	*Perognathus longimembris*			
White-eared Pocket Mouse	*Perognathus alticola inexpectatus*			
Long-tailed Pocket Mouse	*Perognathus formosus*			
Desert Pocket Mouse	*Perognathus penicillatus*			
San Diego Pocket Mouse	*Perognathus fallax*			
California Pocket Mouse	*Perognathus californicus*	X	X	

Revised 1/13/2014

KEY: X = confirmed O = formerly occurred; no recent record ? = possible or probable		Placerita Canyon	Eaton Canyon	Whittier Narrows
Chisel-toothed Kangaroo Rat	*Dipodomys microps*			
Panamint Kangaroo Rat	*Dipodomys panamintinus*			
Agile Kangaroo Rat	*Dipodomys agilis*	X	X	
Heermann's Kangaroo Rat	*Dipodomys heermanni*			
Merriam's Kangaroo Rat	*Dipodomys merriami*			
Desert Kangaroo Rat	*Dipodomys deserti*			
Beaver	*Castor canadensis*			
Western Harvest Mouse	*Reithrodontomys megalotis*	X	X	X
Canyon Mouse	*Peromyscus crinitus*			
California Mouse	*Peromyscus californicus*	X	X	
Cactus Mouse	*Peromyscus eremicus*			
Deer Mouse	*Peromyscus maniculatus*	X	X	
Brush Mouse	*Peromyscus boylii*	X	X	
Piñon Mouse	*Peromyscus truei*	X	X	
Southern Grasshopper Mouse	*Onychomys torridus*			
Desert Wood Rat	*Neotoma lepida*	X	X	
Dusky-footed Wood Rat	*Neotoma fuscipes*	X	X	
California Vole	*Microtus californicus*	X	X	X
Muskrat	*Ondatra zibethicus*			
Black Rat	*Rattus rattus*			X
Norway Rat	*Rattus norvegicus*			X
House Mouse	*Mus musculus*	X	X	X
Porcupine	*Erethizon dorsatum*			
Coyote	*Canis latrans*	X	X	X
Red Fox	*Vulpes fulva*			O
Kit Fox	*Vulpes macrotis*			
Gray Fox	*Urocyon lotor*	X	X	X
Feral Dog	*Canis familiaris*			X
Black Bear	*Ursus americanus*	X	?	
Ringtail	*Bassariscus astutus*	?	O [?Nan]	
Raccoon	*Procyon lotor*	X	X	X
Long-tailed Weasel	*Mustela frenata*	X	?	X
Badger	*Taxidea taxus*	O		
Spotted Skunk	*Spilogale putorius*	X	O	
Striped Skunk	*Mephitis mephitis*	X	X	X
Sea Otter	*Enhydra lutris*			
Mountain Lion	*Felis concolor*	X	X	
Bobcat	*Lynx rufus*	X	X	
Feral House Cat	*Felis domesticus*			X
Black-tailed Deer or Mule Deer	*Odocoileus hemionus*	X	X	
Mountain Sheep or Desert Bighorn	*Ovis canadensis*			

Animal Tracks

Dog Family – Four oval pads and one large triangular pad; toenail marks; front tracks have wider spread toe marks; track spaced evenly left by striding action.

Coyote
(dog is similar)

Fox

Cat Family – Four rounded pads and one large triangular pad; no toenail marks; front and rear pads very similar.

Bobcat
(cat is similar)

Cougar

Rabbit Family – Rounded front feet and elongated hind feet. Prints may not show pad marks. Prints appear in groups left by hopping action.

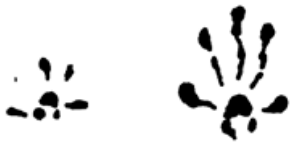
Cottontail Rabbit

Jackrabbit

Opossum Family – Hand-like front foot with five toes, rear print shows opposable thumb-like digit and offset "little finger".

Opossum

Rodent Family – Four or five toes with main pad connected. Prints very hand- and foot-like. Many quite small and difficult to distinguish.



White-Footed Mouse

Woodrat

Ground Squirrel

Gopher

Birds Show three or four toe marks with long toes. Claw-marks often appear. Prints are close together. Perching birds leave paired prints while hopping on ground.

Quail

Crow

Flicker

Duck

Pheasant

Sparrow

Snakes leave no foot prints. **Lizards** frequently leave marks of tail dragging. **Toads** and frogs show webbed hind feet and turned-in front feet.

Toad

Lizard

Snake

Hoofed Mammals – One or two hoofed marks, round or teardrop shaped; tracks overlap due to long stride.

Horse

Deer

Weasel Family – Rounded prints w/four or five pad marks arranged along one side of one large rounded pad. Weasel may show no definite pad print. Skunk shows claw marks.

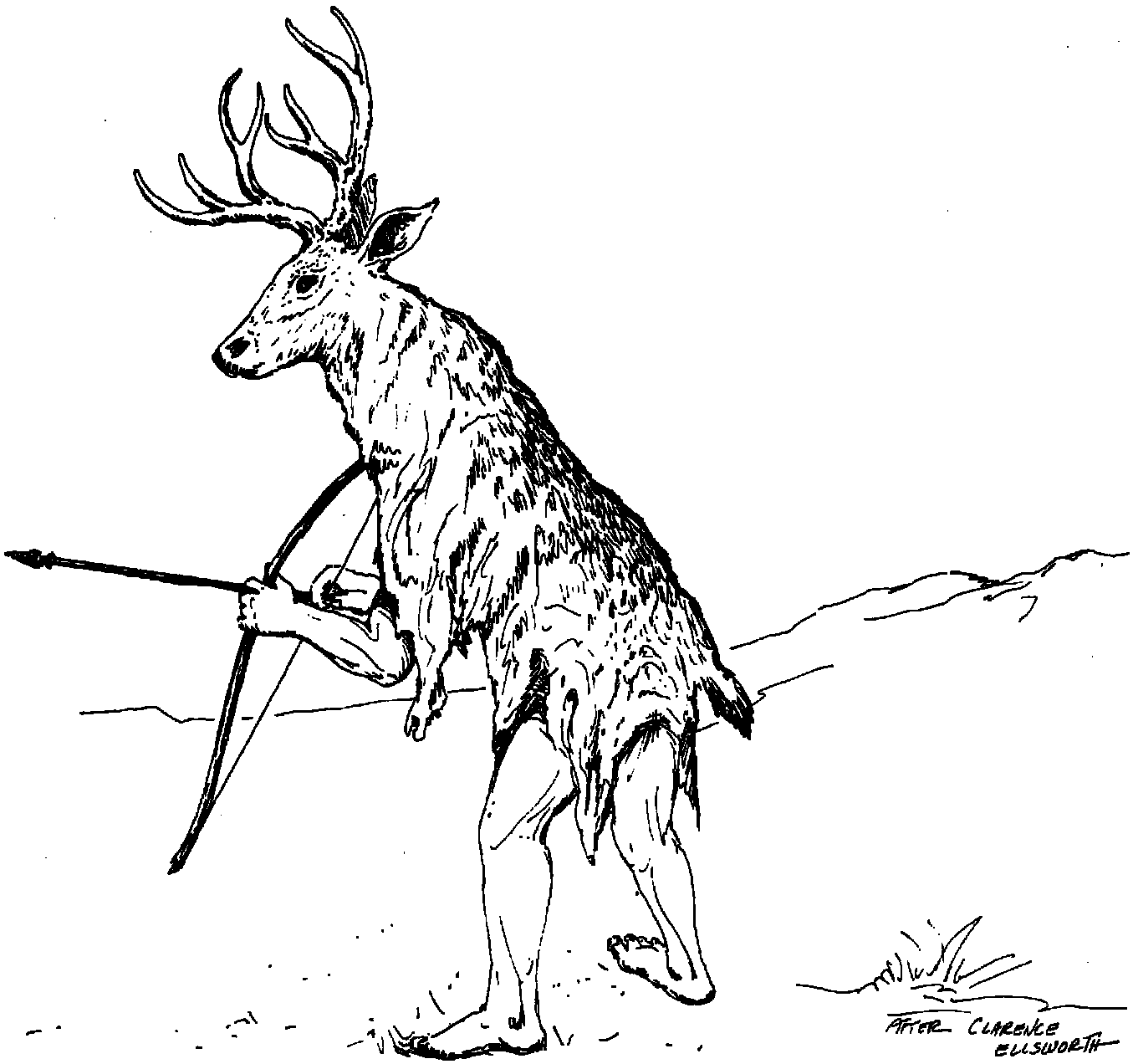
Weasel

Skunk

Raccoon Family – Flat-footed hand- and foot-like prints – each with five toes and claw marks. Tracks often end abruptly at tree or pond.

Raccoon

Native Americans



Native Americans in the San Gabriel Valley

Cynthia Null, 2012

The earliest Native American inhabitants of southern California's coastal plains were here perhaps in significant population around 10,000 b.c. These were probably Hokan-speaking tribes, which were later displaced by the Shoshonian tribes. (Crocker) The "Gabrielinos" were part of this Shoshonian group, which spread south from the southern Sierra between one and two thousand years ago. The Gabrielino of the Los Angeles area were known as "kumvit", from "kumi" which means east in the Shoshonean language. Presently, the local Native Americans prefer to be called "Tongva".

The names Gabrielino and Fernandino were used after the establishment of the two major Spanish missions in their territory in the 1770's. It was to these two missions that the majority of the Natives living on the coastal planes and valleys were removed.

Generally, Gabrielino territory included the watersheds of the Los Angeles, San Gabriel and Santa Ana Rivers and several smaller intermittent streams in the Santa Monica and Santa Ana Mountains; all of the Los Angeles Basin, the Coastline from Aliso Creek in the south to Topanga Creek in the north plus the islands of San Clemente, San Nicolas and Santa Catalina.[1]

A large number of Indian artifacts used for domestic purposes were uncovered in connection with the subdivision of the mesa which is bounded on the west by San Rafael Terrace, on the east by Hillside Terrace and on the north by San Rafael Avenue. Indian artifacts have also been found in quantity in the area south of Lida Street, on the grounds of Linda Vista School, in the Arroyo Seco near the plunge, along the western bank of the Arroyo Seco above the Rose Bowl, indicating that semi-permanent or permanent villages existed also in all these locations in southwestern Pasadena.[2] In the 1890s this area was still known as "Indian Flats".

On the coast there were villages of up to a thousand people, which had political authority over the smaller interior villages. These larger entities held a complex and highly sophisticated society of hereditary chiefs, self-made rich men, and specialized craftsmen. Religious leaders included healers, controllers of weather, masters of fish, wizards, and priest-like individuals who held rites to maintain the harmony of the universe.

The pathetic and vandalized remnants of Indian Rock Art show a tradition unexcelled anywhere in the world for color, abstract and visionary form. Objects of daily life, such as baskets and bowls were equally well made, and impressed even the explorers – hard men who were not used to being impressed by anything the Indians did. A magnificent oral literature flourished, known only from a few survivors. [3]

Southern California natives had a well-established system using shell money. They were also among the only natives constructing board boats when the Europeans arrived. They made bowls, pipes and religious fetishes from Steatite (soapstone), which would not crack in the fire.

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[1] Gabrielino; by Lowell John Bean and Charles R. Mith, pg 538 Smithsonian Institute
[2] Within the Vale of Annadale; pg. 5 Ibid.
[3] Chaparral Ethnobotany; a paper by Dr. Eugene Anderson, Dept. Anthropology, U.C. Riverside 1989

- Women had rights and were treated with equality. Sometimes the shaman and head person or chief was a woman.
- Until Europeans arrived, there had been no organized warfare for hundreds of years in most of the Southern California. There were no war drums, war chiefs and no well-defined tribal organizations.
- There was belief in a future life, evidenced by breaking or burning all possessions of the owner. They believed in the other world, much like this one except every act would be crowned by success.
- The impact of the medicine man was such that he was held responsible for the health of the villagers, so in times of epidemic, his lack of power would cause him to be executed. [4]

Why did not these natives practice agriculture? They certainly knew about it. The answer would seem to be that the planting of corn and beans, and perhaps lack of sufficient water supply, would have interfered with late spring and summer gathering operations, which produced more food than cultivated crops in those days.

Throughout the Pacific Coast, hunters and gatherers resided in larger permanent villages in the winter, but moved out in spring or summer to follow the band of ripening seeds and fattening game in the hills.

In southern California, the more fortunate communities managed strips of land running from the coast to high mountain forests. They would live during the winter on stored food, shellfish and green shoots.

Spring would bring more fresh green shoots. The first major seed crop came in May. Seeds were followed up the foothills and into the mountains where the year climaxed with the great acorn harvest in late summer or early fall. The very luckiest groups had pine nut groves that would ripen at the same time or a little later. The pine nuts were recognized as particularly tasty and nutritious. Communities without oak or pine groves would either visit relatives who had them or trade with their neighbors.[5]

In this world of numerous people and intensive plant use, the most terrible of all possible things was a dry year. A Chumash legend tells that the Sun and Coyote gambled during the year, and on the first day of winter, the Moon judged the game. If Sun was the winner, the year was dry and hot. If Coyote won, the year was a good one, with rain and plentiful food. In the role of Coyote, we meet the religious world of Native Americans. Coyote was one of the creator beings. Southern Californian peoples had an elaborate mythology involving at least one awesome, remote creator and at least one tricky, foolish creator. The latter was always Coyote. Coyote was the most human of the creator beings – a poet, a dreamer, full of all human weaknesses, but also of the solid human virtues of boundless curiosity and a will to try anything once. His mistakes and sins were the most popular of stories. They established this world as a place that is always unpredictable, always going wrong, yet always beautiful, exciting and delightful.[6]

[4] notes, Cynthia Null 1991 lecture
[5] Chaparral Ethnobotany, Ibid p. 3
[6] Chaparral Ethnobotany, Ibid pg. 3-4

Native American Land Use in Southern California

Cynthia Null, 2012

When Europeans first landed in the Americas, their reports cited well established villages with well proportioned, healthy natives, who were much superior in appearance to the Europeans, who often were scarred with smallpox, dirty and ragged in appearance after their long ocean voyage, and lacking in skills to live in their new environment.

What resources and techniques did these native people use to contribute to their superior life style?

In some areas they planted crops, as in the Indians living on the east coast (planting corn, beans, and squash) and harvested fish and game.

The peoples of the San Gabriel Valley learned to use the plants and animals available in this area. Their villages were located near sources for water, and they managed the environment around their villages to maximize its usefulness.

For food, they used acorns as a principle food crop, along with many seeds, fresh greens and other plants, such as yucca, in the proper seasons for gathering. They moved seasonally to places were readily available to harvest resources not readily available in their local area. In certain areas Indians altered their environment to maximize their village life, while continuing to show great respect for the environment and its resources.

One commonly held view about the Americas before Columbus, is that the country was a pristine, untouched wilderness, existing in its then present state for many thousands of years.

We now have evidence that this was not the case; that large areas were indeed managed by the people who lived on the American continents. There were large cities and villages that would not have been sustainable without altering the landscape.

How does that apply to the Native Americans who lived in the San Gabriel Valley? What were some of the land management tools that they used to create the best use of their environment?

Some of the methods they used were:

1. Weeding – they removed unwanted plants growing around favored plant communities

2. Transplanting – introducing native plants to new areas – for example, prickly pear or soaproot. (It is believed that Tree Tobacco was probably introduced from South America).

3. Tilling – the moving of soil to harvest underground perennial roots, tubers and bulbs, frequently dividing these and leaving individual clumps in the soil- examples, camas, soaproot, brodias (wild Hyacinth) & species in the onion family.

4. Sowing – broadcasting seeds collected for native plants, usually in a recently burned area – for example, Lambs quarters, fan palms,

5. Pruning – the removal of dead or living parts from native plants to modify growth form or to enhance fruit or seed production – this was done with willow, elderberry, honey mesquite,

6. Coppicing – a severe form of pruning that involves cutting down a shrub or small tree to a few inches above the ground level to promote growth of long, straight shoots – for instance, wild rose and redbud. (basket materials) (straight shoots for arrow shafts, etc.)

7. Irrigating – supplying selected land areas with water by means of canals to increase a field of plants – such as wild hyacinth or wild rye

8. Burning – the most significant, effective, efficient and widely used vegetation management tool. It was used to reduce dead plant materials, and recycle nutrients, especially for deer grass and basket bush, and to control insect and plant diseases, especially the understory in Oak Woodlands where a cleared area would make it easier to gather acorns. Burning encouraged fresh, nourishing new growth which in turn increased wildlife (fresh food for herbivores like rabbits and deer), who in turn provided food for carnivores) and increased certain insects such as grasshoppers, which were used for food.

Tongva Plant Use – Major Plants

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Staples

Acorns, from oaks (*Quercus spp*.). Ground and leached. Most important species were almost certainly the black oak (*Q. kelloggii*) of the mountains and the coast live oak (*Q. agrifolia*) of the lowlands. At least five other species occur and would have been used. Primarily these are chaparral plants, but oaks occur anywhere that there is any good soil and moisture. Holly-leaved cherry (*Prunus ilicifolia*)-important for its large kernels more than for its thin acid fruit, but both were used. The kernels have to be ground and toasted to remove hydrocyanic compounds.

On Catalina Island the much larger *P. lyonii* replaces this. *P. lyonii* has bigger kernels and much bigger fruits, the pulp being sweet and good, often comparable to cultivated cherries.
Both occur on moist or shady slopes, in dry washes, and at springs. Chia sage (*Salvia columbariae*)--seeds ripen in May or June and are highly nutritious. Washes, grassland, sage scrub.

Grass seeds--unidentified

I strongly suspect that many of the seeds lumped as "grass seeds" in the early accounts were seeds of plants common in the grasslands but not themselves grasses. For example, tarweeds (*Hemizonia* and *Madia* species) and fiddlenecks (*Amsinckia spp*.) were important foods of better-described neighbors of the Gabrielino. Grassland; less common in sage scrub, etc.

Yucca (*Hesperoyucca whipplei*), "Spanish bayonet" or "Our Lord's Candle." Buds and young flowers boiled to remove bitter saponin compounds, then eaten. Believed to be a staple among interior groups but reported by at least some informants to be avoided near the coast. Flowering stalk base ("heart") cut out before stalk grows up, roasted in earth oven. Chaparral and sage scrub, on sunny open slopes. The Tataviam are believed to have used yucca a good deal more than the Gabrielino did. Otherwise, the Tataviam had similar foodways, apparently.

Fruit and Berries

Prickly pear (*Opuntia spp*., esp. *O. occidentalis*). Probably much less important was the related cholla (*Cylindropuntia californica*). Grassland and coastal sage scrub; washes and sunny slopes.

Sumac, especially sugar bush (*Rhus ovata*) and squawbush (*R. trilobata*). Sage scrub and chaparral; the latter mostly in seep and spring areas.

Wild grape (*Vitis girdiana*). Lowland riparian woodland.

Elderberry (*Sambucus nigra ssp.caerulea*). Found in moist areas along washes and near springs.

Manzanita (*Arctostaphylos*, many species). Chaparral and mountain forest.

Wild rose (*Rosa californica*). Riparian forest.

Toyon (*Heteromeles arbutifolia*, “Christmas-berry,” “California holly.”) Chaparral and grassy coastal sage scrub.

Walnut (*Juglans californica*, California Black Walnut). Kernel eaten. Southern oak woodland and, more generally, on north-facing grassy slopes in lowlands, or near springs.

Pines (*Pinus spp*.). Seeds eaten, sometimes sweet inner bark too, probably. Favorites probably Coulter pine (*P. coulteri*) and pinyons (rare in Gabrielino territory, only in far north). Mountain forests and woodlands.

Greens and Other Items

White sage (*Salvia apiana*). Young flowering stalks eaten raw, like celery. Coastal sage scrub.
Wild greens. No special ones listed for the Gabrielino, but neighbors are known to have used miners’ lettuce (*Claytonia perfoliata*), goosefoot or quelites (*Chenopodium spp*.), thistle (*Cirsium spp*. and probably others), dock or wild sorrel (*Rumex spp*.), peppergrass (*Lepidum spp*. and probably various related genera; seeds also eaten and important, cited for Gabrielino by Hugo Reid), watercress (*Nasturtium officinale*), possibly not native, and others. The Gabrielino would certainly have eaten all these too. Most are commonest in moist places. All altitudes and communities.

Ceremonial and Medicinal

Tobacco (*Nicotiana attenuata*, coyote tobacco). Probably the most important plant for ritual and magic. Too strong to be an indulgent. Washes in lowlands generally.

Toloache, Jimson-weed, datura (*Datura wrightli*). Hallucinogenic and very dangerous drug plant used in initiation rituals, curing rites, etc. Dry washes and other disturbed places in lowlands.

Sagebrush (*Artemisia spp*., esp. California sagebrush, *A. californica*). Used probably for killing parasites and for assisting menstruation (related neighboring groups used it particularly for girls at menarche) and, in stronger doses, for abortion. Sage scrub, rarer in chaparral and grassland. Other spp. in mountains, washes.

Yerba santa (*Eriodictyon spp*.). Neighboring related peoples used it--some still use it--as a sort of cure-all, and presumably the Gabrielino did also. Chaparral and washes.

Extensive and complex medicinal use of plants is documented for all neighboring groups and must have been present among the Gabrielino, but nothing is known of this, except as above, today.

Industrial Applications

Baskets:

Rush (*Juncus spp*.). For wrapping the basket foundation. Wet boggy places everywhere.

Squawbush (see above).

Muhlenbergia rigens grass. Tough yet flexible, this was the universal material for the foundation coil. General in lowlands. Now rare (grazing and competition from introduced species has eliminated it from most areas).

Cordage:

Indian hemp (*Apocynum androsaemifolium*). Damp, disturbed places in mountain areas.

Milkweed (*Asclepias spp*.). Grasslands and open moist areas everywhere.

Nettle (*Urtica spp*.) Wet places, all altitudes.

Animal Foods

Essentially every animal was fair game, except the rattlesnake. The Gabrielino were apparently broader in their tastes than other California native populations (or most other peoples of the world). Deer, rabbits, ground squirrels, and other small game were the most important items.

Undocumented Plants

Some common plants widely used in Native California, not documented for the Gabrielino but common in the area and almost certainly used by them:

Seeds, berries, nuts

Wild currants and gooseberries (*Ribes spp*.). Many species, very common in chaparral and forest environments.

Wild buckwheats (*Eriogonum spp*.). Abounding and universal. Seeds edible (like cultivated buckwheat) but neither very good nor very abundant.

Blackberries (*Rubus spp*., mostly *R. californicus*) and thimbleberry (*Rubus parviflorus*, a wild raspberry). Abundant in all moist places with some shade, but rarely produce much fruit, and this is usually taken by animals before people can find it.

Coffeeberry and chaparral redberry (*Frangula californica* and *Rhamnus crocea*). Fruits edible but not very good. Chaparral and wash environments.

California laurel (*Umbellularia californica*, "California bay"). Nuts edible after considerable processing. Shady places in low mountains.

A very wide range of other seeds and nuts can be used. Some genera that are rare in Gabrielino range were important elsewhere (e.g., blazingstar, Mentzelia; Indian ricegrass, Stipa), and probably the Gabrielino rarely bothered with them. But it is probably safe to assume that dozens of species were used.

After the Spanish came, introduced plants like filaree and oats were quickly discovered and used.

Roots and Tubers

The early pejorative term for western Indians was "Diggers," a contemptuous reference to their fondness for roots and tubers, but these food sources have been almost totally neglected in the literature. Recent study farther north shows they were the most important foods for many groups. The Gabrielino must have used many, but we know nothing about this. Among the important ones, to judge by what is reported for the other tribes, were:

Grass nut (or wild hyacinth, brodiaea) (*Dichelostemma capitatum*). Grasslands. Wild carrots (many species of *Lomatium*, *Perideridia*, *Sanicula*, etc.). Mostly mountains, but some species occur in any given environment. Onions (*Allium spp*.). Mostly montane in moist places. Leaves probably also used. Sedge (*Cyperus*). Some species produce nutlike tubers. Cold wet places.

Miscellaneous Foods

Cattail (*Typha spp*.) and tule roots and cattail pollen were widely eaten in pre-contact America. (The roots are really stem bases.)

Several other edible water plants occur locally.

Sweet sap from sugar pine, bigleaf maple (*Acer macrophyllum*, close to sugar maple) and other plants may have been used. Honeydew deposited on certain plants such as reed, due to insect effort, was a standard sweetener in California--important enough to give the names of two major geographic features (Honey Lake and Panoche Valley, the latter in San Benito County) where explorers found Indians collecting this.

Soap Sources

Natural saponins occur in several plants, and all you have to do is mash them in water to get a fine effective lather. Favorite in most of California, and common in the chaparral in Gabrielino country, was *Chlorogalum pomeridianum*, the soaproot or amole. There are those who still swear its root produces a better shampoo than any commercial product. Wild gourd or calabazilla (*Cucurbita foetidissima*) fruits are a good source, and you can eat the seed kernels, too. Yucca has good saponins as well. (The needle-sharp leaf tips of yucca were used as needles, by the way.) These saponins are somewhat poisonous, and were widely used in native America as fish-killers, since they do not make the fish poisonous.

Wood Sources, etc.

Any woody plant could supply firewood. Larger ones supplied construction materials. Arrow and bow materials are somewhat obscure. Almost all the harder woods in our area are very crooked and gnarled (e.g., chamise), while the woods that grow straight are soft and weak (e.g., willow). A common way to finesse this problem in California was to stick a short hardwood foreshaft (of chamise or something like that) onto a long, straight, but weak main arrowshaft. Much use was made of steaming wood till it was flexible and then working it on a stone to straighten it.

Willow and similar withes were plaited into huge acorn granary baskets. Thatch for houses was made of tules (*Scirpus*), or other large tough monocots.

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Placement of historic Gabrielino villages indicates that access to water, marsh, riparian habitat, and grassland habitat was critical, probably in that order of importance.

After the coming of the Europeans and their introduced plants, southern California Indians learned not only to farm and use cultivated plants, but also to gather the seeds of wild oats and other non-native grasses; the seeds and leaves of such plants as filaree; the tender young greens of Russian Thistle and other weeds, and the berries and fruits of European plants gone wild. They quickly learned to appreciate all the new meat animals. Agriculture had been practiced on the desert in pre-Columbian times--corn and squash were raised and probably other crops--and the Gabrielino had been familiar with it. They quickly fitted into the ranching and farming society of the 19th century, though disease and ill-usage decimated their numbers.

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Natural History magazine

National Wildlife magazine

Sierra Club Bulletin

Glossary of Terms

Allopatric – the non-overlapping ranges of two or more populations of organisms.

Alluvium – loose, unconsolidated soil and/or sediments which have been eroded, reshaped by water in some form, and re-deposited.

Altricial – the condition of a newborn that is hairless or without feathers, blind (eyes closed), earflap closed and unable to walk.

Amensalism – an interaction between populations of two species that harms one but not the other.

Angiosperms – a plant in which the sex organs are within flowers and the seeds are in a fruit.

Anther – The pollen-producing part of a stamen. Generally at the end of a stem-like filament.

Aposematic coloration – warning coloration often signifying that the prey animal has defenses such as being unpalatable or poisonous.

Arachnid – an animal with four pairs of legs and a body with two segments, belonging to a large class that includes spiders, scorpions, and mites.

Autecology – studies the interrelations of a single species to its environment.

Autotroph – organism that is self-nourished; able to build organic substances from inorganic substances; a producer.

Bacteria – a single-celled, often parasitic microorganism without distinct nuclei or organized cell structures

Biomass – the total amount of living organic material in a given ecosystem; the standing crop.

Bryophyte – a non-flowering plant, often growing in damp places, that has separate gamete and spore-bearing forms, e.g. moss.

Cache – in biology, a hidden place where animals store food.

Calyx – The sepals of a flower, taken together.

Carnivore – meat eater; same as secondary consumer.

Carrying capacity – the carrying capacity of a biological species in an environment is the maximum population size of the species that the environment can sustain indefinitely, given the food, habitat, water, and other necessities available in the environment.

Cellulose – the chief substance composing the cell walls or fibers of all plant tissue.

Cephalothorax – the fused head and thorax typical of spiders and other arachnids and many crustaceans.

Chitin – protective outer covering a tough semitransparent substance that forms part of the protective outer casing cuticle of some insects and other arthropods, and the cell walls of some fungi.

Chlorophyll – The green pigment in leaves that absorbs light and enables photosynthesis, the production of food for the plant.

Clade – a group of organisms, such as species, that reflects a common ancestor and all of its descendants, often not assigned a rank, such as class or order.

Class – a taxonomic rank fitting between phylum and order.

Climate – the composite or generally prevailing weather conditions of a region, as temperature, air pressure, humidity, precipitation, sunshine, cloudiness, and winds, throughout the year, averaged over a series of years.

Climax community – the final stage of a community succession.

Commensalism – the relationship between organisms of two different species in which one derives food or other benefits from the association while the other remains unharmed and unaffected.

Competition – is an interaction between organisms or species, in which the fitness of one is lowered by the presence of another. Limited supply of at least one resource (such as food, water, and territory) used by both is required.

Compound – Divided into multiple parts. A compound leaf is one that is divided into multiple leaf-like parts, called leaflets.

Condensation – conversion of gas to liquid: the process by which a vapor loses heat and changes into a liquid.

Core – the central part of Earth. Earth's core is molten in parts and is composed of an alloy of iron and nickel.

Corolla – the petals of a flower collectively, forming a ring around the reproductive organs and surrounded by an outer ring of sepals.

Crepuscular – active during twilight (dawn and dusk).

Crown-sprouting – those shrubs capable of growing shoots from the root crown, after a fire or other disturbance.

Crust – the outer layer of the Earth.

Crustaceans – an invertebrate animal with several pairs of jointed legs, a hard protective outer shell, two pairs of antennae, and eyes at the ends of stalks. Lobsters, crabs, shrimp, crayfish, water fleas, barnacles, and wood lice are crustaceans.

Cuticle -is a non-cellular protective layer covering the outer cell layer (epidermis) of the green, aerial parts of land plants.

Deciduous – Shed periodically.

Dicot – A somewhat obsolete term for a flowering plant with two embryonic leaves in the seed, generally having flower parts in 4's or 5's, and pinnate or palmate leaf venation. Most are now called Eudicots, instead. Some are called Magnoliids.

Diurnal – day-active.

Ecosystem – a natural unit of living and nonliving components which interact to form a stable system in which an interchange of materials takes place between the living and nonliving components.

Ecotone – a transition or contact zone between two or more diverse communities.

Ectoparasites – a parasite that lives on the outside of its host, e.g. on the skin or in the hair. Fleas are ectoparasites.

Ectothermic – relating to an organism that regulates its body temperature largely by exchanging heat with its surroundings; cold-blooded.

Edge effect – the tendency for increased variety and density of organisms at community junctions (ecotones).

Endemic – confined to a certain region (**Endemism**).

Endoparasites – parasite that lives inside its host, e.g. a tapeworm.

Endothermic – relating to an organism that internally generates heat to maintain its body temperature; warm-blooded.

Estivation – dormancy during summer or dry season.

Eudicot – A flowering plant with two embryonic leaves in the seed, generally having flower parts in 4's or 5's, and pinnate or palmate leaf venation. A more current term for most Dicots.

Evaporation – process in which something is changed from a liquid to a vapor without its temperature reaching boiling point.

Exoskeleton -hard covering on the outside of organisms such as crustaceans, insects, turtles, and armadillos that provides support and protection.

Extinct – died out or ceased to exist.

Extirpate – completely get rid of, kill off, or destroy-generally within a given geographic area.

Filament – The generally stalk-like part of a stamen that holds up an anther

Food chain and **Food web** – the transfer of food energy from the source in plants through a series of organisms with repeated eating and being eaten is the food chain. The interlocking patterns of food chains makes up the food web.

Fruit – The ripened ovary containing one or more seeds. Fruits may be fleshy or dry.

Fungi – a single-celled or multicellular organism without chlorophyll that reproduces by spores and lives by absorbing nutrients from organic matter. Fungi include mildews, molds, mushrooms, rusts, smuts, and yeasts.

Gymnosperms -a woody vascular plant in which the ovules are carried naked on the scales of a cone, e.g. a conifer.

Habitat – the place where an organism lives; the place where one would go to find a given organism.

Herbivore – plant eater; same as primary consumer.

Heterotroph – organism that is other-nourished; obtains energy from the breakdown of complex organic substances; a consumer.

Hibernation – dormancy during winter, generally accompanied by lower metabolic rate and temperature.

Home range – the area over which an animal generally moves in obtaining its food.

Humidity – the amount of moisture in the air.

Hydric – "wet"; habitats with plentiful rainfall and well-drained soils.

Hypha – (plural hyphae) branching tubular filaments.

Igneous – describes rock formed under conditions of intense heat or produced by the solidification of volcanic magma on or below the Earth's surface.

Incomplete metamorphosis – A life cycle of certain insects, such as crickets and grasshoppers, characterized by the absence of a pupal stage between the immature and adult stages.

Indicator species – a species whose presence, absence, or relative well-being in a given environment is indicative of the health of its ecosystem as a whole.

Insectivore – any plant or animal that feeds primarily on insects.

Introduced – Growing outside its natural area as a direct or indirect result of human activity.

Invasive – Having a tendency to spread, causing a displacement of native species and detrimental alteration of ecosystems.

Kingdom – The highest classification into which living organisms are grouped in Linnean taxonomy, ranking above a phylum.

Limiting factors – a set of environmental requirements which each species and organism must meet for survival. These include temperature, light, water, soil condition, topography, availability of food, etc.

Magnoliid – An flowering plant with two embryonic leaves in the seed, generally having flower parts in 3's, and pinnate or palmate leaf venation. A more current term for some early-evolved plants that were called Dicots.

Mantle – the layer of the earth between the crust and the core.

Mediterranean climate- having hot summers and warm winters, with most of the rainfall occurring in the winter.

Mesic – moderately moist-habitats characterized by or requiring moderate amounts of moisture.

Metamorphism -in rocks a pronounced change effected by pressure, heat, and water that results in a more compact and more highly crystalline condition .

Metamorphosis – a complete or marked change in the form of an animal as it develops into an adult, e.g. the change from tadpole to frog or from caterpillar to butterfly.

Mineral – any of a class of substances occurring in nature, usually comprising inorganic substances, as quartz or feldspar, of definite chemical composition and usually of definite crystal structure, but sometimes also including rocks formed by these substances as well as certain natural products of organic origin, as asphalt or coal.

Molt – to shed feathers periodically, especially seasonally, in order to allow replacement of what is lost with new growth.

Monocots – any of a class of chiefly herbaceous angiospermous plants having an embryo with a single cotyledon, usually parallel-veined leaves, and floral organs arranged in cycles of three.

Mountain building – The creation of uplands by movements of the earth's crust.

Mutualism – relationship between two organisms of different species that benefits both and harms neither.

Native – Growing naturally in an area without direct or indirect introduction by human activity.

Neutralism – the theory that some changes in evolution are governed by random mutations that become fixed in populations by chance rather than by natural selection.

Niche – the functional status or role an organism plays in its community.

Nocturnal – night-active.

Omnivore – animal that eats both plant and animal material.

Ovary – The often swollen portion at the base of the pistil. The ovary contains the ovules that become seeds. As the ovary ripens, it becomes the fruit.

Overpopulation – The population of an environment by a particular species in excess of the environment's carrying capacity.

Palmate – Radiating from a common point, like spread fingers, describing the lobes or veins of some leaves, or the leaflets of some compound leaves.

Parasitism – symbiosis in which one organism lives as a parasite in or on another organism.

Pedipalps – either of a pair of appendages that are part of the mouths of spiders and other arachnids.

Percolation – the slow movement of water through the pores in soil or permeable rock.

Perianth – The sepals and petals of a flower, taken together. Often used when the parts are not easily distinguishable.

Petal – One of the often large and colorful flower parts that are immediately inside the sepals. A part of the corolla.

Photosynthesis – utilization of the energy of light to combine carbon dioxide and water into simple sugars, releasing oxygen in the process.

Phylum – a major taxonomic group into which animals are divided, made up of several classes.

Pioneer community – hardy species which are the first to colonize previously disrupted or damaged ecosystems.

Pinnate – Having parts (lobes, leaflets, veins) arranged on both sides of a central axis.

Pistil – A female part of a flower, consisting of an ovary, style, and stigma.

Plate junctions – a place where tectonic plates meet.

Pollinate – to transfer pollen from a stamen to the upper tip (stigma) of the pistil of a flower.

Precipitation – rain, snow, or hail, all of which are formed by condensation of moisture in the atmosphere and fall to the ground.

Precocial – the condition of a newborn that has hair or feathers, eyes open, and the ability to move about, and requiring little parental care.

Predation – the relationship between two groups of animals in which one species hunts, kills, and eats the other.

Primary consumers – organisms that eat plants; first order consumers.

Primary succession – the process of community change on an area which has not been previously occupied by a community (such as a newly exposed rock or sand surface).

Producers – largely green plants, which are able to manufacture food from simple inorganic substances; autotrophic organisms.

Protective coloration – the combination of surface colors and patterns on an animal that helps it blend into its surroundings and so evade predators.

Protista – a kingdom comprising a variety of unicellular and some simple multinuclear and multicellular organisms.

Raptor – bird of prey.

Riparian – situated or taking place along or near the bank of a river.

Rumen – the first stomach of a cud-chewing animal whose stomach has multiple chambers (ruminant).

Secondary consumers – organisms that eat animals; second order consumers.

Secondary succession – community development in an area from which a community was removed (such as a plowed field or cutover forest).

Sedimentary – describes rocks formed from material deposited as sediment by water, wind, or ice and then consolidated by pressure.

Sepal – One of the leaf-like, often green, flower parts, just below the petals. Part of the calyx. Sepals form the covering of the flower bud.

Sere – the whole series of communities which develop in a given situation. A single community taken from a given period of succession is called a **seral stage**.

Setae – a slender, usually rigid bristle or hair.

Sexual dimorphism – the existence of differences in the appearance of the male and female of a species.

Spinnerets – tiny tubular structure, usually one of two pairs, that exudes the fluid produced by the abdominal glands of a silk-producing spider.

Spiracles – a small paired aperture along the side of the thorax or abdomen of an insect or spider through which air enters and leaves.

Stamen – A male reproductive part of a flower, consisting of a filament and an anther.

Stigma – the part of a flower's female reproductive organ carpel that receives the male pollen grains.

Style – The stem-like portion of the female flower part (pistil) that arises from the ovary and holds the stigma in a position for optimum pollination.

Subtropical – relating to or found in areas between tropical and temperate regions, and experiencing tropical conditions at some times of the year or nearly tropical conditions all year round.

Succession – the orderly process of community change; the sequence of communities that replace one another in a given area.

Symbiosis – a close association of animals or plants of different species that is often, but not always, of mutual benefit.

Tepal – one of the divisions of a flower perianth, especially one that is not clearly differentiated into petals and sepals, as in lilies and tulips.

Sympatric – the overlapping or coinciding of geographical ranges of two or more populations of organisms.

Territory – that portion of the home range that is actively defended.

Transpiration – It is the loss of water vapor from parts of plants (similar to sweating), especially in leaves but also in stems, flowers, and roots.

Trichome – an outgrowth of a plant's outer cell layer epidermis. Trichomes have various shapes and functions, and include root hairs.

Weathering –the disintegration and decomposition of rocks and minerals by natural processes such as the action of frost or percolating ground water.

Xeric – “dry”; habitats in which plant production is limited by availability of water.

Index