Chapter 4
Organisms of the Redwood Forest

Some kinds of organisms are found in many different kinds of environments. Redwood forest examples of these include the raccoon, wood rat and poison oak. Some communities have organisms that are found nowhere else. Such species are called **endemic**. No truly endemic redwood forest species have been identified, i.e., plants and animals of the redwood forest can be found elsewhere, at least occasionally. There are, however, several near-endemic species whose ultimate survival may depend on the continued existence of redwood forest, as the redwoods provide 75% or more of their range. At least 42 species of redwood forest vertebrates, and 16 invertebrates, are listed as endangered, threatened, or otherwise of concern. Some of these species seem to require forests with the characteristics of old-growth forests, including diversity of tree sizes and ages, the presence of snags or downed trees, or large stands of trees.

As noted elsewhere, the focus of *Redwood Ed* is on the redwood forest itself. The aquatic ecosystems of the redwood forest are extremely important to the forest, and the redwood forest has important effects on the streams and rivers that flow through it. In *Redwood Ed* I won't discuss much about the aquatic ecosystems except to point out that the streams historically have been important breeding grounds for a variety of **salmonid** fish, *i.e.*, salmon and trout. Silt from erosion can bury the gravel or fill the deep, cool pools that these fish need to successfully live and breed. Removal of large and small trees along stream channels affects aquatic ecosystems in many ways, including increased warming because of less shade. Some studies indicate that the once plentiful decaying salmon carcasses provided an important source of minerals for the redwood forests. *The Redwood Forest* (Noss, 2000) has a fairly extensive treatment of the aquatic ecosystems of the redwood forest. Because of the susceptibility of the streams to damage, modern timber management plans must include buffer zones to try to protect the streams.

In addition to various books that are listed in the Resources section, a free CD of Education Programs for Grades K-5 is available from Muir Woods National Monument. The CD includes background information, images of some redwood forest organisms and human activities, and lessons. See MacDonald (2003).

What's in a Name?

When a child sees a new type of animal or plant, the first thing he or she usually wants to know is its name. This is true of adults, too, and it indicates a basic human desire to make a connection with an organism by knowing its name.

For most organisms, there are two names: the "common name" and the "scientific name." Our common name, for example, is "human," while our scientific name is *Homo sapiens*. There are advantages and disadvantages to both scientific and common names.

Common names are usually easier for us to understand – they're in our common language. They are often descriptive. A redwood tree does, in fact, have red-colored wood. A striped skunk does have stripes, and a rough-skinned newt has rough skin. Common names can also be confusing or misleading. The California bay tree is also known as the California laurel, the bay-laurel, and the pepperwood. Neither poison oak nor tanoak are truly oaks. Douglas-fir is not a true fir, and the same tree is sometimes called Oregon pine…and it's not a pine either.

Another disadvantage of common names is that they differ in different places. Gardeners are familiar with the pocket gopher that enjoys eating our plants. In the southeastern states there lives a tortoise called a gopher tortoise.

Also, different languages have different names for the same organism. Italians working in the mills of redwood country would call the raccoon procione, while the French would call the same animal raton laveur. A Swedish lumberjack would call it sjubb, while a German would call it der Waschbar. Russians at Fort Ross would call the raccoon eHOT (pronounced yeh en oh tea), while a Chinese laborer might call it huan xiong and a Spanish missionary might talk about the mapache. Different Native American groups had different words for raccoon: in Tolowa it's kwen-sha; in Coast Yurok it's tweg-gaw, in Pomo it's kah-doos, while the Coast Miwok would call the raccoon hoo-ma-ka. However, scientists from around the world would know the raccoon as *Procyon lotor*.

Scientific names, on the other hand, may be hard to pronounce or remember, as they are typically derived from Latin or Greek words, or "Latinized" forms of other words. They are, however, generally descriptive of the organism. The coast redwood, for example, is named *Sequoia sempervirens*: "*Sequoia*" to honor the great Native American leader and "*sempervirens*" to recognize the tree's long life. Scientists all around the world know that *Sequoia sempervirens* is the coast redwood, and that all other types of trees, even the giant Sequoia redwood of the Sierra and dawn redwood of China, have different scientific names. The giant Sequoia, also called the Sierra redwood and big tree, is *Sequoiadendron giganteum*, and the dawn redwood is *Metasequoia glyptostroboides*.

Another advantage of a scientific name is that it has two parts, the genus name and the specific epithet, which combined make the species name. The genus of an organism indicates a group of organisms that are very similar (closely related evolutionarily) to each other. The species name indicates the particular (specific) kind of organism. The genus is written first and is a capitalized proper noun, followed by the species name which is usually an adjective and not capitalized. Both genus and species are italicized or underlined. For example, a common oak in northern California is the black oak, *Quercus kelloggii*. The closely related Oregon white oak is named *Quercus garryana*. The tanoak tree, which is not a true oak, is in a different genus, and its scientific name is *Lithocarpus densiflorus*. All oaks of the genus *Quercus* are more closely related to each other than they are to *Lithocarpus*.

See the activity "Name That Plant" in Section IV.

Plants and animals were originally grouped or classified by observation of their physical structures. Some kinds of organisms from very different groups have developed similar looking and functioning structures. For example, bats and flying squirrels have adaptations that allow them to fly or glide through the air, much like birds. They aren't, of course, birds. Over time, scientists have developed a variety of methods for grouping organisms according to how closely related they are evolutionarily. Not only are physical structures examined closely, but fossil evidence, genetic studies, blood chemistry, and DNA are used to try to obtain an accurate understanding of how organisms are related. This study of how organisms are related is called **taxonomy**, and taxonomists continue to clarify organisms' relationships to each other. Some of the scientific names in *Redwood Ed* would have been different 30 years ago, and some may well change in the near future as taxonomists learn more about the evolutionary relationships of organisms. Even contemporary authors may use different scientific names for the same organisms. For example, the scientific names used by Stebbins in the *Peterson Field Guide to Reptiles and Amphibians* (2003) sometimes differ from those used by Behler and King in the Audubon Society's *Field Guide to North American Reptiles and Amphibians* (1979).

In *Redwood Ed*, I have used the "valid" names as accepted in the Integrated Taxonomic Information System (< www.itis.usda.gov > or < http://www.cbif.gc.ca/pls/itisca/ >).

Taxonomy

When I took high school biology in the 1960s, we were taught that living things could be divided into two "kingdoms:" Plantae (plants) and Animalia (animals). Some things that didn't quite fit into either category were called protists. Currently, most taxonomists use 5 or 6 kingdoms:

1. Archaebacteria: some ancient types of bacteria; don't have a nucleus

2. Eubacteria: most bacteria; without a true nucleus or nuclear membrane; chemically different from Archaebacteria

3. Protista: organisms with a nucleus and membrane-bound organelles; includes algae

4. Plantae: green plants…mosses, ferns, grasses, flowering plants, conifers

5. Fungi: molds, mushrooms, yeasts

6. Animalia: animals

Each kingdom is divided hierarchically into smaller groups of organisms. Within each subgroup, the organisms are more closely related to each other than they are to organisms in other groups. A kingdom has several phyla (singular: phylum). Each

phylum has several classes, which typically have several orders, which usually have several families, which may have several genera (singular: genus). Most genera have several **species**.

As noted above, the study of organisms and how they are related and classified is a constantly evolving science. Not only does it change as we find out more about their evolutionary relationships and discover new organisms, but names of groups change, and not all taxonomists agree on every classification.

Here is a simplified classification of the bobcat, *Lynx rufus*, which is classified in the groups indicated in **bold** below.

KINGDOM: All living things are usually classified into the 6 kingdoms listed above:

Archaebacteria	Eubacteria	Protista	Fungi	Plantae	**Animalia**

PHYLUM: Animalia is divided into different phyla, including, among others:

Porifera (sponges)	Annelida (earthworms)	Mollusca (snails, slugs)	Arthropoda (insects, spiders)	Echinodermata (sea stars, urchins)	**Chordata** (fish, birds, mammals)

CLASS: The Phylum Chordata is divided into different classes, incuding:

Chondrichthyes (sharks, rays)	Osteichthyes (trout, perch)	Amphibia (frogs, newts)	Reptilia (snakes, lizards)	Aves (birds)	**Mammalia** (mice, cats, people)

ORDER: The class Mammalia is divided into different orders, including:

Marsupialia (opossums)	Lagomorpha (rabbits, hares)	Rodentia (mice, squirrels)	Cetacea (whales, porpoises)	Artiodactyla (deer, elk)	**Carnivora** (skunks, cats, seals)

FAMILY: The order Carnivora is divided into different families, including:

Canidae (foxes, coyotes)	Ursidae (bears)	Procyonidae (raccoon, ringtail)	Mustelidae (weasels, minks, otters, skunks)	**Felidae** (bobcat, mountain lion)

GENUS: The family Felidae is divided into different genera, including:

Felis (mountain lion)	*Panthera* (lions, tigers)	***Lynx*** (lynx, bobcat)

SPECIES: The genus *Lynx* has several species, including:

Lynx canadensis (Canadian lynx)	***Lynx rufus*** (bobcat)

Species

Names of species are generally given as a combination of the genus (capitalized and italicized) (*Lynx*) and the species name, which is italicized but not capitalized (*rufus*).

There is one kind of animal, the bobcat, that is named *Lynx rufus*.

Sometimes species are divided into subspecies, races, or varieties.

Another way to look at the classification of the bobcat would be:

Kingdom: Animalia

Phylum: Chordata

Class: Mammalia

Order: Carnivora

Family: Felidae

Genus: *Lynx*

Species, epithet or trivial name: *rufus*

Scientific/species name: *Lynx rufus*

Knowing some word roots can help make the learning, or at least understanding, of scientific names less intimidating to teacher and student alike. Learning word roots is useful for everyday reading, too. Consider the names of the groups in the classification of the bobcat, *Lynx rufus*:

Animalia: Obviously, the word root is "animal," which the bobcat is. "Animal" comes from the Latin *anima*, for living being or life. If one is animated, they are lively; computer animation seems to make things come to life.

Chordata: Animals in this group have a flexible rod-like structure called a notochord. A chord is a string of a stringed instrument, and a cord is a flexible rope-like material.

Mammalia: Mammals nurse their young with mammary glands.

Carnivora: Carnivores are meat eaters: Latin: *carnis* (meat), *vorare* (to eat). Carnivores may have a voracious appetite.

Felidae: *Felis* is Latin for cat. Feline means cat-like.

Lynx: Probably comes from the Greek *lynx*, "to shine," for the animal's shining eyes. Lynx-eyed is to have very keen sight.

rufus: From the Latin *rufus* for brownish-red or rust colored.

Some students enjoy learning about the etymology (origins) of words and word roots. Knowledge of word roots can be valuable in later schooling and elsewhere. A good source for science word roots is:

< www.biology.ualberta > (Type "word roots" in the search box.)

Another good resource for word roots is the *Dictionary of Word Roots and Combining Forms*, by D.J. Borror (1988).

What's a "species?"

By “species,” scientists typically mean organisms that are able to mate and produce fertile offspring. All kinds of domestic cats are able to mate and produce fertile offspring, and do so naturally, so all domestic cats are of the same species – *Felis domesticus.* An alley cat is the same species as a Siamese cat, as is a Persian cat. They can all successfully mate. The mountain lion (a.k.a. cougar, a.k.a. catamount, a.k.a. puma, a.k.a. panther) is classified in the same genus as the domestic cat because they have many structural similarities. It is, of course, a different species – *Felis concolor.* Both *F. domesticus* and *F. concolor* have 30 teeth. Bobcats, while they look much like domestic cats, can’t successfully mate with them and are different in other ways, such as the ratio of tail length to foot length and number of teeth (28), so they are classified as a different genus and species – *Lynx rufus.* The Canadian lynx is closely related to the bobcat (The Lynx also has 28 teeth.), so it is classified in the same genus, but as a different species – *Lynx canadensis.* Bottom line: scientific names show how organisms are related to each other, and each kind of organism has its own unique scientific name that is the same anywhere in the world.

In *Redwood Ed*, both common and scientific names of organisms will be used. If the student or teacher wishes to find out more about a particular organism, I suggest using the scientific name, as it will yield more precise information. Sometimes a common name applies to more than one species. In such cases I've indicated the genus name (capitalized and italicized), followed by "spp," to indicate more than one species. For example, there are several species of oaks in the redwood region, so I might refer to them collectively or as unspecified species as *Quercus* spp.

Adaptations for Survival

Why is there such a diversity of living things on Earth, or in a particular ecosystem such as a redwood forest? What causes that diversity? The complexity of the chemical molecule named deoxyribonucleic acid (DNA), coupled with sexual reproduction and numbers of chromosomes results in a seemingly infinite variety of genetic combinations. Couple this with the mutations that constantly change the DNA and chromosomes, and the possible variations are even greater. As a result of this variation and diversity, each individual organism is slightly different from the others. Most of the differences are insignificant. However, when there is competition for resources, some individuals may survive and others may not. Those with **adaptations** that enable them to survive may pass on those adaptations to their offspring. Organisms that don't survive to reproduce can't, of course, pass on their characteristics to their offspring.

Some adaptations are structural (wings, camouflage coloration), some are physiological (the ability to grow rapidly, termite-resistant chemicals), while others are behavioral (migrating, competition for mates, tool making). When thinking about adaptations, it

should be kept in mind that organisms **don't** develop adaptations in order to survive. Those that, due to natural genetic variability, **already** have certain adaptations may survive and reproduce, while those that don't have the necessary adaptations might not survive and reproduce. Thus, offspring inherit "good" adaptations from successful parents.

Teaching Idea

When I teach about the concept of adaptations, I try to emphasize the idea of diversity within a species being desirable with regards to the survival of the species. You can have "what if" discussions with your students…What if people with black hair can survive global warming better than those with blond hair? What if people with slow metabolisms survive better if there is a food shortage? Will people decide to grow black hair or change their metabolisms in order to survive? Obviously those who already have those adaptations will be the ones to survive and pass them on to their offspring. I refer to this as "pre-adaptation," and emphasize that we can't predict which adaptations will be advantageous in the future, and we can't decide to develop physical adaptations.

This discussion can also be useful in encouraging tolerance and appreciation of diversity among the students.

Every habitat (and microhabitat) has conditions that make different adaptations advantageous. Adaptations that are useful in one environment might not be useful in another. Some organisms of the redwood forest have interesting adaptations that enable them to survive in the redwood forest environment or in particular microhabitats.

Some common redwood forest organisms are described on the following pages. I've tried to point out particularly interesting, unique, or important adaptations.

A Few Words About Evolution

Some teachers are hesitant to teach about evolution, and this is understandable, as some parents reject the idea. The state of California, on the other hand, supports the teaching of the theory of evolution as a valid and important part of science education. It even uses evolution as a theme progressing through the grades, provides examples of court cases supporting education about evolution, and provides examples of evolution education in the 1990 *Science Framework for California Public Schools*.

One approach is to be clear that one is teaching evolution as a theory, and not require students to say that they accept or agree with the theory. If parents ask that their children not be taught about evolution, the child can be excused, but I recommend that you do so only after discussing it with the parent. You can point out that the child will need to understand evolution if they are to be able to counter the arguments that they will doubtless encounter later in life. Another reason that students should understand

the theory of evolution, of course, is that questions about it may appear on various high school and college tests. You might also point out that many scientists are also religious and have been able to reconcile their religion with evolutionary theory.

Examination and discussion of the great diversity of life in any particular habitat provides an excellent opportunity to discuss the diversity and competition that form the basis of the theory of natural selection.

Aquatic Environments

The redwood forest ecosystem includes not only forests, but also aquatic environments such as ponds, creeks, and rivers, clearings such as the "prairies" of the hilltops in the northern redwood region, and mixed forest that includes various oaks, Douglas-fir, madrone, and other trees. Those subdivisions of the redwood forest are important, but in *Redwood Ed* I will generally limit the organisms described to those found in the redwood forest itself, along with a few other trees.

If you are interested in pursuing studies of the aquatic ecosystems, I suggest investigating resources such as the following*:*

Adopt-A-Watershed NEW Name - Earthwater	www.adopt-a-watershed.org New website – www.earthwater.org
California Classroom Aquarium Education Project (C.A.E.P.) (a.k.a. Salmonids in the Classroom, Trout in the Classroom, Salmonid Project)	www.dfg.ca.gov/oceo/caep
Project WET	www.projectwet@watereducation.org
Project WILD® – Aquatic	www.dfg.ca.gov/projectwild
Save Our Streams (Isaac Walton League)	www.iwla.org
Watershed Restoration (CA Dept of Water Resources)	www.watershedrestoration.water.ca.gov
Wetlands Protectors (CA Coastal Commission)	www.coastal.ca.gov

Some Common or Important Organisms of The Redwood Forest

The following are brief descriptions of a few of the hundreds of organisms that students might encounter on a visit to a redwood forest. This is not a complete list, of course, but it includes many of the most common or conspicuous organisms. Please see Appendix IV and V for several books that might be worthwhile additions to classroom libraries.

I have tried to include many of the kinds of organisms that visitors are likely to see. In addition, some common organisms that are not so likely to be seen are included. Some other organisms that are not common, but are important, are also described. There is some variation between the flora and fauna in the southern and northern redwood regions, so it would be a good idea to check with the interpretive staff of whatever park is going to be visited to try to obtain a local species list. The organisms described below are, of course, but a small fraction of those that one may see upon visiting a redwood forest. I highly recommend bringing with you one or more of the guides listed in the reference section. Among them are simple keys that students can use to identify many common plants and animals, as well as field guides that help with identification through the use of pictures.

Keep in mind, too, that simply memorizing names of organisms is probably not an important goal. However, knowing some organisms' names will make a visit to the redwood forest more interesting.

See the activities "Name that Plant," and "Similar, But Not the Same!" in Section IV.

Bacteria

While students won't see individual bacteria, or even populations of bacteria, it is important to remember that they play a very important role in any ecosystem. Bacteria provide food for many small organisms. Just as importantly, they serve as recyclers of dead organisms, returning nutrients to the ecosystem through the process of decomposition.

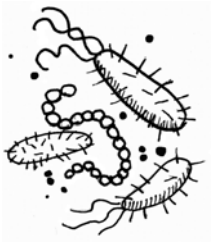


Figure 17. Bacteria take many forms.

Protista (including Algae)

Because they are generally aquatic organisms, the algae (singular: alga) and other protists are found mostly in streams and ponds. Algae may be microscopic, or they may be larger, sometimes forming stringy masses along the edges of streams and ponds.

As photosynthetic organisms, algae are classified as "producers" because they use energy from the sun to produce organic chemicals such as sugars, starches, and cellulose through the process of photosynthesis. Not only are complex chemicals produced through photosynthesis, but oxygen is also released as a waste product. This oxygen may dissolve in the water, where it is available for other organisms, or it may bubble out of the water and be released into the atmosphere.

As producers, algae form the base of the aquatic food pyramid and the beginning of aquatic food chains.

Lichens

Algae can are also important as part of the organisms called **lichens**. Lichens are actually organisms that consist of a fungus and an alga living together in a **mutualistic** relationship, i.e., one in which both organisms benefit. The alga (or sometimes a blue-green bacterium) provides nutrients for the fungus through photosynthesis. The fungus provides a sheltered environment where the alga is protected from drying out. Over 90 species of lichens have been identified in the redwood forest along the Mendocino coast alone (Noss, 1988). In many areas, the lower trunks and branches of redwoods may be coated with gray-green lichens. Other lichens may dangle from branches or cover rocks.

Fungi

Approximately 300 species of fungi have been identified in the redwood forest. (Noss, 2000) Many species are epiphytes, living in the trees, or can be found in and on decaying logs and forest floor litter (duff).

Fungi serve as important food sources for some animals, and are also important as decomposers of dead or dying organisms, returning nutrients to the environment. Fungi also kill many kinds of trees that would compete with the redwoods. Even with its tannins, the redwood is not entirely immune to attacks by fungi, but redwoods are seldom killed by fungi. Fungi also form mutualistic associations with redwood roots, helping pass dissolved nutrients to the redwood root system.

Redwoods seldom reproduce successfully by seeds unless the forest floor has been disturbed by a fire, logging, or silt deposited by flooding. Sometimes this is because the roots of the seedling dry out because they can't penetrate the thick layer of duff quickly enough. Often, though, the seeds die because of "damping off" fungus…fungus that kill the seed before it even has a chance to grow.

Plants

Hundreds of plant species are found in the redwood region, and we have space for only a few in *Redwood Ed*. I highly encourage the reader to obtain one or more of the excellent plant guides that are available, some of which are listed in Appendices IV and V.

Non-Vascular Plants:

Non-vascular plants include mosses, liverworts, and hornworts. Since they do not have specialized **vascular tissues** to carry water and other materials, they are all fairly small plants that live in moist areas such as decaying logs in shady areas and rocks along streams. In such places, they are among the first

organisms in the succession sequence. The lack of vascular tissue not only limits their ability to transport materials, but it also limits their size because vascular tissues also hold up leaves in vascular plants.

Figure 18.

Mosses: Phylum Bryophyta
Various genera and species of mosses live in the cool, damp environment of the redwood region.

Look for the spore capsule on its stalk. Mosses reproduce with **spores**, as opposed to **seeds**.

Vascular Plants:
Most plants with which we are familiar are vascular plants, i.e., they have vascular tissues (**xylem** and **phloem**) that carry water and other materials throughout the plant. They have true roots, stems, and leaves.

Horsetails: Phylum Pterophyta, genus Equisetum
The horsetail, or scouring rush, is among the most primitive of vascular plants. The common name "horsetail" comes from its appearance, while "scouring rush" derives from its abrasive silica, which made it useful for scouring pots and pans. Some species of *Equisetum* have the stems surrounded by branches that stick out from the joints or nodes, while others look like a jointed spear.

Modern horsetails are very similar to giant species that lived during the time of the dinosaurs (as did the redwoods!).

The tips of young plants were sometimes boiled like asparagus, and were used as a diuretic. Too much, however, can cause illness.

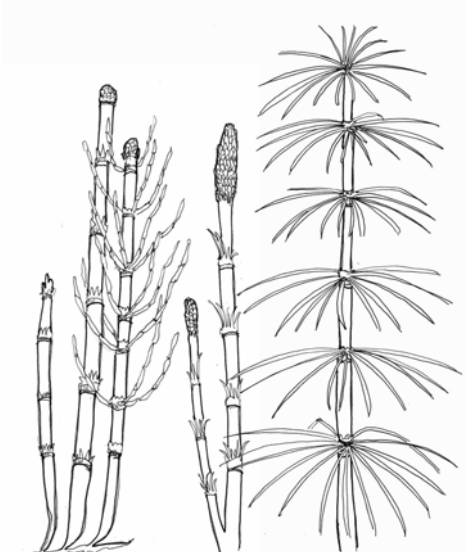


Figure 19. Horsetail (*Equisetum* spp.)

Ferns: Phylum Pterophyta
Ferns are among the most primitive of vascular plants. Unlike the "higher" plants, however, ferns reproduce with spores rather than seeds.

The spores are produced in sporangia on the undersides of the leaves. Along with leaf shape, the location, shape, and distribution of the sporangia are often used in identifying species of ferns. The *Pacific Coast Fern Finder* (Keator and Atkinson (1981), *Plants of the Coast Redwood Region* (Lyons and Cooney Lazaneo, 2003), and *Pocket Flora of the Redwood Forest* (Becking, 1982), among other resources, are useful in identifying types.

Sword Fern: *Polystichum* spp.

Look for the projection from the base of the leaflet, which somewhat resembles the hilt of a sword. Several fronds, from 2 to 4 feet in length, arise from a single base.

Sword ferns are among the most common ferns in the redwood region, sometimes forming dense clusters. They are relatively resistant to drought and do well in moist environments.

The tips of young leaves, called fiddle-heads, can be boiled and eaten. To keep fish or other food clean, Native Americans sometimes laid fronds on the dirt floors of their cooking pits.

Figure 20. Sword Fern (*Polystichum* spp.)

Bracken Fern: *Pteridium aquilinum*

The bracken fern is extremely wide-ranging, with numerous varieties living from the subarctic to tropical regions. Their triangular fronds, which may be up to four feet long, are often highly branched.

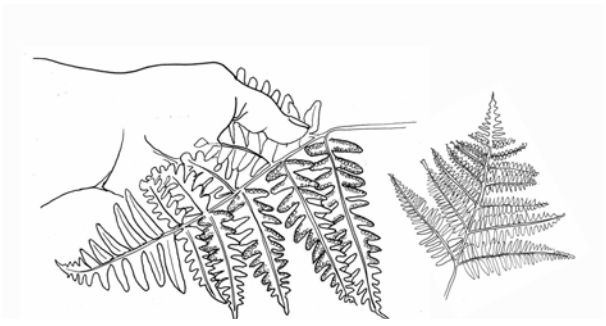


Figure 21. Bracken Fern (*Pteridium aquilinum*)

Bracken ferns may be found from shady, moist areas to relatively dry openings in the redwood forest. The fronds die back in the winter.

While the young fiddleheads can be eaten in limited quantities, large quantities, or older plants are toxic! Native Americans use the roots to create patterns in baskets.

California Maidenhair Fern: *Adiantum jordanii*

The maidenhair fern is usually found on moist rocky outcroppings. The leaflets (pinnae) are rounded and grow from short stems along a 1-2 foot dark colored central stem. The spores line the edge of the underside of the pinnae.

The dark stem was used by Native Americans, who pounded them to obtain long black strands for use in basket weaving.

Five-Finger Fern: *Adiantum pedatum*

The five-finger fern isn't necessarily five-fingered…they may have more than five segments growing out from a central area of a single frond in a finger-like fashion. These ferns are often found growing from moist crevasses in rocks and along streams. The spores are hidden on the underside of the leaf's curled margin.

Like the maidenhair fern, the five-finger fern is used in basketry.

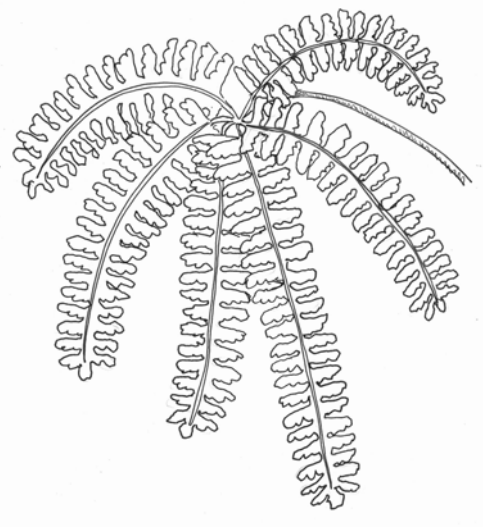


Figure 22. Five-Finger Fern (*Adiantum pedatum*)

Gymnosperms: cone-bearing trees

Coast Redwood: *Sequoia sempervirens*

Height to 360 feet (109 m) or more, often to over 300 feet (92 m), diameter of 10-13 feet (4 m) in alluvial flats, up to 33 feet (11 m); usually smaller on hillsides.

The thick, reddish brown bark is resistant to fire and to insect attack. The bark may be up to a foot thick, absorbs moisture readily, and is relatively free of resin, and therefore more resistant to fire.

Reproduction is often from sprouts that grow from lignotubers or basal burls that form at the base of the trunk. Forms olive-sized cones that produce tiny seeds, but the seeds often fail to grow for a variety of reasons. The male and female cones often hang in clusters and are found on the same tree. (See also Figure 2 on page 12.)

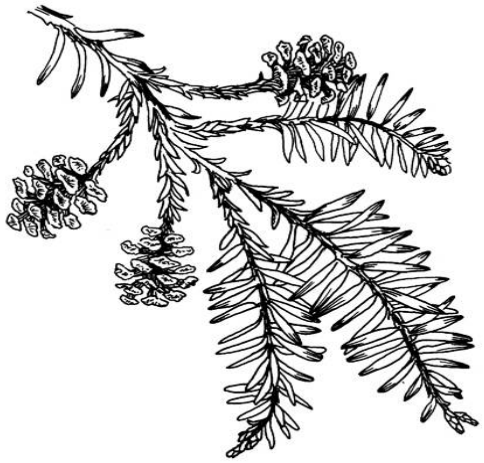


Figure 23. Coast Redwood (*Sequoia sempervirens*)

Native Americans used the strong roots for fiber, and used the wood as planks for building structures, canoes, and other uses. Redwood is now used extensively for lumber.

Redwoods are distinguished from Douglas-fir by the cones, more fibrous bark with long parallel grooves, and leaves (needles), which grow flatter from green twigs.

Douglas-fir: *Pseudotsuga menziesii*
Height 80-200 feet (61 m), sometimes more than 300 feet (92 m)
Diameter: usually 2-5 feet (1.5 m), occasionally over 10 feet (3 m)

"Doug-fir" commonly grow in association with redwoods, especially on hillsides or hill tops. They are the most important lumber trees from California to British Columbia.

Douglas-fir can be distinguished from the coast redwood by the cones, less fibrous bark without the long parallel grooves, and leaves (needles) that are about ¾ inch long and grow in whorls around the twigs. The cones are 3-4 inches long and have bracts with 3 points that extend out from between the rounded scales. The cones hang downward from the branches.

This tree is not a true "fir," hence the scientific genus name of *Pseudotsuga.*

Douglas-fir needles can be steeped to make a vitamin C-rich tea.

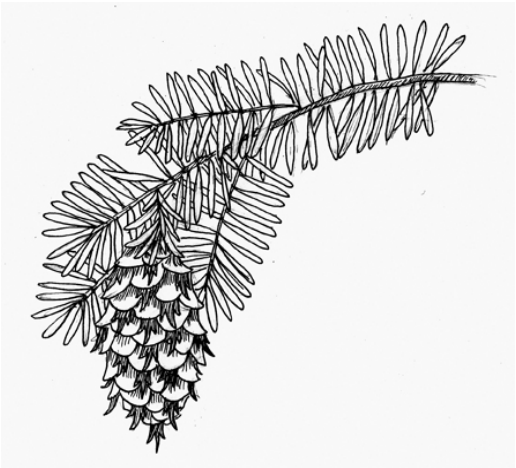


Figure 24. Douglas-fir (*Pseudotsuga menziesii*)

Coast Hemlock (Western Hemlock, Pacific Hemlock, West Coast Hemlock):*Tsuga heterophylla*
Height: to 100-200 feet (61 m)
Diameter: to 6 feet (2 m)

These trees often grow near the coast in the northern redwood region. In some cases, they tend to shield the salt spray-intolerant redwoods so that the redwoods grow closer to the coast than they otherwise might. They are more shade tolerant than Douglas-fir and may replace them in areas from which fires are excluded.

The western hemlock often grows from seeds that germinate on fallen logs, and the long roots often grow over the logs, resulting in nickname of "octopus tree." Such a "nurse log" may have several hemlocks growing along its length, resulting in a line of hemlocks growing where a log once lay.

The durable wood is used as lumber and paper pulp.

The needles are about half an inch long, growing from brown twigs, while the needles of Douglas-fir are longer. Cones about ½-1 inch long.

The wood is used for lumber and pulp. Because it is often harvested with various species of fir trees, the lumber is often marketed as "hem-fir."

Grand Fir: *Abies grandis*
Height: 150-200 feet ((61 m), maximum 250 feet (76 m))
Diameter: 2-3 feet (1 m), sometimes to 5 feet (1.5 m)

The Grand Fir grows from northern California to British Columbia. The needles grow out in flat sprays from the branches, more like a redwood than a Douglas-fir. The needles are ¾ to 2 inches long and have a rounded notch at the tip. The cones sit upright on the branches (as opposed to the Douglas-fir cones, which hang downward.) Like the western hemlock, grand fir are very shade tolerant and may replace Douglas-fir in areas where fire is excluded. Grand fir are not very resistant to insect and fungus attacks, so they rarely live to be over 300 years old.

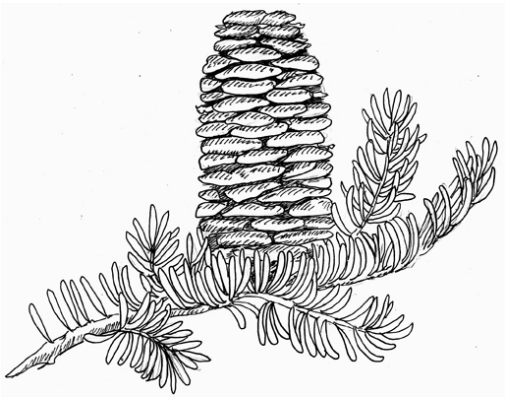


Figure 25. Grand Fir (*Abies grandis*)

The seeds of the grand fir are an important source of food for wildlife, but the lumber is not very durable so it is used mostly to make boxes.

Sitka Spruce (Coast Spruce, Tideland Spruce, Yellow Spruce): *Picea sitchensis*
Height: 100-160 feet (48 m), sometimes to 215 feet (65 m)
Diameter: 3-4 feet, rarely to 17 feet

The Sitka spruce lives in the coastal mountains from Caspar Creek in northern California to Alaska, and is rarely found more than 30 miles from the coast. Like the coast redwood, the tree seems to be dependent on coastal fog.

Their roots are exceptionally tolerant of moisture, enabling them to live in places such as Ketchikan, Alaska, with 151 inches of rain per year. The tree is often covered with mosses and ferns.

The needles are arranged spirally around the stem and are ½-1 inch in length with sharply pointed tips. The cones are 2-4 inches long and hang downward. Spruces can be distinguished from firs by the small woody pegs left on the branchlets after the needles fall off, giving the branches a very rough texture.

The sharp points of the needles provide some protection from browsing by deer and elk, which prefer the more tender hemlock and other plants.

Sitka spruce is used for lumber, plywood, and paper pulp. Sitka spruce trees from old growth forests can produce wood with narrow-spaced rings that is, pound for pound, stronger than steel. This strong wood is used for making boats, aircraft, and musical instruments.

Angiosperms: flower-bearing plants

Madrone (Pacific Madrone): *Arbutus menziesii*
Height: 25-80 feet (24 m), occasionally over 100 feet (30 m)
Diameter: 2-3 feet, sometimes to 5 feet
Blooms: early spring, with orange berries developing in late summer

Common in the mixed evergreen forests, especially on upper slopes. Madrone often grows from multiple trunks with twisted shapes formed as the branches reach for light. Smooth bark which peels off in the summer to reveal smooth light green wood, which later becomes a rich dark red-brown color.

Figure 26. Madrone (*Arbutus menziesii*)

The evergreen leaves have a thick waxy cuticle that helps prevent water loss. Madrones are well adapted for surviving fires and will readily stump sprout. Native Americans and early settlers used the leaves and berries as foods and medicines.

Oaks

There are many varieties of oaks in California, with several found in the redwood region. None live in the redwood forest *per se*, but some can be found in clearings and in mixed forests. To distinguish among the oaks, I recommend using a key such as the *Pacific Coast Tree Finder*, by Tom Watts (1973).

Male flowers develop in the spring and soon fall from the tree. The female flowers form acorns. Acorns of many varieties were a vital, major food source for Native Americans, and continue to be important for many animals, including deer and bear.

Coast Live Oak: *Quercus agrifolia*
Height: 30 to 50 feet (15 m), sometimes to 90 feet (27 m)
Diameter: 1-2 feet (0.6 m), sometimes to 3 feet (1 m)
Blooms: February-April

Figure 27. Coast Live Oak (*Quercus agrifolia*)

Most common of the redwood region live oaks, especially in the southern and central redwood region. When not crowded, forms a rounded crown with wide-spreading branches. The top surface of the sharply-toothed leaves is shiny dark green, while the lower surface often has a tan colored furry covering in the area where the veins join, and the leaf is deeply curved. The oblong acorn has a pointed tip.

The wood is not straight enough for lumber, but is often used as firewood.

A closely related oak, the Shreve oak, is common in the central and southern redwood regions. Some consider the Shreve oak to be a variety of the coast oak, *Quercus parvula* var. *shrevei*; others consider it to be a form of *Quercus wislizeni*; and still others classify it as a separate species, *Quercus shrevei*. Some evidence indicates that the Shreve oak is somewhat resistant to Sudden Oak Death (Dodd *et al*., 2002)

California Black Oak: *Quercus kelloggii*
Height: usually 30-75 feet (23 m), occasionally approaching 100 feet (30 m)
Diameter: 1-3 feet (1 m), sometimes to 4 feet (1.2 m)
Blooms: March-May

The black oaks grow at higher elevations, especially on the eastern slopes of the coastal mountains in the central and southern parts of the redwood region. The deeply lobed leaves have sharp points and are large, sometimes reaching almost 10 inches in length.

While most oaks are evergreen, the black oak is deciduous.

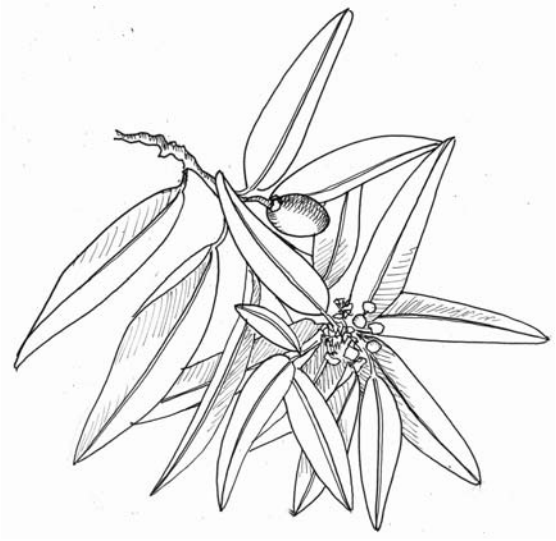
In many areas of California, the black oak's acorn was an important food source for Native Americans.

Figure 28. Black Oak (*Quercus kelloggii*)

California Bay (California Laurel, Bay-Laurel, Pepperwood, Oregon Myrtle): *Umbellularia californica*
Height: 30 to 80 feet (24 m)
Diameter: 1-3 feet (1 m)
Blooms: December-April

The California Bay is common on wooded slopes in the Coast Range.

The long leaves are pointed at the tips and wedge-shaped at the base, and have a strong fragrance. They are leathery and dark green in color.



The Native Americans used the leaves to cleanse wounds and cure headaches. The leaves were also used as a flea-repellant in their dwellings. The nuts were roasted to remove the bitter taste and eaten whole or ground into flour.

Today the leaves are dried and used as a spice which is similar to the more expensive European bay leaves. The wood is often used to make bowls and other fine wood products.

Figure 29. California Bay (*Umbellularia californica*)

Alders

Red Alder: *Alnus rubra* (also *Alnus oregona*)
Height: usually 40-80 feet (24 m), occasionally to 100 feet (30 m)
Diameter: to 2.5 feet (0.8 m), occasionally to 4 feet (1.2 m)
Blooms: January-March

White Alder: *Alnus rhombifolia*
Height: usually 40-70 feet (18 m), occasionally to 80 feet (24 m)
Diameter: to 2 feet (0.6 m), occasionally to 4 feet (1.2 m)
Blooms: January-March

The red alder grows along coastal streams from Santa Cruz county to Alaska. The edges of the leaves are rolled under.

The white alder is more common in the southern redwood region, in more inland locations such as the eastern slopes of coastal mountains, and in the Sierra. The edges of the leaves are not rolled under.

The leaves of white alder are finely toothed, while the red alder leaves are more coarsely toothed (larger "teeth").

The bark is gray-white in color. The elongated male flowers, called catkins, release pollen in February and March. The female catkins are cone-like, to 1 inch in length, and resemble an elongated coast redwood cone.

Alders are one of the few trees that can use nitrogen from the atmosphere. They, like legumes, have nitrogen "fixing" bacteria in their roots. The bacteria are able to capture nitrogen from the air and combine it with oxygen to form compounds that plants can use.

They need a fair amount of sunlight and moisture, so they usually grow along streams. Alders grow rapidly and can grow to 40 feet tall in a decade.

Figure 30. Red Alder (*Alnus rubra*)

Native Americans used the red alder for basketry, with the roots used as a fiber and the inner bark used to produce an orange dye. The wood is used in furniture making. White alders are sometimes planted as ornamental trees.

Big-leaf Maple (Big Leaved Maple): *Acer macrophyllum*
Height: to 100 feet (30 m)
Diameter: 3-4 feet (1.2 m), rarely to 8 feet (2.4 m)
Blooms: March-May

The big-leaf maple often forms dense strands along streams and in moist areas throughout the coastal mountains.

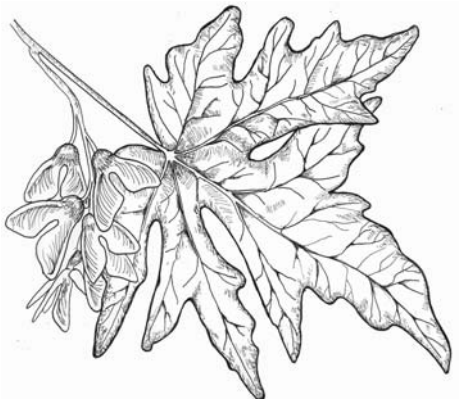


Figure 31. Big-leaf Maple (*Acer macrophyllum*)

The bark of young trees is smooth and light gray-reddish in color. As the tree grows older, the bark darkens and becomes more rough.

The leaves have a typical maple-leaf shape with deep notches. In the fall, they turn a bright yellow or orange color. The long, drooping clusters of yellow-green flowers produce double-winged fruits. The wings on the seeds enable them to be blown far from the parent tree as they fall to the ground, thus reducing competition between the seedling and the parent tree.

Maple wood is used for making furniture, paneling, and veneer. A syrup can be made from the sap.

Tanoak (Tanbark Oak): *Lithocarpus densiflorus*
Height: 50-100 feet (30 m), rarely to 150 feet (45 m)
Diameter: 1-3 feet (1 m), rarely to 6 feet (1.8 m)
Blooms: May-June

The tanoak is not a true oak tree, but its leaves, acorns, and flowers closely resemble the true oaks. It is common throughout the redwood region, especially in mixed evergreen forests.

The tree grows straight and tall and has smooth gray bark. The leaves are a glossy green on the top and are coarsely toothed along the edges.

Tannic acid was extracted from the bark of tanoak and used to tan leather. It was used in the tanning industry throughout the redwood region in the 1800s and early 1900s. (Some experiments were also done using redwood bark to tan leather.)

Because of their large size, the acorns of the tanoak were favored by native people wherever they were found.

Figure 32. Tanoak (*Lithocarpus densiflorus*)

California Hazel: (California Hazelnut): *Corylus cornuta*
Blooms: January-March

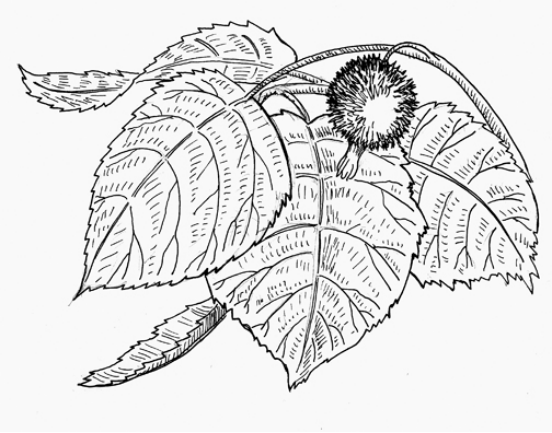


Figure 33. California Hazel (*Corylus cornuta*)

The hazel is common in various parts of the redwood region, from shaded streams to wooded slopes. The shrubs grow to 10 feet in height, with an open, spreading growth pattern. The soft leaves have pointed tips with saw-tooth edges.

Nuts, similar to filbert nuts, ripen in mid-late summer and are very tasty, although animals such as squirrels and birds often eat them before they are fully ripe. Native Americans also used the stems and young shoots in their basketry

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Elderberry:
Blue Elderberry: *Sambucus mexicana*
Blooms April-June

This plant is common away from the coast along chaparral borders. Its blue berries are edible and can be made into jams and wine.

Red Elderberry: *Sambucus callicarpa*
Blooms: March-July

The berries of the red elderberry are poisonous and should not be eaten!

Stinging Nettle: *Urtica* spp.
Blooms: May-October

The stinging nettle generally grows along streams, but may be found elsewhere in the redwood region. They can grow to over five feet in height, and the plants are covered with small poison-filled hairs that inflict a very irritating sting.

Young leaves and stems can be cooked and eaten like spinach.

Figure 34. Stinging Nettle (*Urtica* spp.)

Wood Rose: *Rosa gymnocarpa*
Blooms: April-September

This small shrub may grow to four feet or more tall and produces dainty, light pink flowers that are about an inch across. The thorns are straight. As the seed matures, a "hip" is formed in the fall.

Rose hips were, and are, used to make a vitamin C-rich tea.

The California Rose, *Rosa californica*, has a somewhat larger and pinker flower, curved thorns, and the leaves are hairy on the underside.

Redwood sorrel: *Oxalis oregana*
Blooms: February-September

Redwood sorrel is very common in redwood forests, often covering the ground in a beautiful green carpet. The clover-like leaves are very sensitive to sunlight and will fold or droop down when exposed to direct sunlight. It is thought that this helps conserve water, as the stomata or openings through which water escapes the leaves are more numerous on the underside. As the flowers get older, they turn from white to a deep pink color.

Figure 35. Redwood Sorrel (*Oxalis oregana*)

The stems and leaves contain oxalic acid, which gives them a tangy, acidic taste. They can be eaten raw in moderation or cooked.

Wake Robin: (Western Trillium)
***Trillium* spp.**
Blooms: March-May

The wake robin is common in the shady redwood forest, especially in damper areas and along streams. There are three large dark green leaves atop a 5-8 inch stem. The 3-petaled flower changes from white to purple as it ages.

Figure 36. Wake Robin (*Trillium spp.)*

Poison Oak: *Toxicodendron diversilobum* (formerly *Rhus diversiloba*)
Blooms: March-May

Figure 37. Poison Oak (*Toxicodendron diversilobum*)

Poison oak is extremely common throughout the redwood region and grows in damp, shady redwood groves as well as on sunny open hillsides. It may grow as low-growing ground cover, a cluster of short sticks, a tall shrub, or even as a tree-climbing vine with thick stems over 40 feet long.

To identify poison oak in the spring and summer, look for three leaves. The leaves may be nearly smooth-edged, or deeply lobed, hence the name "diversilobum." In the fall, the leaves turn red and fall off.

To identify poison oak in the winter, look for stems that are almost pencil-thick and taper very little until they get to the end.

The Native Americans were apparently not very much affected by the oils of poison oak and had many uses for it. They used the stems in basketry, and obtained a juice from them to create a dark dye. The juice was also used as medicine for a variety of ailments and in a tattooing process.

California Blackberry: *Rubus ursinus*
Blooms: March-August

Blackberries are usually found in sunny areas and often form thickets in meadows and along roadways.

Like poison oak, the blackberry plant has leaflets in groups of 3, but it can be distinguished by the teeth along the edge of the leaflets (as opposed to poison oak's smooth or lobed leaves) and by the presence of many thorns. Blackberry patches often have poison oak growing among the berries, so be careful when picking berries!

Figure 38. Blackberry (*Rubus ursinus*)

White or pink rose-like flowers produce berries which ripen in late summer or fall. The closely related Himalaya blackberry (*Rubus procerus* or *R. discolor*) is replacing native blackberries in some areas and is considered an invasive plant.

Some Native Americans used the plant to make dark dye for their baskets.

Thimbleberry: *Rubus parviflorus*
Blooms: March-August

Common in the redwoods and mixed evergreen forest areas, the thimbleberry shrubs often form dense thickets 3-4 feet tall. The large leaves are very fuzzy, and the edible flowers produce tasty red berries that ripen in the summer.

The salmonberry, *Rubus spectabilis,* produces yellowish or reddish berries.

Bedstraw: *Galium* spp.
Blooms March-April

Bedstraw is a spreading vine with square stems and leaves that grow in whorls around the stems. It grows in moist shady areas where it sometimes forms dense mats. It has small hooks which enable it to climb over plants, logs, etc.

While attractive in the woods, the plant can be invasive in gardens. The small seeds cling to clothing and facilitate the spread of the plant.

Western Azalea: *Rhododendron occidentale*
Blooms: June-September

The azalea lives along streams and in moist meadows in redwood and mixed evergreen forests. The showy white or cream-colored flowers cover the bush, especially in sunny areas. The leaves are thinner than those of the related California rhododendron, *Rhododendron macrophyllum*, which has rose-purple colored flowers and doesn't need as moist an environment.

All parts of the plant are poisonous.

Elk Clover: (California Spikenard): *Aralia californica*
Blooms: July-August

Sometimes called spikenard, the elk clover is usually found along streams or in very moist areas. It can reach 10 feet in height, and the leaf stems may be as much as a foot in length. Individual leaflets can be up to 5 inches wide and 7 inches long. The small white flowers of early summer form purplish-black berries in the fall.

Miner's Lettuce: *Claytonia perfoliata* (formerly *Montia perfoliata*)
Blooms: February –May

Figure 39. Miner's Lettuce (*Claytonia perfoliata*)

Miner's lettuce often covers the ground in moist areas. It is easy to identify by its round leaves at the tips of 3-8 inch long stems. Tiny white flowers form in the center of the leaves.

Claytonia sibirica ("Indian lettuce") has more oval and pointed leaves.

Miner's lettuce can be eaten raw in salads or boiled like spinach. A tea made from the leaves works as a laxative.

California Huckleberry: *Vaccinium ovatum*
Blooms: February-June

Huckleberries can be found throughout the redwood region. They are most commonly found in redwood and mixed evergreen forests, but can be found in chaparral areas, too.

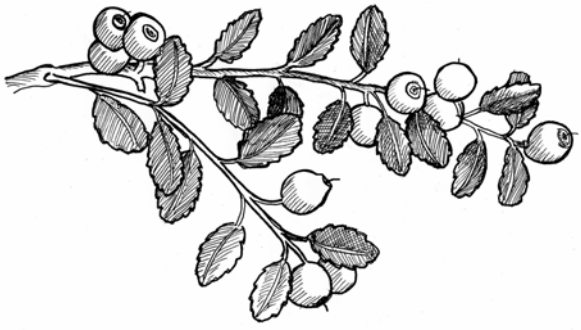

Figure 40. California Huckleberry (*Vaccinium ovatum*)

The evergreen shrub often forms large thickets 3-8 feet in height. The small, white bell-shaped flowers produce deep blue colored berries in the fall. Plants in sunnier areas produce sweeter berries. The berries are similar to blueberries and can be eaten raw or cooked in pies or jams.

The red huckleberry, *Vaccinium parvifolium*, is deciduous and produces red berries in late summer.

Solomon's Seal: *Polygonatum* spp. (formerly *Smilacina* spp.)
Blooms: February-July

Both slim (star) Solomon's seal (*Smilacina stellata*) and fat (or false) Solomon's seal (*Smilacina racemsa*) live in shady areas of the mixed evergreen and redwood forests. Both have white flowers that produce berries. The slim Solomon's seal berries are greenish yellow with purple-red stripes, while those of the fat species are red, sometimes with small purple spots. Opinions vary on the edibility of the berries, so eating them is not recommended.

Trail plant: *Adenocaulon bicolor*
Blooms: May-September

Trail plants grow in mixed evergreen forests, often forming sizeable patches.

The arrowhead shaped leaves are green and smooth on top, and white and wooly on the underside. The name derives from the way that a broken leaf, with its light colored underside, points like an arrow, thus showing the path taken by a person or animal.

Redwood Violet: (Evergreen Violet): *Viola sempervirens*
Blooms: February-June

Redwood violets are common in moist areas of the redwood forests, often abundant along streams.

This low-growing plant has heart-shaped leaves and yellow flowers with purple veins on the lower three petals. Violets are related to pansies, and their flowers are somewhat similar.

Skunk Cabbage: *Lysichiton americanum*
Blooms: March-June

Skunk cabbage has a large yellow spike-like flower which is surrounded by a yellow "clasping leaf," called a spathe, which gives off a strong odor. The leaves can reach a length of four feet and a width of a foot. The plants generally grow in large patches in wet, boggy areas near springs and year-round creeks.

Exotic Species

The following plants are not native to the redwood region; they are "exotic" or "introduced" plants. They tend to be very aggressive colonizers and may displace native species of plants. They are thus described as "invasive."

Pampas Grass: *Cortaderia* spp.
Blooms: The large, showy flowers tend to remain on the plants for a long time.

Native to Argentina, pampas grass is commonly found along roadsides and abandoned fields. It is a very aggressive invader and can quickly form an impenetrable barrier with its thick, bushy growth of blades that are very sharp. They grow in clumps three to five feet wide and five feet or more high. The flowers are borne on very showy plumes, and the seeds are widely dispersed by the wind.

Brooms:
Scotch Broom: *Cytisus scoparius*
French Broom: *Genista monspessulana*
Spanish Broom: *Spartium junceum*
Blooms: March-June

The brooms are quickly invading natural areas and crowding out native vegetation throughout the coastal region. These tall shrubs have yellow flowers similar to those of pea plants and produce their seeds in pods, also like peas.

Periwinkle: *Vinca major*
Blooms: March-July

Periwinkle is commonly grown as a low-growing ornamental garden plant, but it has escaped into many natural areas. It prefers the moist shady areas of the redwood forest. The leaves are a dark and shiny green, and the flowers are 5-lobed, purple, and funnel-shaped.

Cape Ivy: *Delaireia odorata* (formerly German Ivy, *Senecio mikanioides*)

This fast-growing vine can sprout a new plant from each section or node of the stem. This ability makes is very difficult to eradicate, and enables it to spread rapidly after floods, landslides, or even removal efforts. It forms dense blankets that smother other plants up to 30 feet high. Since it often grows along streams and rivers, it threatens many sensitive riparian species. It can be distinguished from the native wild cucumber by the cape ivy's lack of tendrils, which the native wild cucumber has.

Teaching Idea

A useful brochure called Invasive Weeds of Marin and Sonoma Counties (2003) *has been produced by the Marin Sonoma Weed Management Area. This colorful and informative brochure is also useful in other counties. It can be obtained from agricultural commissioners or U.C. Cooperative Extension Services.*

The Santa Cruz County Wildlands Restoration Team has produced a booklet titled A Plague of Plants (2002, by Ken Moore) *that discusses the problem of invasive species and how people can help. Over two dozen plant species are described, and suggestions for removal, disposal, and follow-up are provided.*