

# **FireWorks Encyclopedia**

**Featuring Species  
from the Sierra Nevada**



## Fireworks Encyclopedia

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# American black bear

(*Ursus americanus*)

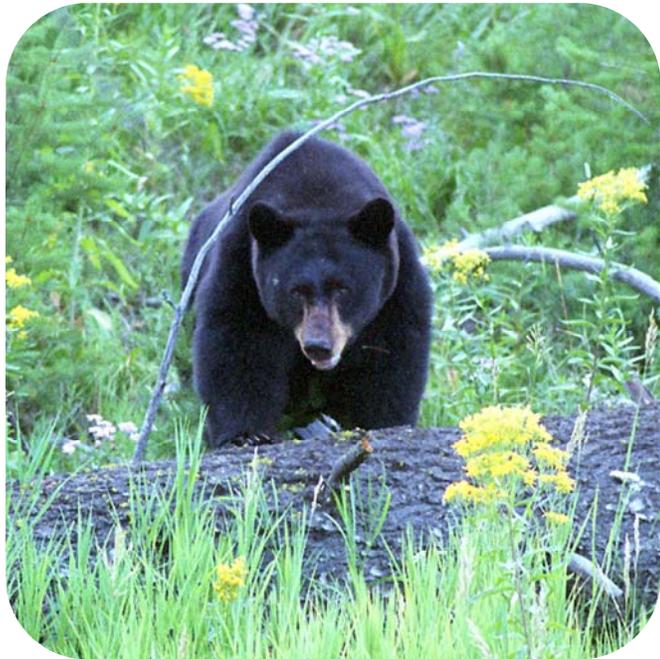


Image by Terry Spivey, USDA Forest Service.

**Den mother.** I began life in my mother's winter den in the mountains. My mother started preparing for my arrival several months before I showed up. She searched for a good place for a den. This could be a cave, a place with thick shrub and soft earth, a sheltered spot under fallen trees, or a hollowed out tree. When she finally found a spot that would fit all three of us (Mother, Brother, and me), she cleared enough space and lined the den with grass and rotten wood so it would be cozy all winter.

Mother entered the den late in the fall and went to sleep for a long time. She woke up when we were born, in the middle of winter, but went right back to sleep after cleaning us up. She must have been tired! Inside the den it was dark, but it was also warm and snug against the harsh winter weather. What a comfortable, safe place for my brother and me to be born!

**A small start:** This may be hard to believe, but I was about the size of a rat when I was born—much smaller than you were. I was totally helpless, too. I was blind and didn't have any teeth. My brother and I stayed inside the den for the rest of the winter, nursing and

growing. By the time I was strong enough to walk and keep up with Mother, it was springtime outside, time for us to see what food the melting snow might uncover.

Mother taught me all about food. My brother and I followed her everywhere, carefully watching what she ate. Did I tell you I'm an *omnivore*? I love to eat grass, flowers, and seeds, but I'm not at all picky. I'll also eat insects, mushrooms, and small animals—dead or alive. If I find garbage lying around outside, I'll eat that too. In fact, I'm a master burglar when it comes to garbage cans, coolers, and backpacks. Don't leave them anywhere where I might find them!

**What Mother taught us:** Wet meadows provide juicy new grasses and horsetails in the spring, when not much else is up. As the weather warms and the snow melts in the mountains, foothills, and forests, I follow creeks and streams, eating the plants that grow along their edge. Have you seen torn up logs when you are hiking? Perhaps that was me making a mess. My sharp, short claws help me uncover ants, grubs, and beetles that make their home in decaying logs. Short, sharp claws also come in handy for climbing trees.

Throughout the summer, all sorts of fruits ripen—gooseberries, manzanita fruits, rose hips. I like them all! In places where oak trees grow, I gorge on acorns.

I can find a meal almost anywhere. An ant colony in a decaying log, a boulder swarming with mating ladybugs, honey in a bee tree, even the rotting carcass of a deer that didn't live through the winter—they're all food for me!

**Fat is where it's at!** Why am I constantly eating? For a bear, storing up lots of fat makes the difference between life and death. By eating as much as possible when there's plenty of food around, I'm well prepared to make it through the winter when all my food has vanished beneath the snow. You could say I store my winter's food supply right on my body.

If I have enough stored fat, I can go for nearly six months without eating or drinking. How? I go into a

deep sleep. This sleep is similar to hibernation, but I am able to wake up at any time to take advantage of warm winter days. This kind of sleep is called *torpor*. During this time, my body changes stored fat into the energy I need to stay alive. Nothing leaves my body, because my wastes are recycled. Amazing, isn't it? I'm totally inactive during this time; I don't move much except to get more comfortable. When spring comes, I might have lost a quarter of my weight, but my muscles are still as strong as ever.

**Fast food.** Bears have a challenge from spring through fall: to quickly put on as much fat as possible. Moving around between little snacks uses too much energy for the amount of fat gained. Finding lots of high-energy food in one spot is much more efficient. The tricky part is knowing exactly when and where to look for large concentrations of food. Another lesson from... guess who? Teacher Mom, of course!

When you're willing to eat anything, many places provide good food: shrub patches, avalanche chutes, wet meadows, and hillsides, and river bottoms. I just hang out and eat until all the food is gone. I wake up before sunrise to start eating, I usually take a nap for a couple of hours in the middle of the day, and I'm often in bed soon after sunset.

My family and I cover lots of ground to check out our traditional feeding areas. Sometimes we roam over 100 square kilometers searching for food.

**Big two year-old.** I'm into my second year of life now, and look at me! I weigh almost 100 kilograms. How much did you weigh when you were two? My brother and I take care of ourselves now. Our mother will find a mate when summer begins and have more cubs, so this will be our last spring together. My brother and I might stay together for a few years. When I'm 4 years old I'll be ready to mate and start my own family. If things go well, I'll have a pair of cubs every three years or so. Over my 20-year life span I might have 15 cubs if I'm lucky.



Bear cubs.

Image by Joy Viola, Northeastern University.

## Fire Facts

A wildland fire is no problem for a black bear. It can be big or small, "cool" or "hot." The bear will just move away from the fire and wander somewhere else to find food. Within its large home range, there are always unburned areas to explore.

Fires create one of the black bear's favorite feeding spots—a berry patch. It doesn't take long for a burned area to grow into a brush field loaded with berries. Decades later, the same spot is likely to be a dense forest.

Forests with a patchwork of burned and unburned spots are ideal black bear habitat. A bear can feed in the openings but has the cover of trees nearby, providing a safe spot for rest and sleep.

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# Annosum Root Rot

(*Heterobasidion annosum*)

I am a fungus. I am like a plant in many ways, but I do not get my energy directly from the sun, like plants do. Instead, I tap into tree roots and the bases of tree trunks to get nutrition.

**Where do I live?** I live in nearly every forest in the northern hemisphere. I mostly live inside conifers like pines, firs, spruces, and hemlocks. I do not usually live in hardwood trees, but I occasionally live in Pacific madrone and a few shrubs.

**What do I look like?** I can be quite hard to see. That is because I mostly hide underground in tree roots or in the bases of tree trunks. There I form long, delicate chains of cells, called hyphae. My hyphae are only about a millimeter across, but in a few places they get organized into something you can really see, like in my conks. If you look carefully, you may see some conks growing right at the base of a tree. They are a little like fruits except that they produce spores rather than seeds. My conks are shaped kind of like seashells. They are usually light gray or brown on top and whitish underneath. I can even make tiny conks that are shaped a little like popcorn, but you would not want to eat them!

**Growing Up:** I usually grow from spores that were made by conks. In summer, my tiny spores travel long distances with the wind. When they land on a freshly wounded tree or freshly cut stump, they grow into hyphae and extend into the stump and roots. Once my hyphae are inside a root, they can spread from one root to another and even infect the roots of neighboring trees. My spores can spread fast and far, but my hyphae can only spread as fast as tree roots can grow. I can spread through the soil only if I'm riding inside a root.

I cannot last very long without nutrition from a tree. When my hyphae reach a wounded tree or root, they dissolve its bark and grow right into the wood cells to absorb nutrients. Scientists call this my *host tree*, making it sound like I'm their guest for dinner. I guess I am— but my host IS my dinner!

In the western United States there are two types of



Annosum root rot made these roots look stringy.  
Image courtesy of USDA Forest Service,  
Northern and Intermountain Region.

Annosum root rot. One type infects pines, incense-cedar, western juniper, and manzanita. The other type infects firs, giant sequoia, and hemlocks. Fortunately for my host trees, each type rarely spreads to the other type's trees. This means that where one of us has infected fir trees, pine trees are usually safe, and where one of us has infected pine trees, the firs are usually safe.

**Glorious Rot:** My arrival in a tree begins the noble, glorious process of ROT. Rotting a tree is a tough job, but someone really does have to do it, or the forest would fill up with dead wood! Eventually, the trees that I've infected die and fall over. Other fungi will join us in the rotting party. Together we will help the wood break down into small pieces that help the soil stay healthy, and we will turn molecules from the wood into nutrients that can be used by growing plants.

**Am I useful?** I suppose my host trees would tell you I'm the opposite of useful. As I take more and more nutrients from their roots, they grow less and less. They make fewer needles. The wood at their bases gets weak, so a strong wind might blow them over.

Bark beetles might find it easier to feed on their phloem. After many years, an infected tree dies. I don't worry about killing off my food supply, though. By the time one host tree dies, I have infected many others nearby. After my host trees die and fall over, they become homes for voles and other small mammals. Then predators like American martens and fishers will hunt in these fallen logs.

Where I have killed several trees, I create small gaps in the forest. At the center of the gap, you will find a lot of dead trees and rotting logs. Because the gap gets plenty of sunlight, you may also find shrubs and wildflowers. Around the edge of the gap, you will find the trees that I infected just recently. They are growing slowly, and you may think they look a little bit weak or sick. But to me, they just look like home.

## Fire Friendly

Scientists in the western United States are not yet sure how fire affects us. Fire can kill out host trees, but it probably cannot make us go away. We can live deep underground in tree roots, even after they are dead! In places where we grow close to the surface, fires probably kill or damage our hyphae. Scientists who have studied me in the southeastern United States and Europe think that fires reduce our growth but do not kill us off. Maybe you will become the scientist who figures out how fires affect us in the western states!



Conks from Annosum root rot.  
Image courtesy of Robert L. James, USDA Forest Service.

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# Baker cypress

(*Hesperocyparis bakeri*)

How many kinds of plants can you identify? I am named to honor a person who could identify almost every plant he saw. His name was Milo Baker, and he lived from 1868 until 1960. He found more than 2,700 different kinds of plants in northern California!

**Look at me:** I am a rare kind of conifer. You can find me in only about a dozen places, and all of them are in northern California or southern Oregon. I grow in dry places on mountains from about 1,000 to 2,500 meters in elevation. I often grow in dense patches. Sometimes stands of Baker cypress are out in the open by themselves. Sometimes they are surrounded by open forests with other kinds of trees, such as Jeffrey pine, ponderosa pine, red fir, and white fir. When this happens, you could say I make little islands of Baker cypress in a sea of other kinds of forest.

My leaves are tiny and green. They look like overlapping scales. Sprays of these sweet-smelling leaves hang down from my thin branches. My bark is thin and reddish-brown. The outer layers peel away as I age.

I am an evergreen tree. I am not one of the tallest trees in the forest, since I rarely grow more than 30 meters tall. But I am one of the toughest trees you can find. I can survive in soils so rocky and so low in nutrition that other trees would not even think of growing there.



Baker cypress bark. Image by Kyle Merriam, USDA Forest Service.



A healthy Baker cypress growing in rocky soils, with few other trees nearby.

Image by Kyle Merriam, USDA Forest Service.

I love sunlight. My seedlings need sunshine to get a healthy start. They grow very slowly if bigger trees tower over them. Scientists in California found some trees in shady spots that were 40 years old and about 1 meter tall. Most children are taller than those trees by the time they start Kindergarten!

Adult trees need lots of light too. If other kinds of trees outgrow us, they block the light. Then our growth slows down, and we cannot produce many cones.

## Fire Friendly

I love fire. You may think that doesn't make sense, because I grow in crowded stands and my bark is thin, so fires usually kill me. But I need fire to open my seed bank. My cones are serotinous, which means that a hard waxy, coating seals them tight. Fire melts and boils the coating away, and then the cones open and release their seeds. The timing is perfect, because the seeds land in the best possible place to germinate: bare soil where fire has burned away the litter and duff. The seeds quickly grow a few leaves for making food and a long taproot for absorbing moisture from the soil. After a fire, you might find as many as 80 seedlings in just 1 square meter!

As my seedlings grow up, they keep their lower branches. These make it easy for a *surface fire* to climb up into the crowns of adult trees. *Crown fire* sounds scary, but I do not worry about it. It is exactly what I need to open my cones and start a new generation of Baker cypresses.

**Money in the bank:** People like to store their money in the bank so it will be safe until it is needed. I like to store my seeds in a bank, too. I start making seeds when I am in my teens. My little round cones may hold dozens of seeds, but they cannot get out easily because I keep my cones sealed tight, stuck to my trunk and branches. This is called a seed bank. My bank account gets bigger every year. I can store as many as 10,000 seeds in a single tree!

**The hotter, the better:** I am a fan of fire, but not just any kind of fire. I think surface fires are useless unless they produce a lot of heat. Most surface fires

are not hot enough to open my cones, but they ARE hot enough to kill my seedlings before they can put any seeds in the bank. I like it best if I can have a fire that kills most of the trees, like a crown fire, when I am about 50 years old or older. Hundreds of years ago, fires used to visit my forests at least every 50 or 100 years, but they do not come as often anymore. I miss them. I hope a fire comes through before other kinds of trees outgrow me and put me in their shade.

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# Bark beetles

(Multiple Species in western North America)

There are thousands of species of bark beetles, and we live in forests all over the world. In western North America, most of us live in conifer trees. Each species lives in certain kinds of trees. Mountain pine beetles—like me — live in lodgepole pines, ponderosa pines, sugar pines, limber pines, and whitebark pines. Jeffrey pine beetles live ONLY in Jeffrey pines. Western pine beetles live in ponderosa pines and Coulter pines. Spruce beetles live in spruce trees. Engraver beetles live in pines. Fir engravers live in firs. It seems like there is a species of beetle for almost every species of tree!



Mountain pine beetle.

Image by Ron Long, Simon Fraser University.

**Where do we live?** For most of our lives, we live just under the bark of our “host” tree. That is why we are called bark beetles. We come out into the sunlight only at the end of our lives, when we are grown up and ready to mate.

We are especially fond of forests that have lots of conifers growing close together. That is why I love Rocky Mountain lodgepole pine forests. After *crowns fires*, these trees often grow forests where most of

the trees are about the same age and size. If they do not have any fires while they’re growing up, the trees all reach the perfect size for us at about the same time. What a treasure trove of food and shelter! Like me, most kinds of bark beetles love dense conifer forests that have not burned in a long time.

**Growing Up:** We begin life as eggs but, like most insects, we change dramatically through our lifetimes. This is my life story, the story of a mountain pine beetle. The stories of other kinds of bark beetles are all a little different.

It was the middle of summer, just last year. My mother chose a tree in the middle of a dense forest as the perfect place to mate and lay her eggs. She bored a hole in the tree’s bark. At first, a lot of pitch came out through the hole. It was so much that she almost drowned! But she finally got in to the tree’s phloem, where she produced a special scent, like perfume, to attract other bark beetles. This scent is called a pheromone. My father caught a whiff of it and found it irresistible. He flew over and bored into the tree. There he found my mother, mated, and fertilized a bunch of eggs, including mine! Then my mother began tunneling in an almost straight line toward the treetop. Every so often she stopped to lay a tiny, pearl-white egg along the side of the tunnel. By the time she had laid all of her eggs, her tunnel was nearly 60 centimeters long.

It took only two weeks for me to hatch. You probably would have taken one look at me and said, “Gross!” I was short, thick, and soft— a larva— all white except for my little brown head. I spent the whole fall inside the tree bark, eating and making a tunnel crosswise through the phloem. I did not do much at all during winter, when the weather was cold. When it warmed up in the spring, I began eating and tunneling again. Between my mother and me and all of my siblings, we created a sculpture inside the tree’s bark. Scientists call our masterpiece a “gallery.” The

galleries made by mountain pine beetles are always shaped like a tall, wide feather or fern. The galleries made by other kinds of bark beetles look more like starfishes, mazes, or snowflakes.

When I was about eight months old, I formed a soft white shell and became a pupa. Inside it, I finally became the kind of beetle you would recognize—dark brown and shiny, with stiff little wings and a small head, about 6 millimeters long. That is about as big as a grain of rice. I bored through the tree's bark and saw daylight for the first time! Now I am ready to find a mate and a perfect tree for laying my own eggs.

**Never alone:** Even if a bark beetle looks like it is by itself, it is not really alone. We always carry the spores of a fungus along with us. When we bore through a tree's bark, we carry the fungus in too. The fungus interrupts the flow of water from roots to leaves and keeps the tree's moisture just perfect for my larvae to survive.

Where there are conifers, there are always a few of us around. Where a forest has a lot of trees big enough to nurture our larvae and weather conditions are just right, our numbers can increase year after year until there are millions of us. Then we can attack thousands of trees all at once. We call this a feast, but — if we kill most of the big trees of our host species — you might call it an epidemic!

**Am I useful?** Life is pretty uncertain for a bark beetle. Some kinds of worms eat our eggs before they can even hatch. Woodpeckers think that a tree full of our larvae is a feast just for them. Some wasps lay their eggs in our larvae, so THEIR larvae will have me for lunch after THEY hatch! Nuthatches and other birds eat us when we come out into the daylight. Flies and other beetles eat us, too. We certainly do our part to support the other living things in the forest!

## Fire and Me

We like every kind of fire. Crown fires kill us when they kill our host trees. But there are so many trees and beetles in the forest that crown fires cannot get rid of us completely. Instead, they mark the beginning of a new forest that will be ready for us to live in when the trees get older.

*Surface fires* do not kill us, but sometimes they injure our host trees. If a tree is weakened and produces less pitch, it is easier for us to get in to lay our eggs. So surface fires sometimes help us reproduce. If a surface fire kills just a few trees, it makes make the remaining trees a little farther apart and creates sunny openings where new seedlings will grow. We can live and reproduce well in this kind of forest. However, we are not likely to cause an epidemic in this kind of forest because it has trees of many different sizes.

We may be small, but we can change the way fire burns in a forest. If we have killed thousands of trees in an epidemic, the dead trees and their dry, red needles provide a huge fuel supply for a fire. Fires in recent beetle-killed forests often spread fast and burn very hot. Scientists are still learning about how fires burn in beetle-killed forests after all of the needles have fallen and only tree skeletons are left. Maybe you will help figure this out!

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# Black fire beetle

(*Melanophila acuminata*)

**Fire seekers:** When other animals run from a forest fire, I head straight for it. That is because I love fires, especially crown fires! There are many other fire-loving insects. Unfortunately for me, some of these insects follow fires so they can eat me!

Many of the beetles in my family are spectacularly dressed in a rainbow of glossy, iridescent colors, which is why our family is called the “jewel beetles”. But I am just plain black. My scientific name, *Melanophila*, means “black-loving” not because I am black, but because I lay my eggs in the freshly burned, blackened wood found in burns.



Black fire beetle. Courtesy of AG Prof. Schmitz, <http://idw-online.de/pages/de/image73525>



Black fire beetles may use many kinds of burned conifer trees to lay their eggs.  
Image by Glacier National Park Fire Management.

**Smoldering nurseries:** As soon as I detect a fire, I rush there. I especially like fires that burn a lot of trees, like crown fires. I mate near the glowing wood and hot ashes, and then I lay my eggs under the bark of the freshly burned trees. The trees may still be smoldering when I find my way in! I am not fussy about the kind of tree in which I lay my eggs. I lay them in many kinds of conifers, including pines, firs, and spruces.

My eggs need to cool through the winter before my larvae can develop. These short, thick, white, worm-

like babies begin to grow in spring. They eat the phloem of recently killed or weakened trees. They cannot eat the phloem of healthy trees because the trees are protected by special chemicals. Most of my offspring emerge from under the bark during the first year after the fire. However, they may emerge over several years even though I laid all of my eggs at the same time. If larvae do not emerge the first year after fire, they hibernate until they are ready to emerge.

Not all of my larvae grow to be adults. Woodpeckers arrive at a burned area soon after we do. When they pry the bark away from the burned trees, they uncover millions of eggs and larvae. It is enough food for breakfast, lunch, and supper every day for two or three years! Black-backed woodpeckers are so fond of beetle larvae that they move in right after a fire, stay for a few years until our populations go down, and then move to another, more recent burn.

**Built-in smoke and heat detectors:** I can be found everywhere in the Northern Hemisphere where forest fires occur. Even though I am just the size of a bean, I can fly long distances. This helps me find forest fires from far away. I also have two body parts that help me find fires. First, I have antennae that are very sensitive to smoke. I can detect just a few



parts per billion of smoke particles in the air. This is like sensing a single drop of orange juice in a backyard swimming pool! Second, I have sensors in little pits on each side of my thorax that detect heat. These features can help me find forest fires from up to 12 kilometers away! It was not until the 1960s that scientists figured out how I find fires. Once they realized how impressive I am, the U.S. Air Force began studying me to improve their heat-sensing technology.

### Fire Facts

Black fire beetles swarm by the thousands toward fires. The bigger and hotter the fire, the more likely they are to find it. They are a nuisance to firefighters throughout the fire season, latching onto their clothes and biting them. Perhaps the firefighters should have pet woodpeckers to keep them company!

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# Black-backed Woodpecker

(*Picoides arcticus*)

A mountainside with hundreds of blackened tree skeletons reaching to the sky is a dream come true for a black-backed woodpecker like me. A recent burn is the perfect place for me to live and raise a family. Hard to believe? Let me explain.

**Smoke detectors:** All those standing dead trees probably do not mean much to you. Big deal, you're thinking. To me they represent lots of food. I am not particularly interested in the trees themselves. It is what lives inside the wood that gets me excited. The burned trees are crammed full of my favorite food... wood boring beetle larvae. Plump and juicy, these white, worm-like creatures— also known as grubs— are so delicious! How did the larvae get here?

Not long after a fire burned across the mountain, hundreds of "fire bugs" began appearing, seemingly out of nowhere. More than 40 kinds of insects, mostly beetles, are attracted to recently burned forests. One kind is even named after fire – the "black fire beetle"! The beetles mate, then lay their eggs under the charred bark of freshly killed and dying trees. Once their eggs hatch, the larvae have an unlimited supply of good wood to feast on. Very convenient— for them and for me!

Competition for space in burned trees is intense among beetles. Early arrivals get the best sites and deposit the most eggs. Because of this, many beetles have developed ways of homing in on burns. Some are alerted by smoke and use it to find their way to a fire. The black fire beetles have special heat sensors on their bodies. These allow the beetles to take a very direct route to a fire, often beating the rest of the "fire bug" crowd. These heat-sensing beetles are called *Melanophila*, a Latin word meaning "dark lovers." Their name refers to the blackened, fire-charred trees where they mate. They are such expert fire finders that they have zeroed in on a fire from as far away as 160 kilometers.

**Grubs, anyone?** Wood-boring beetle larvae generally

tunnel only two to five centimeters into a tree. They stay there for a year or so before turning into adult beetles. During this time, wood surrounds them on all sides so they are safe from most predators. But they are not safe from me! I use my strong woodpecker bill like a pry bar to loosen and chip off large flakes of bark. Beneath the bark are small holes where larvae have entered the wood. These holes show me exactly where to start hunting for my lunch. Steadily chiseling away the wood, I finally uncover a larva and spear it with my barbed tongue. Yum! Would you care for some?



Male black-backed woodpecker.  
Image courtesy of Ron Wolf.

**Woodpeckers only!** I'm not too worried about predators while I'm busy working. The back of my head and my entire back are black, so I blend in beautifully with the charred sides of burned trees while I hunt for food. This burn will provide me with



a year-round supply of food for a few years. Even in winter I'll be able to find food. And it's all reserved for woodpeckers. Other kinds of birds can't get grubs from these trees.

**Perfect combination:** The burn has attracted other black-backed woodpeckers besides me. When spring arrives, I will find a mate and we will pick out a nest tree in the burn. Only a recent burn offers the ideal combination: a nest tree and plenty of food trees within easy reach. We will be able to feed our young without a hitch. Our nest tree died decades ago, long before this last fire, and has decayed nicely over the years. A sturdy outer shell of wood surrounds a totally rotten center. Perfect!

My mate and I work together to excavate our nest cavity. It is tough going to chip out an entrance hole in the hard outer wood. It is much easier to hollow out the inside, but it takes a while since the cavity needs to be big enough to hold our nestlings until they are old enough to fly. Our completed nest cavity is about 25 centimeters deep and 12 centimeters in diameter. Such a warm, safe place to raise our young! To make our home super safe, we also remove any tree bark from around the entrance hole. Predators like tree squirrels will have to deal with a slippery surface if they want to get in!

**Room available:** Finally, everything is ready. I lay 3 white eggs in the bottom of the nest cavity. After 12 days of incubating, we have 3 lovely nestlings. My mate and I work hard at caring for our nestlings, making many trips to the nest with food. Besides eating lots of beetle larvae, the nestlings eat many insects picked off the bark of trees. Our young will be able to fly in about 25 days, but they will follow us around for several weeks to learn more tricks about finding food.

We only use a cavity for one nesting season. It will not be vacant for long, though. Mountain bluebirds and tree swallows are just two kinds of birds that

raise their young in old woodpecker cavities. There are many others. Someone will surely move in the spring after we leave.

Now you know why a recent burn is my kind of place. Next time you see one, think of me. I'll be there!

### Fire Facts

Fires that kill a lot of trees, like crown fires, create perfect habitat for black backed woodpeckers. In fact, it is so good that many pairs may nest within a single burn. Why not? Food is everywhere. A great supply of grubs is available right under the bark of the dead and dying trees. The black-backed woodpecker must also find a good nest tree amid these food-rich trees. Only rotten trees are soft enough for them to make a nest hole in. So black-backed woodpeckers usually nest in rotten trees in the middle of a dense clump of burned snags. The birds must set up housekeeping quickly, because this great arrangement will only last 5 or 6 years. After that, there are fewer beetles feeding on the dead trees. And once the woodpeckers' food supply is gone, so are the woodpeckers! Then they will look for another recently burned forest that offers more beetle larvae.

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# Bracken fern

(*Pteridium aquilinum*)

Would you like to meet a plant that grows on every continent except Antarctica? How about one that likes both wet and dry soils, hot and cool weather, and shady and sunny conditions? How about one that can live for a thousand years? How about one that is really good at getting minerals out of the soil? If your answer is “yes,” then look for me! I can grow in many different conditions, and I am really good at getting the nutrition I need, so I have found good habitat all over the world. I grow in every one of the United States – even Hawaii! My favorite places are those with deep soils. My least favorite places are deserts and swamps.

Ferns have been around a very long time, much longer than humans. We were growing on the earth 300 million years ago, before the time of the dinosaurs. Many of my ancestors from those early times died but did not rot away. They were squeezed and pressed and covered by many layers of rock, until they became coal and oil. You probably use some of my ancestors as fuel!

Scientists have found fossils of ferns that were 10 meters tall. Some kinds of ferns still grow taller than people, and others are smaller than your little finger. I am a bracken fern, and we usually grow 1 to 2 meters tall.

**Spores, not seeds:** Ferns are different from trees and flowering plants, starting with the names for our body parts. The feather-shaped plant that you see here is called a “frond.” What you might call a stem is really a “stipe.” What you might call a leaf is really a “blade.”

The most important difference between us and many other plants is the way we reproduce. Most plants create new plants by producing seeds. Each seed contains a baby plant with the same number of genes as its parents, and it germinates into a plant that looks like its parents. But I create new plants by spores, not seeds. I store them inside little brownish packages under the edges of my leaves. Unlike seeds,

each spore contains only half of my genes. My spores are so small and light that they can fly hundreds of miles on the wind. Then they germinate into plants that are so tiny you can hardly see them. They do not look at all like me! They live a very short time, and their only job is to combine genes from two different spores so a new fern like me can grow.



Bracken fern plant.  
Image by Robert Vidék i, Doronicum ft.

**Network of Rhizomes:** The easiest way for me to make new fronds is by sprouting from my rhizomes. My rhizomes can be 2 or 3 centimeters thick, and they can grow more than a meter in a single year. New fronds sprout up along the length of each rhizome and then grow their own rhizomes. The rhizomes weave over and under and around each other. They form a thick network underground, while my fronds form a thick garden aboveground. All of the plants that grow from my rhizomes have exactly the same genes, so the whole patch is called a clone. Individual fronds die off every year or two, but a clone might get to be more than 1,000 years old.

**Unfriendly Neighbor:** I like to have the neighborhood all to myself, so I am not very nice to other kinds of plants. My rhizomes weave around the roots of tree seedlings, shrubs, and wildflowers. They make it hard for these competing plants to get enough water and nutrients. Sometimes my fronds

make chemicals that keep other kinds of plants from growing. Sometimes my fronds block the sunlight from shorter plants. My dead fronds fall over and shade the seedlings of other plants.

I am not very nice to animals, either. Animals can eat my fronds in the spring, when they are new and fresh. But as I grow, I make many chemicals that are hard for animals to digest, so most animals leave me alone.

Insects do not leave me alone though. Some of them eat my fronds. Others hide in my thick litter on the ground. They lay their eggs in my blanket of dead fronds, and sometimes birds hide there too. Ants are my insect friends. In spring and summer, I make a sweet nectar on my fronds that ants love to drink. Sometimes these ants protect me. They attack the caterpillars that try to eat my fronds.

People all over the world have found ways to use my fronds and rhizomes. People gather my sprouting fronds in early spring, when they are good to cook and eat. Because of their shape, these delicate new fronds are called “fiddleheads.” People grind my rhizomes into flour. People in Europe used my dead fronds to cover the roofs of their homes. That could be VERY dangerous if a spark from the chimney landed on the roof!



Bracken fern fiddlehead.  
Image by Rob Routledge, Sault College.

## Fire Friend

I can burn easily and grow back quickly after any kind of fire. My dry, dead fronds make a perfect blanket of fuel on the ground because they are fine and fluffy, and there are usually a lot of them. Fire kills my fronds, but it hardly ever kills my rhizomes. They like to live 10 centimeters or more below the soil surface, so the heat from fires cannot reach them.

Soon after fire, new fronds sprout from my rhizomes. They grow fast because they have lots of sunshine and little competition from other plants. The wind carries my spores into burned areas. These will grow well because they like the way fires change the chemistry of the soil. Growing in burned soil may also change the chemistry in my fronds for a year or two, making them easier for animals to eat. Fire and I are fast friends!

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# California black oak

*(Quercus kelloggii)*

I am the most common oak in the forests of the mountains in southern Oregon, California, and northern Mexico. When you see a towering oak sharing the skyline with conifers, it is probably me. Ponderosa pine, sugar pine, white fir, and incense-cedar are some of my neighbors.

**What do I look like?** I grow straight and narrow in crowded forests, but my branches spread far and wide when I am in the open. I can grow to be more than 30 meters tall, and my trunk can be 8 meters around. The conifers in my neighborhood will eventually grow taller than me and leave me in their shade, but that will take a long time. I am a deciduous tree. That means I shed my leaves every fall. My bark gets rough, uneven, and thick as I age. It can be 5 centimeters thick when I am old, about as thick as your wrist. My acorns are long and thin, about the size of an adult's thumb.

**Growing up:** I grow from acorns. They take 2 years to develop, so I have tiny, young acorns and large, full-grown acorns on my branches at the same time. I start making acorns when I am about 30 years old. I can make about 6,000 acorns in a good year. Rodents and some birds cache acorns in the ground, planning to come back later to eat them. Western gray squirrels and scrub jays are my best acorn planters. They usually do not eat all the acorns they cache, so some of my acorns get to grow into trees.

Open, sunny places without litter on the soil are my favorite places to grow. When I was a seedling, you might have thought I was growing slowly, but that is because you could not see underground. Down there, I was busy growing deep roots. When I was about 6 years old, I had a growth spurt that made me tall and thin. When I was about 25, my trunk began to grow wide. Then I grew fast until I turned about 65. I hope to live many more years, but now I will grow more slowly. California black oaks usually live about 200 years, but some are over 500 years old. Armillaria and other decay fungi may infect my roots, trunk, and branches. That would cause my wood to



California black oak sprouting after a fire.  
Image by Michael Yager.

## Fire and Me

Now that I am full-grown, surface fires probably will not harm me. My thick bark can protect my cambium from heat, as long as the fire is not too hot. Fires may kill my seedlings and saplings though. Very hot surface fires and crown fires can top-kill or kill even old trees like me. Frequent fires help me by killing shade-loving conifers like white fir, which like to overcrowd and shade me out.

I sprout from my root crown after fire kills or injures my aboveground parts. Sometimes I even sprout from my trunk. My sprouts grow faster than conifer seedlings, so I am usually the tallest living tree on places that burned recently. My sprouts even grow faster than my own seedlings because they already have large roots that provide water. Fires create open areas and remove litter and duff from the top of the soil. That makes perfect places for my seedlings to grow from acorns.



rot from the inside out. Eventually, these fungi will probably kill me.

**Food for everyone:** It seems like everyone feasts on my acorns! Western gray squirrels usually eat the most. In winter, my acorns may be about half of a western gray squirrel's whole diet. Chipmunks, ground squirrels, dusky-footed woodrats, bears, and mule deer also eat my acorns. Then there are the birds. They think I am a cafeteria! Jays, blackbirds, chickadees, crows, and woodpeckers are just a few of the birds that eat my acorns. I need to make thousands of acorns because I need some left over to grow into new trees.

Some animals use my leaves or wood. Mule deer and rabbits eat my leaves, and many insects live in the cracks of in my bark. Woodpeckers and other birds cruise up and down my trunk to find and eat these insects. Woodpeckers also drill out my wood to make cavities for their nests. Wood-decaying fungi soften my wood and make drilling easy for them. After woodpeckers abandon their nests, western gray squirrels or California spotted owls may move in. When I die and fall over, bears and other ground-dwelling mammals may den in my hollow trunk and branches.



Miwoks burned Yosemite Valley regularly to keep the California black oaks healthy.  
Image by Tom Reyes.

**People and me:** American Indians considered my acorns the tastiest of all the acorns from oaks that grow in the West. They ground the acorns into flour and made bread, soup, and even pudding. Desert tribes traded obsidian and other valuables for my acorns. Today, my wood is used for furniture, flooring, lumber, and firewood.



Indians used this rock for grinding acorns into meal.  
Image by Mike Yager.

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# California red fir

*(Abies magnifica)*

**An armful:** I am a California red fir. I can be up to 60 meters tall and my trunk can be 2.6 meters wide—so wide that an adult human cannot reach all the way around me! When I was young, I had thin bark. Now that I am old, my bark is thick and has rough cracks in it. If you break off a chunk of my bark, you will uncover the magnificent reddish color inside. My needles are shaped like tiny hockey sticks. They are 2.0 to 3.5 centimeters long. You have to look closely to notice where the bent tip of my “hockey stick” attaches to my twig.

I live mostly in California, but I also live in southwestern Oregon and western Nevada. I usually grow high up in the mountains. I can grow with many different kinds of trees. When I grow low on a mountain, I often grow with white fir, ponderosa pine, and Douglas-fir. When I grow a bit higher up, I often grow with Jeffrey pine or just with other California red firs. At my highest elevations, I can grow with Sierra lodgepole pine and mountain hemlock.

**Seeds are it:** The only way I can reproduce is by seeds. I was about 40 years old when I started producing cones and seeds. I produce a big seed crop every 2 to 6 years.

My long cones stand upright on my upper branches, like a jeweled crown. They are pollinated in May and June, and they ripen in August. In fall, they begin to fall apart while still attached to my branches. That means you hardly ever find my cones on the ground. My seeds have small wings to help them “fly” on the breeze, but they do not fly far because my seeds are large and heavy. Scientists have learned that my seeds only fly about twice as far as I am tall. So here is a math problem for you: If I am 30 meters tall, how far away can my seeds get by flying? They might get further away if an animal helps by caching them.

**Snowed in:** The snow gets very deep in the places where I live. In fact, there may still be snow on the ground in July. That is okay with me. I grow best in areas with cold, wet winters and warm, dry summers. My seeds usually germinate in spring. They can germinate in, on, and under snow. Of course, seeds that germinate above the ground in the snow rarely survive. My seeds germinate best in soils where there is little or no leaf litter. I can handle long periods without rain in the summer, but my



California red fir cones grow upright on the uppermost branches. Image courtesy of Charles Webber © California Academy of Sciences.

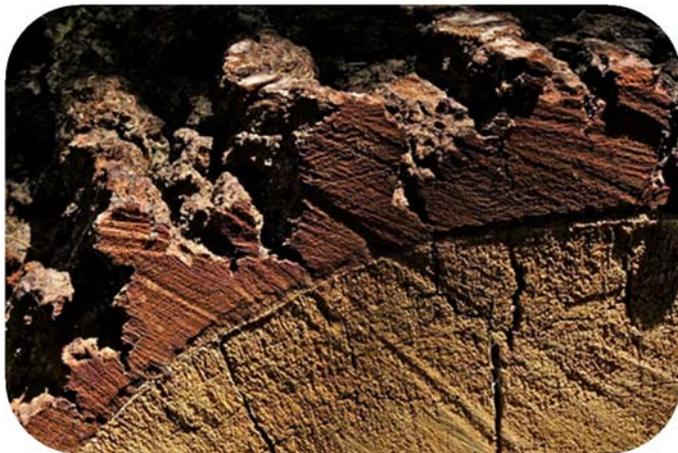
seedlings need to quickly grow a deep taproot to survive these dry periods.

**Growth spurts:** Young California red fir trees usually grow very slowly. It can take as long as 25 years for a seedling to reach 1 meter tall! How tall will you be when you are 25? We do not mind growing in shade when we are young, but when we get older we grow best in full sunlight. A few years ago, a fire killed a

few trees and created a nice forest opening near me, giving me more sunlight. I have been growing faster ever since!

**Important tree:** My forests provide important habitat for many animals. Where my forests are dense, martens like to den in large snags, stumps, and logs. Squirrels cut off my cones and cache them to eat during winter. Mule deer browse my twigs in spring. Other animals that use my forests include fishers, wolverines, black bears, pocket gophers, chickadees, pileated woodpeckers, great gray owls, and more than 100 other kinds of birds. Many birds forage in my branches, looking for insects.

**Kiss of death:** Fir dwarf mistletoes are parasites that can really harm me. They sink their roots into my branches and steal my water and nutrients. If I become infected, I will grow more slowly and make fewer seeds. Eventually I will weaken and die, or a strong wind will blow me over. I am most likely to get infected by dwarf mistletoe when I grow in dense forests, because the mistletoe seeds spread easily from tree to tree.



California red fir bark on mature trees is thick and able to resist fire.  
Image courtesy of Jean Pawek.

## Fire Facts

California red fir seedlings and saplings are easily killed by fire because they have thin bark. Older trees are better protected from the heat of surface fires because they have thick bark. Even large, old trees are killed by fires that torch individual trees or by crown fires. California red firs do not NEED fire, but their seedlings like to grow in places where fire has killed some trees and opened up the canopy, providing more light to the forest floor.

In the past, fires burned California red fir forests on low-elevation, dry hillsides about every 10 years. Higher, wetter areas burned every 50 to 100 years. Most of these fires spread slowly along the ground and did not kill many trees. Small crown fires occasionally burned in the treetops, killing patches of trees. Then shrubs would grow in the open patches, making good habitat for many rodents and birds.

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# California spotted owl

(*Strix occidentalis occidentalis*)

I am a light brown owl with white spots and stripes covering my body. My eyes are dark brown. My baby owlets are pure white.

**My home:** Most California spotted owls live in California, like our name says. We are usually found in the southern Cascade Mountains and the Sierra Nevada. Some of us live in the mountains in coastal and southern California. A few even live in northern Mexico.

My favorite place to live is in old-growth forests with a lot of cover, different sized trees, snags, and fallen logs. I'll use steep slopes as long as they have plenty of trees overhead. I am not too particular about the kinds of trees in my forests. Ponderosa pine, California red fir, redwood, bigcone Douglas-fir, and oak trees will all do. I just need old, large trees to roost and nest in. Fallen logs are good habitat for my prey.

I do not like being too hot or too cold. In the summer, I often roost on low branches so I can be in the cool shade. In the winter, I roost high in the trees so I can feel the sun's warmth. Some of my friends move down the mountainside in the winter to where it is warmer, but they don't move too far. All of us like to stay pretty close to home.

**Nest finders:** We do not build our own nests. Instead, we look for a place where we can raise our young without doing any construction work! My nest is in a cozy cavity inside a huge, old tree. Some of my friends have nests on top of big trees with broken tops. Others use nests that other animals have abandoned, and some even nest on top of a witches'-broom on a tree branch. That is the thick growth that a tree forms when mistletoe is growing in its branches. One thing is certain: We like big, old trees. Scientists learned that many of the trees that we nest in are more than 200 years old!

I defend my nest and my young fiercely. I will attack you or any other animal that gets too close to my nest. But I do not often fight with other California

spotted owls. Our nests are far apart, which gives us plenty of room to move and hunt without bothering each other.

**One mate:** My mate is very important to me. I keep the same mate for life, although we live alone when it is not breeding season. We often use the same nest year after year. I incubate our eggs, while my mate brings me food.

I laid my first eggs when I was 2 years old, but I do not lay eggs every year. When there is not enough food to feed our whole family - me, my mate, and our owlets, I do not lay eggs. I also do not lay eggs when spring is too cold or wet for our owlets to stay healthy.

I typically lay 2 eggs in April and incubate them for about a month. When my owlets hatch, they are covered in soft, white down that keeps them warm. In 3 to 4 weeks, they grow the long, tough feathers that they need for flying. When they are about 5 weeks old, they can flutter or climb from the nest to nearby trees. But they need me and my mate to feed and protect them until they learn to fly well and hunt on their own. That takes 3 to 4 months.



Adult California spotted owl.  
© 2012 by Kameron Perensovich.

When my owlets move out at the end of the summer, they don't go far. They usually find their

own nests less than 30 kilometers from where they hatched. My owlets may live up to 17 years!

**Night hunter:** I am nocturnal. That means that I sleep during the day and feed at night. I hunt from a perch. I sit and wait silently. When I see something tasty, I swoop down and ambush it! Two of my favorite foods are dusky-footed woodrats and northern flying squirrels. I also love to eat other small mammals, birds, and insects. Fishers, hawks, eagles, and great horned owls are among the many animals that want to eat me, but so far, I have managed to get away.

### Fire Facts

California spotted owls can easily escape fires without getting burned. However, fires can burn their nest trees. If a nest is burned during the spring or early summer, before owlets can fly, the fire will kill the owlets.

California spotted owls need forests filled with large, old trees for their nests and habitat. When a surface fire burns through their habitat without killing the big trees, it may make life better for the owls because it helps create a patchwork of different habitats. Dense patches of trees are good for nesting and roosting, while more open patches are good for hunting. But crown fires are a different story. When fires are very hot or burn through the tree crowns, they kill most of the big, old trees over a large area. Then the owls have nowhere to nest. They have to leave and look for a new home, and it may be hard to find another forest with the large, old trees they need.

### Biological Facts

There are 3 kinds of spotted owls, and all of them are having trouble finding enough habitat. California spotted owls are called a “Species of Special Concern” in California because the areas where they can live are getting smaller and fewer. Some of the things that make life hard for them include big, severe wildfires, climate change, logging of big trees, and another kind of owl – the barred owl - that likes the same kind of habitat. The 2 other kinds of spotted owl, the northern spotted owl and the Mexican spotted owl, are called “Threatened species” because they have very little habitat left, so very few are still around.

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# Canyon live oak

*(Quercus chrysolepis)*

Some of the western oaks are fussy about where they'll live, but not me. You can find me on exposed ridgetops and along shady streams. Like my name suggests, you are most likely to find me in deep, shaded canyons.

You can find me on recent burns, in old forests that have not burned for over 150 years, and in all stages in between. I grow in all types of soil. My neighbors may include California black oak, tanoak, Pacific madrone, ponderosa pine, Coulter pine, and coast Douglas-fir. In southern California, I grow with big cone Douglas-fir.

You can find me in forests, woodlands, and chaparral from southwestern Oregon to southwestern New Mexico. You can find me in northern Mexico too. I am most common in California, especially in the Coast Ranges and in the Sierra Nevada.

**Very variable:** I am an unusual oak because I can grow in many shapes. When I grow in moist canyon bottoms with deep soils, I may get to be 30 meters tall. But on dry sites with shallow soils, I may only become a short, shrubby plant. I am evergreen. That means I keep my leathery, shiny leaves year-round. Sometimes my leaf edges are spiny, but sometimes they are smooth. My acorns are fat and roundish. They sit in a yellow cup covered with short, fuzzy yellow hairs. My bark is flaky and kind of thin, even when I am full-grown.

**Growing up:** I grow from acorns, which take 18 months to develop. I grew my first acorns when I was 20 years old. I produce thousands of acorns in a good year, but I do not have the energy to do that every year. Rodents and birds help plant my acorns by caching them in litter and soil. These animals usually do not eat all the acorns they cache, so some of the uneaten acorns can grow into trees.

My seedlings grow best in shade, while seedlings of most oak species grow best in the sun. I also grow more slowly than other oaks. That may be one



A canyon oak woodland.  
Image by Dan Simpson.

reason I am not as common as they are, even though I can grow in so many different places.

I can live for more than 300 years. During this long lifetime, root disease and decay fungi infect my roots, trunk, and branches. This causes my wood to rot from the inside out, making my trunk ideal for woodpeckers to nest in. Eventually, decay fungi can kill me.

**Helpful to wildlife?** Many animals eat my acorns, even though they taste very bitter. Western gray squirrels, ground squirrels, dusky-footed woodrats, bear, and mule deer are some of the mammals that chow down on my acorns. Woodpeckers, crows, band-tailed pigeons, wild turkeys, and other birds also eat them. Woodpeckers eat insects that live in my bark. Many birds use my branches for perching and nesting.

Rabbits, deer mice, porcupines, and other mammals eat my leaves and twigs. Since I am evergreen, mule deer eat my leaves all winter long.

Cavities in my trunk and branches make good nesting and hiding places for animals. The cavities are made by fungi, which rot the wood inside my trunk and

roots. Woodpeckers enlarge the cavities for nests. After woodpeckers abandon their nest cavities, western gray squirrels and California spotted owls may move in. Snakes and salamanders hide in my small cavities. When I die and fall over, bears and other ground-dwelling mammals den in my hollow trunk and branches.

**Helpful for people?** I have valuable wood. It is used for tool handles because it is so hard. In the past, my wood was used for ship frames and wagon wheels. American Indians used to grind my acorns into meal and cook with it. They liked the acorns from other trees better, though. Mind they had to be washed over and over to remove their bitter flavor.

## Fire and Me

I am very sensitive to fire, at least for an oak tree, because my bark is so thin. Fires usually kill my seedlings and saplings. My flaky bark sometimes catches fire, which then burns up my trunk and torches my crown, and that kills me.

“Cool” surface fires usually top-kill me, but that doesn’t matter because I am a champion sprouter! Unless my root crown is killed, I can grow many sprouts within a few weeks after fire. My sprouts are still connected to the large, deep roots of the original tree, so they can obtain water and grow very fast after a fire. Within a few months after fire, my sprouts may be 1 meter tall. If fires occur very often, I stay short and look like a shrub, because my sprouts do not have enough time to grow tall between fires.

I can also grow from acorns after fire, but my seedlings grow more slowly than my sprouts because they have to develop brand-new roots to obtain water.



Acorns of canyon live oak.  
Image by Chris Wemmer.

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# Cheatgrass

(*Bromus tectorum*)

I am an invasive grass. People call me “invasive” because I am good at spreading into new places and ruining the habitat for native plants and animals. I especially like to invade grasslands, shrublands, and some ponderosa pine forests. I like places with dry summers and wet springs. I am quick to grow in areas that have been burned or grazed or where the soil has been stirred up. I cause big problems in the western United States. I am so good at taking over new areas that I may replace the native plants and change the way fires burn.

**Where do I live?** I am originally from southern Europe, northern Africa, and southwestern Asia, but now you can find me almost all over the world. I was accidentally brought to North America in the late 1800s. I have invaded most of the grasslands and shrublands in Idaho, Utah, and in the eastern parts of California, Washington, and Oregon.

I can grow at elevations as low as 600 meters and as high as 4,000 meters. I can grow in many types of soils. I can survive in areas with very little water, but I grow best where early spring rain is plentiful.

Since I grow in so many places, I grow with many types of plants. I grow beside trees like ponderosa pine, Jeffrey pine, Douglas-fir, and California black oak, shrubs like sagebrush and antelope bitterbrush, and grasses like bluebunch wheatgrass and Idaho



Fire burning through cheatgrass.  
Image by U.S. Fish and Wildlife Service Headquarters.

fescue. I do not like it in old, dark forests where sunlight rarely reaches the ground.

**Small but Fierce:** I am a small grass. I am usually no taller than your knee, but I can still flower and produce lots of seeds! My seedlings are bright green. As they grow, they turn purplish-red.

Then they dry completely and turn straw-colored. I have fuzzy leaves. My flowers droop from the ends of my stems. The tips of my flowers have long, spiky awns, which stick to animal hair and human clothing. I love it when animals take my seeds on a journey. They help disperse my seeds!



Cheatgrass plant with flowers.  
Image by John M. Randall,  
The Nature Conservancy.

**Growing Up:** I am an annual. This means that I germinate, grow, produce seeds, and die all within one year. What a busy life I lead! I can only grow from seed because I do not have special underground parts that let me come back year after year. That is no problem for me though, because we cheatgrass plants make a lot of seeds. Most of us make at least 25 seeds in our short lifetime, but I heard of one cheatgrass plant that made more than 5,000 seeds! Our seeds can survive in the soil or litter for 2 or 3 years.

We do not mind living in a crowded neighborhood. More than 600 of us could grow in an area the size of a notebook page. With so many of us growing together and producing so many seeds, it is not surprising that we can stay around year after year and easily spread to new areas.

I can germinate from seed and begin to grow either in late fall or early spring, when most native grasses and shrubs in my habitat are dormant. That gives me a head start in using the water and nutrients stored in the soil. My neighbors – mostly perennial grasses and shrubs - may think I am a cheater because I start the growing race before everyone else does. Maybe that is why I am called cheatgrass.

**Am I Helpful?** Songbirds and wild turkeys eat my seeds. Grazing animals, including deer and pronghorn, eat me in early spring, when I am green and nutritious. However, I quickly dry out and die, so I do not make a good meal for very long. My dried, spiky flowers sometimes hurt the eyes and mouths of grazing animals.

## Stop the Invasion!

Land managers are trying to stop the spread of cheatgrass. They pull the plants out by hand, mow them off, burn them with *prescribed fires*, bring in animals to graze on them, and spray them with herbicides. They also plant seeds of other grasses, especially native species, to try to crowd cheatgrass out. They are now learning how to use a fungus called “black fingers of death” to kill cheatgrass seeds.

## Fire and Me

I am usually dead and dried out before fires burn through my home, so I do not worry about fires killing me. No matter what kind of fire comes through, I will be here again next year. Fires sometimes kill my seeds, but I make so many of them that plenty will survive to grow new plants.

I have a dramatic effect on fire in western grasslands and shrublands. I grow in the spaces between shrubs and bunches of grasses. Before I came, there were gaps between the plants and it was harder for fires to spread from plant to plant. Now I create a lot of fluffy, dry fuel in those spaces every summer. This makes the places where I live much more likely to burn. There are places in the West that used to burn every 30 or 40 years but, now that I have come, they burn every 4 or 5 years. When fires are more and more frequent, native plants find it hard to recover between them. I do not mind one bit, because fewer native plants mean more and more habitat for me.

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# Deer brush

(*Ceanothus integerrimus*)

If you guess that deer like to eat me, you are right. People call me an “ice cream plant” because they have seen deer munch my leaves and twigs like I am a dessert. I am also a favorite treat of cattle and domestic goats.

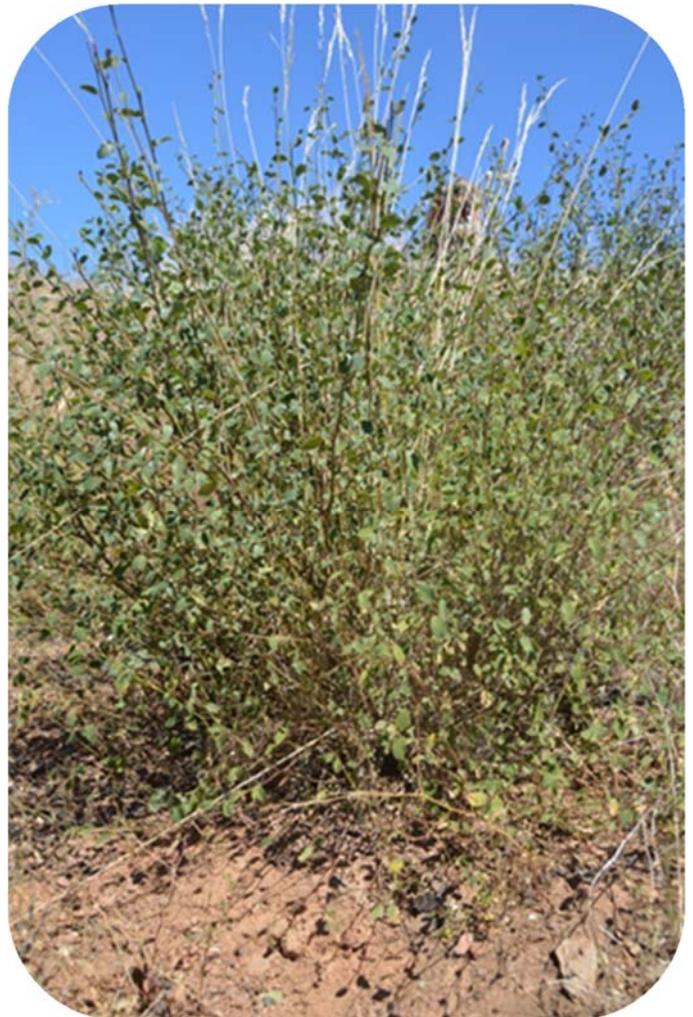
I grow in chaparral, oak woodlands, and young conifer forests. I am most common in high-elevation chaparral, where I grow with greenleaf manzanita and mountain whitethorn. The trees that I grow with include blue oaks, white oaks, California black oaks, ponderosa pines, white firs, and red firs. You can find me in Washington, California, Arizona, and New Mexico. I am most common in California.



Deer brush in flower.

Can you spot the ponderosa pine seedlings nearby?

Image © 2015 Barry Breckling.



Deer brush.

Image by Ilana Abrahamson.

**Pretty me:** I am a good-looking shrub. My flowers are white, pink, or purple, and my leaves are bright green. I am deciduous. I drop most of my leaves in the fall, but I keep a few through the winter. Dropping my leaves gives me a break from those leaf-munching deer! I flower in spring, starting when I am about 4 years old. My pretty flowers are popular with insects. Native bees, honeybees, and butterflies pollinate them. My fruits ripen in summer. When they are fully ripe, they dry out and twist open suddenly. Then my seeds explode out like pellets from a shotgun. They leave the mother plant in a hurry, but after they land on the soil, they might wait for as long as 100 years before they germinate and my seedlings start growing.

That is because my seeds are dormant. They have very hard “coats” that have to be cracked open before my seeds can germinate. That usually happens when fire heats my seeds or they get crushed by something heavy. My seedlings like to



grow on open, sunny places in soil without much *litter* and *duff*—like in places that recently burned.

**Many uses:** People like to plant me around their homes because I am so pretty. Beekeepers like me because my nectar makes good honey. I also help enrich the soil, because bacteria in my roots can move nitrogen from the air into the soil.

## Fond of Fire

If you guess that I like fire, you are right again. I like all kinds of fire. They usually kill or *top-kill* me—but that is fine by me because I grow really well from seeds after fire. Scientists have found that I only live about 40 years. That is not very long for a shrub. I depend on fire to help me germinate, and fires create the open places and bare soils that I need to grow my best.

Many chaparral shrubs sprout from their root crowns after fire. That is the place where the roots meet the stem. I can do that too, but I am not very good at it. If you walk over a recently burned area where I have stored seeds in the soil, you will probably find thousands of my seedlings. However, you will probably find only a few sprouts, and they are likely to die within a few months after fire.

I do not grow well in shady places that have not burned in a long time. When trees make too much shade, we gradually die out. For the animals, this may be like having the ice cream shop in your neighborhood go out of business.

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# Deer mouse

(*Peromyscus maniculatus*)

Do you think that I look like a deer, as my name suggests? I certainly do not think so! Maybe I got my name because I am such a good runner and jumper—like a deer—not because I look like one.

**Where do I live?** Deer mice are found throughout North America. You can find us living from the hot deserts to the cool mountainsides. We live in grasslands, shrublands, woodlands, and forests. Although it seems like we can live just about anywhere, that is not exactly true. There are 67 different kinds of deer mice, and some prefer to live in forests, while others prefer grasslands.

**Starting out:** My 4 brothers and sisters and I were born in our mother's cozy nest. Before giving birth, our mom dug a burrow in the soil and made a cup-shaped nest out of mosses, grass, and roots. It may not sound luxurious to you, but it kept us warm and protected us from predators during those early days, when we were blind, naked, and completely helpless. We spent our first few weeks huddled in our nest with our mom. Raising the 5 of us must have been hard work for her.

We weren't helpless for long. By the time I was 2 weeks old, I had a full coat of fur. By 3 weeks, I could finally see. When I was only 6 weeks old, I was almost full-grown and ready to leave Mom and the nest! Can you imagine being on your own when you were that young? We have to get a lot done during our short lives. Deer mice don't live long, often less than 1 year!

**Growing up:** When I left my mom's nest, I didn't go very far—I only travelled about 150 meters away before I picked out the area that would be my new home.

When I was about 7 weeks old, I found my first mate and became pregnant. It was only 3 weeks from the time I became pregnant to the time I gave birth. I had 3 mouse pups in my first litter. Deer mice can



Deer mouse.

Image by David Cappaert, Michigan State University.

have as many as 9 pups in a litter—what a huge, sudden family!

Even though I can have babies all year long, I am more likely to have babies in the spring, summer, and fall, when food is abundant. It only takes a few months to raise a family, so I will probably have about 4 litters in my lifetime. That means that I could have as many as 36 babies, but around 16 is more likely. It is exhausting just thinking about it!

**To eat...or to get eaten:** It probably sounds like all I do is mate and raise pups, but I also spend a lot of time searching for food and eating. I am *nocturnal*, which means I am active at night and I rest during the day.

I eat mostly seeds and arthropods. That includes insects, caterpillars, and spiders. I also eat nuts, berries, and small fruits; sometimes I even eat leaves. I am not picky. I just eat what's available. I like to fatten up and store some seeds before winter. It is harder to find food when I have to tunnel through the snow looking for buried treats. Some winter nights I would rather not leave my nest at all!

During the day, I rest in my nest. I like to stay hidden because so many animals love to eat me. Snakes, owls, coyotes, ringtails, and foxes are only a few of my many predators. Deer mice are an important part of many animals' diet. Life as someone's dinner is quite stressful!



Deer mouse.

Image by David Cappaert, Michigan State University.

## Fire and Me

If a fire burns through my habitat, I will probably be OK. I can survive almost any kind of fire. I usually burrow underground where the soil will protect me from the heat and flames. But deer mice can get hurt or die in wildland fires if they can't escape in time. I sure hope not to be one of them! In the first weeks after a fire, there are not very many plants to hide me, so I have to be extra careful to avoid predators.

Deer mice usually love areas that have recently burned. After the ash settles into the soil and the plants sprout back to life, there are plenty of tasty, fresh plants and lots of insects. The seeds in this new crop of grass and wildflowers are perfect for me. I also love it when fires burn the grass and leaf litter, because that makes it much easier for me to run along the open ground and to find food at night. In fact, there are often a lot more deer mice in the first spring or summer after a fire than before the fire.

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# Coast Douglas-fir

(*Pseudotsuga menziesii* var. *menziesii*)

I am a tall evergreen tree. Two kinds of Douglas-fir live in the United States. I am called “Coast Douglas-fir” because I live closer to the coast than the “Rocky Mountain” kind.

Douglas-firs were first described in writing in 1791 by Dr. Archibald Menzies. Thirty years later, David Douglas found this tree in Oregon. Now the tree's common name – DOUGLAS-fir—comes from one of these scientists, and its scientific name – *menziesii* – comes from the other!

**Where do I live?** I grow from central California up through British Columbia. The farthest east you can find me is in Nevada, just over the border from California. I can grow at sea level and at elevations higher than 2,000 meters in the mountains.

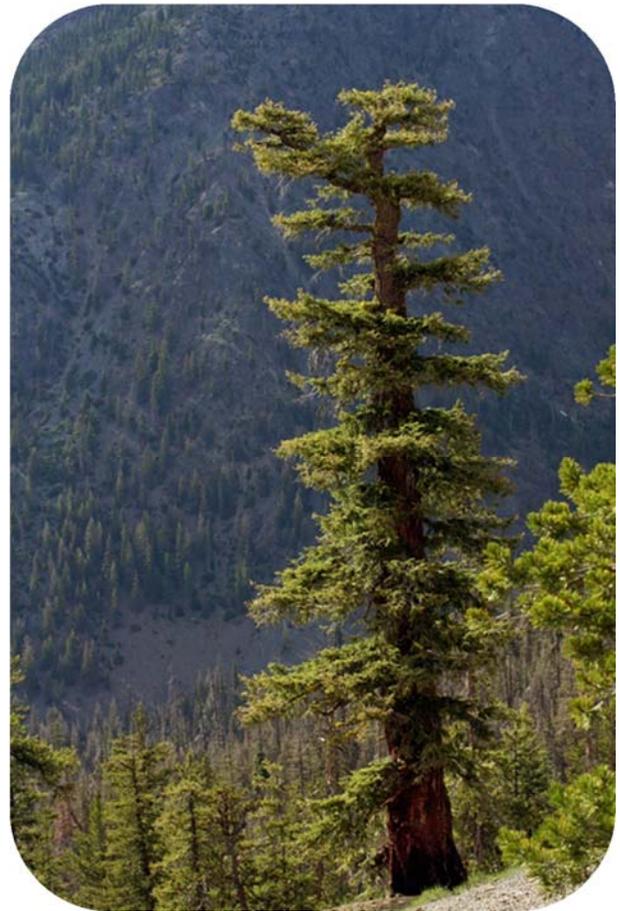
I can grow in wet places that do not get too hot or too cold, and in dry places that get really hot during summer. I grow with different neighbors, depending on where I live. In wet coastal forests, I grow with moss-covered conifers like hemlocks, firs, and Sitka spruce. In the Sierra Nevada, I grow with ponderosa pine, sugar pine, incense-cedar, firs, and oaks.

**How do I look?** I can grow to be about 75 meters tall, and my trunk can be two meters thick. My roots spread out from my trunk, but they do not usually grow very deep.

My needles are short— 2 to 3 centimeters long. Some people think my twigs look like bottle brushes because my needles grow right out from them in every direction.

When I am young, my bark is gray and smooth and covered with small blisters filled by resin. As I get older, my bark gets very thick and forms deep, corky, brown furrows.

**Growing Up:** I grow from seed. My seeds germinate best on bare soil that is not covered by *litter* and *duff*. My seedlings grow best where there is a little shade overhead. When they get a little bigger, they like a lot of sun. Where there is a lot of shade I grow slowly, with a spindly trunk and few needles. I don't look great then, but I am stubborn, so I can live a long time like this. Dense patches of such spindly trees are called “thickets.” Nowadays, I form a lot of thickets in forests that have not burned in a long



Old Douglas-fir tree.  
Image courtesy of Walter Siegmund.

time. I grow little by little in the shade of the tall pines and make the forests thicker and thicker.

**How do I reproduce?** I put my seeds in cones. My light brown cones feel papery. They grow 5 to 10 centimeters long. My seeds are fairly heavy, but each of them has 3-pointed “wing” that helps it float on the wind as it falls from the cone. The seeds usually land within 100 meters of my trunk. The wings on my



Douglas-fir cone.  
Image by Mary Ellen (Mel) Harte.

seeds peek out from under the cone scales. They look like tiny mouse feet sticking out between the scales. Some people think they look like serpents' tongues.

New leaves begin to unfurl from my buds in spring. Within a few weeks, they are full grown. At the same time, I begin to grow new cones. By

the end of summer, next year's leaves are stored in the tiny buds at the tips of my branches, and my cones are filled with ripe seeds. The seeds fall to the ground, but they will wait until the next spring to start growing.

**Am I useful?** Squirrels cut the cones from my branches, drop them to the ground, and pile them up for winter food. My seeds are an important food for many other animals too. Chipmunks, mice, voles, shrews, and many kinds of birds eat them. In some years, insects can't seem to get enough of them! Douglas-fir beetles eat my phloem from under my bark, and the larvae of some moths eat my needles. They may eat so many needles that it looks like all the trees on a hillside have died.

I provide hiding places for big animals like deer and elk— especially during winter. They usually do not bother to eat me, but if food is very scarce in the winter, they might eat my leaves. Spotted owls and voles live in my forests filled with old Douglas-firs.

People use my long, straight trunks to build their homes. My wood can also be used for plywood, fences, flooring, and furniture.

**What does fire do to me?** When I am young, my bark is thin, and *surface fires* can easily kill me. Where the branches of young trees hang close to the ground, surface fires sometimes use them as *ladder fuels* and climb into the taller trees, *torching* their crowns.

When I am old, my thick bark helps me survive surface fires, but I cannot survive torching or *crown fires*.

## Life after Fire

I like to grow in the openings created by fire. I can begin growing from seed right after fire, but I usually grow more slowly than the pine trees that grow nearby. If I am living in a dense thicket, I will continue to grow very slowly as I mature. If I am living out in the open, I begin to grow quickly when I'm about 20 or 30 years old. I can live a long time. Douglas-firs often live for more than 500 years, and some have even lived longer than 1,000 years!

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# Dusky-footed woodrat

(*Neotoma fuscipes*)



Female dusky-footed woodrat in Plumas National Forest, California. It is carrying a radio transmitter so scientists can learn about its needs. Can you see its antenna? Image by Robin Innes.

**Pack rats:** You won't find me in city sewers or in garbage cans like black rats or brown rats. Although at first glance I might look like those other rats, I am a pack rat with a furry tail and big ears, and I live in some of the world's most interesting wildlands. I occur in Oregon, California, and Baja California Norte. I can be found in chaparral, oak and juniper woodlands, streamside thickets, and deciduous and mixed-conifer forests with shrubby understories. I prefer areas with dense overhead cover. That protects me from predators, especially spotted owls. I am one of their favorite foods.

**The house that Woodrat built:** Although you can sometimes find me in human houses, I prefer to build my own homes. I build houses out of sticks, bark, and other plant parts, as well as pretty much any other materials I can find. Sometimes I decorate with bones, feathers, and other objects that I find lying around, like pens or keys. Just like Templeton in Charlotte's Web, I like to collect things. But unlike

Templeton, who gorges on Wilbur's slops, I will NOT eat just anything. I prefer a vegetarian diet of seeds, nuts, acorns, fruits, green plants, and fungi. No food on the ground? That is no problem for me because I like to climb trees, especially to get oak leaves and acorns, my favorite foods. I eat some foods right away, while I store other foods in my house to eat later.

My houses may be on the ground supported by trees or rocks, or up in a tree, either on a limb or in a hole. The houses I build on the ground are usually domed-shaped, like an umbrella. I am always adding new materials to my houses. Old houses on the ground can be more than 2 meters tall! Some dusky-footed woodrats have just one house, but I have several. Every now and then, I sleep at a different house. I

can be active any time of the day or night but I usually sleep during the day. Woodrat houses are often used by several woodrats, but not at the same time. When one woodrat moves out, another one often moves in. A single house may be occupied by several

generations of woodrats. Scientists found one house that was lived in for more than 13 years!

**Housekeeping.** I am no slob. My house is very well maintained. There are rooms lined with grasses and bark for resting and nesting, and a pantry full of acorns and other foods. I keep foods that can be poisonous when fresh in a separate room to age.



A dusky-footed woodrat house in mixed-conifer forest in Plumas National Forest. Image by Robin Innes.

When they are ready to eat, I move them to the pantry.

My house has several latrines for waste. I poop more than 100 pellets a day, so it is very important to clean my latrines. When they get full, I shove my pellets out the openings of my house.

**I don't like to share.** I do not usually share my house with other woodrats, except for my babies. I have 1 to 4 babies each year. They stay with me for the first few months of their lives. When they move out, they usually do not travel very far, sometimes just to the house next door. One of my offspring may inherit my house when I die.

### Fire Facts

Fires help dusky-footed woodrats if they create good conditions for oaks to sprout and grow from acorns. If fires are severe enough to kill a lot of oaks, they reduce acorn crops, and dusky-footed woodrats may go hungry.

Dusky-footed woodrats live in many plant communities where fire used to occur often. These fires might could kill woodrats, reduce their food, and destroy some of their houses, but they fires also helped create the shrubby habitat that woodrats love.

In chaparral, woodrats may be uncommon right after fire, when food and cover are sparse. They become more common when shrubs become dense. In mixed-conifer forests, woodrats are most common several decades after fire, when understories have lots of shrubs.

**Keystone species:** My houses are important for many animals besides me. Mice, shrews, salamanders, newts, frogs, snakes, spiders, and insects use my houses for food and cover. Scientists have found that species diversity was higher in areas where woodrat houses were present than in areas without woodrat houses.

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# Fisher

(*Pekania pennanti*)

**Cat-like:** I am a small, dark brown mammal about the size of a house cat. Like a cat, I have retractable claws, so I can climb trees easily. I have a long body with short legs, rounded ears, and a bushy tail. I am closely related to other long-bodied mammals like martens, weasels, and otters. Females, like me, are smaller than males. I weigh about 2 kilograms, while males are about twice my size!

**“Fisher”?** Despite my name, I do not eat fish. I eat porcupines, snowshoe hares, western gray squirrels, Douglas squirrels, northern flying squirrels, shrews, voles, mice, and many other kinds of mammals. I eat birds and insects, too. I will eat any animals I can find in rotten logs and decaying stumps. My long body helps me catch rodents in their underground burrows. My superb tree-climbing ability helps me catch squirrels in the treetops. My secret to catching a tasty meal is the element of surprise. I sneak up and pounce on them from behind! But I can’t catch a porcupine from behind because they are covered with quills. I must attack its face because it has no quills there. The porcupine tries to protect its face by turning its back to me, so we dance around in circles until it is exhausted. Then I roll it over and eat its unprotected belly. I also eat nuts and berries, but I don’t have to sneak up on them.

Even though I eat many kinds of food, I am very picky about where I spend my time. I like dense, old forests with lots of large trees and logs and branches scattered on the ground. I like conifer forests, but my homeland can contain hardwood trees too. I do not like a lot of openings in my forests. My home may sound messy to you, but to me it is perfect!

I hunt by myself. I am usually out at night or in the dim light of dawn or dusk. Sometimes I travel long distances in search of prey. I like to rest and hide in tree cavities, logs, rock crevices, bird and squirrel nests, and holes in the ground. Big trees and logs are great places for both hunting and resting, since they are good habitat for the mammals I like to eat.



Face to face with a fisher. Do you see its long claws? Image courtesy of the U.S. Fish and Wildlife Service, Pacific Southwest Region.

**Dens and kits:** I mate in spring and have my babies about a year later. I can have as many as 4 babies in a litter. They are called kits. They cannot see when they are born, and they have very little fur to keep them warm. I protect and care for them all by myself. My mate does not help at all. I keep them in my den for 2 or 3 months. It is usually in a cavity in a tree or log. By summer, my kits can leave the den for a little while, but they stay close to me until they learn how to hunt on their own. By fall or winter, they will leave and find their own homes. They may travel 100 kilometers before finding the right place! My youngsters can have kits of their own when they are 2 years old. I hope to live 10 years or more. To do that, I will have to avoid being eaten by a mountain lion, coyote, fox, wolverine, Canada lynx, or bobcat.

**Range:** Fishers are common in Canada and in the Northeast and Great Lakes regions of the United States. Many years ago, there were a lot of us in the northern Rocky Mountains, Pacific Northwest, and

California, but nowadays you'd be very lucky to see one of us – or even our tracks. Hunting and trapping have been hard on us, and logging and roads have reduced our habitat.

### Fire Facts

When fires are small, adult fishers can usually escape and move to unburned parts of their habitat. However, kits may not be able to move fast enough to escape. If a fire just burns small patches, leaving a lot of trees and fallen logs for denning and resting, fishers may not be affected much. If a fire clears the ground and kills a lot of trees over a large area, fishers find it hard to find enough prey and den sites. They have to move away and search for better habitat.



Adult fisher.

Image courtesy of the U.S. Fish and Wildlife Service, Pacific Southwest Region.

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# Fox sparrow

(*Passerella iliaca*)



Fox sparrow. See my pink legs?  
Image courtesy of Dave Menke, U.S. Fish and Wildlife Service.

**Foxy lady:** I am a fox sparrow. We are named for the rich reddish feathers that many of us wear on our wings and backs. We look different depending on where we live. Some of us have foxy red, gray, or even dark brown feathers. Fox sparrows that live in California, like me, have reddish wings and wear gray on our backs. You may notice the dark splotches on our chests.

Fox sparrows occur throughout Canada, the United States, and northern Mexico. Some fox sparrows migrate, while others stay put. Those of us that migrate fly north to Canada and the western United States in summer and fly south to the southern United States and northern Mexico in winter.

**Seeing double:** You are likely to see me sending up a spray of leaf *litter* as I scratch the ground in search of food. I use the “double-scratch” method, making a little forward jump and then scratching back the leaf litter with both feet at once. This uncovers the insects, fruits, and seeds that I like to eat. I eat all kinds of insects, including beetles, fly larvae, caterpillars, ants, and bees. I also like spiders and millipedes. You may even see me scratching for

fallen seeds underneath bird feeders, especially if they are close to the cover of dense trees and shrubs. I spend a lot of time on the ground, and I rarely venture far from cover.

**Sweet song:** I like dense shrublands the best. You might hear me singing in woodland thickets, *chaparral*, and shrubby areas near rivers and streams. You might hear me in forests too. Female fox sparrows like me sing occasionally, but males sing much more. They sing a beautiful clear, whistled song, usually from a hidden perch up in a tree.

**It’s a secret:** My nest is almost always on the ground under low shrubs. Once in awhile, I build it in the low branches of a shrub or tree. I build it out of grasses, mosses, lichens, shredded bark, twigs, and leaves. I line it with the softest stuff I can find, like feathers, fur, moss, or fine grass. Scientists think that only female fox sparrows build nests, but they are not sure, and I am not telling! Our nests can vary a lot in size, from 7 centimeters across to more than 30 centimeters across—that is bigger than your foot!

**A trick of the wing:** I lay 2 to 5 eggs each spring. I incubate the eggs for about 2 weeks. I do not get any help from my mate. After the eggs hatch, my babies are helpless. They cannot survive in the first few days if my mate and I do not feed and care for them. They grow fast, though. Before they are 2 weeks old, they are ready to go out on their own.

My mate and I defend our nest from predators. Hawks, jays, weasels, chipmunks, and snakes may try to eat our eggs and nestlings. When one of them gets too close to my nest, I use my “broken wing” trick. I pretend to be injured. The predator thinks it can get an easy meal out of me, so it follows me as I lead it away from my nest. Suddenly I “recover” and make a quick getaway, leaving the predator wondering what just happened. I have to be very fast though. I can live to be 10 years old, but not if a predator gets me first!

## Fire Facts

Any kind of fire can improve habitat for fox sparrows, but not right away. Fires help create the dense, shrubby habitat that we love, but that takes awhile. In the Sierra Nevada, for example, it may take 10 years after fire before shrubs become dense enough to shelter us. Until this happens, we won't spend much time in the burned area. We cannot survive in places where fires have removed all of the litter, because that is where we hunt for insects. We cannot live in places where the shrubs are young and small, because they do not yet bear fruit and seeds. But it only takes a few years for shrubs to grow tall and dense after fire. Then they produce lots of fruit and seeds and litter for our insect food to live in. Then we will return to the burned area.



This fox sparrow is showing off the dark spot on its chest.  
Image courtesy of James C. Leupold,  
U.S. Fish and Wildlife Service.

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# Incense-cedar

(*Calocedrus decurrens*)

I am a tall evergreen tree. That means I wear my green leaves all year round. I live in most of the forests of the Sierra Nevada and Cascade mountains except the hottest, driest ones and the highest, coldest ones. I can live near sea level and also at elevations as high as 3,000 meters. I love variety. Most of the forests where I live have many kinds of trees. Some of my favorites are Douglas-firs, white firs, Jeffrey pines, and the wonderful giant sequoias. Like all of these trees, I can grow to be very old – maybe 500 years or more.

**How do I look?** I can grow to be nearly 60 meters tall, and my trunk can be more than 1 meter thick. I am very good at growing roots. They spread out from my trunk, crisscross each other, and sink deep into the ground.

When I am young, my bark is thin. It gets thicker as I age. By the time I am grown up, my bark can be as thick as your arm. It is reddish-brown, with deep furrows and narrow strips hanging loose from the trunk.

My leaves are green overlapping scales. Flat sprays of leaves hang from my branches. I make pollen in small, male cones at the tips of my leaves. These are shaped like beads or teardrops. In early spring, they release pollen into the air and it pollinates my female cones. These are small and brown. When they dry out and open at the end of summer, they look like stiff brown flowers. Each cone releases a few seeds, which float gracefully to the ground on their two papery wings.

Some kinds of trees are fussy about where their seeds germinate and where their seedlings grow, but I am

not. My seeds can germinate on bare soil or in *duff*, in sunlight or in shade. They do best in places with a thin layer of *litter* and a little bit of shade. Where it is very shady, my seedlings grow very slowly, but they are very patient. They can wait for many years until some of their tall neighbors fall over, creating a sunny opening in the forest. Then the incense-cedars that have been waiting in the shade grow fast and spurt into the tree canopy.

**Am I useful?** Let me tell you how important I am in the forests where I live. Larvae of some insects eat my seedlings. In fact, these insects kill more of my seedlings than dry weather does! Mule deer eat my leaves and twigs. Dusky-footed woodrats eat my seeds.

Birds use me in many ways. Brown creepers walk up and down my trunk, eating the insects that live in my bark. Their brown feathers are perfect camouflage, especially because they can hide in the furrows of my bark and nest under the bark shreds that hang on my trunk. White-headed woodpeckers, red-breasted nuthatches, and golden-crowned kinglets also eat the insects in my bark. Hundreds of tiny birds find shelter in my thickets of seedlings, especially in winter. Bald eagles, California spotted owls, and great gray owls build nests and raise their young in the crowns of my biggest trees.

Hundreds of years ago, the Cahuilla Indians of California used my bark to build cone-shaped houses that they used in the fall, when they traveled through the mountains to harvest acorns. Indians also used my wood to build permanent houses. Nowadays, people use my wood to make many things, including pencils, guitars, outdoor furniture, and houses. My wood lasts a very long time. It contains chemicals that insects avoid, so people store their clothes in chests made from my wood. The moths that could eat holes in their clothes stay out!



A spray of incense-cedar leaves. The golden-yellow beads at the tips of twigs are male cones that will release pollen.

The flared brown scales near the bottom of the photo are female cones that opened and released their seeds last year.

Image courtesy of Charles Webber ©  
California Academy of Sciences.

## Fire Facts

Most of the forests where incense-cedar grows are used to fire. In the past, *surface fires* burned through these forests every 10 or 20 or 30 years. These fires killed most of the young incense-cedars. They killed many of the adult trees that had low branches. Surface fires can use low branches as *ladder fuels* to climb up into the tree crowns, and that kills the trees. Some of the old trees survived surface fires because their thick bark protects the cambium from heat.

In the past, *big crown fires* were unusual in these forests. That was good for incense-cedars, because they cannot survive crown fire. They also find it hard to form a new forest in a big burned area because their seeds cannot float very far from the forest edge into the burn.

Even though adult incense-cedar trees can survive some fires, they do not NEED fire like many of their neighbor trees do. For example, pine trees need fire to clear the soil so their seeds can germinate. But incense-cedar seeds can germinate even where the soil is covered with litter. Pines need fire to make big, sunny openings where their seedlings will grow, but incense-cedar seedlings can grow in shade as well as sunlight.

The longer a forest containing incense-cedars goes without fire, the more incense-cedars it will have. As these forests develop without fire, the more incense-cedars it will have. As these forests develop without fire, thickets of young incense-cedars grow under the treetops. As the tall trees die and fall down, some of the little incense-cedars replace them in the forest canopy. But if a surface fire gets into an old forest with a dense thicket of incense-cedars in the understory, it can easily climb up into the tops of the big trees. Then it may kill nearly every tree in its path.



Fire scars on the trunk of an incense-cedar.  
Image courtesy of Walter Roth.

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# Jeffrey pine

(*Pinus jeffreyi*)

I am an evergreen tree. I have long, graceful needles that shine in the sunlight. They are often more than 20 centimeters long, and they grow in clusters of 3. But just because you can recognize these traits, you cannot be sure it is me. I look a lot like one of my neighbors, the ponderosa pine. At first, scientists thought we were the same species. Now they know we are different, but you will have to look closely to be sure you're looking at me. The best way to tell us apart is by our cones. Both of us have prickles on our cones, but mine point inward while ponderosa's point outward, often poking your hand. You can remember which tree is which with this saying: "gentle Jeffrey, prickly ponderosa." I was named after the Scottish botanist John Jeffrey, who suggested that I was different from ponderosa pine.

My thick roots hold me firmly to the ground with a deep taproot and many roots that reach out over a large area. Scientists have found Jeffrey pine roots 30 meters away from their trunks!

**My home:** I live mostly in California. You can also find me in southwestern Oregon, northwestern Nevada, and northern Baja, Mexico. I can grow in many climates and at many elevations—from the edges of high mountain meadows to the borders of dry deserts. While ponderosa pine and I can both thrive in dry places with few nutrients in the soil, I often choose places a little higher. You can find me growing with many other kinds of trees, including ponderosa pine, incense-cedar, western juniper, Douglas-fir, white fir, and California red fir. I am often one of the oldest, biggest trees around.

**Growing up:** I can reproduce only from seeds. If my stem and crown are killed, I have no way to sprout from underground. My seedlings grow best in open places with bright sunlight. By the time they are 10 years old, they may be more than 2 meters tall.

**Making new trees:** I am a conifer, which means I put my seeds in cones. My cones are big, brown, and shaped like little beehives. My seeds have a paper-like "wing." When they fall from my cones, these wings help them float a short distance away from me.

If you find a lot of cones under a Jeffrey pine, you may think it is easy for us to reproduce. But that is not true. It often takes 20 years before I am strong enough to make many cones. It takes more than a year for me to make a crop of seeds—longer than it takes to grow a

new human being! After my seeds fall to the ground, they need just the right amount of sunlight and moisture for several years to become strong seedlings. And that can only happen if they don't get eaten first!

**Helping my neighbors:** Most of my seeds are stolen by animals, but that is fine with me. Chipmunks, ground squirrels, and Clark's nutcrackers cache my seeds to eat later. If they don't eat all of the cached seeds, these may grow into new trees. I am happy to share my seeds with these animals. They get food to eat and I get my seeds dispersed and planted.

I am quite useful to other creatures too, although their use is not always good for me. Rabbits, deer, gophers, and mice eat my seedlings. Fungi get their nutrients from my wood, leaving it soft enough for woodpeckers to excavate for their nests. Jeffrey pine beetles burrow through my bark to lay their eggs in my cambium. Their larvae then eat my cambium and tunnel out as they grow. This can weaken or kill me. Dwarf mistletoe is a tiny plant that makes its home in and on my branches. This can weaken or kill me too. Chickadees, bluebirds, and California spotted owls are some of the birds that use cavities in my trunk for their nests. Humans use my long, straight trunks to build their homes. Native Americans use my needles to weave baskets and sometimes eat my hardened sap like candy.



Mature Jeffrey pine tree.  
Image courtesy of Jhodlof.

## Fire and Me

By the time I was about 12 years old, my trunk was 5 centimeters wide and my bark was thick enough to protect me from the heat of most *surface fires*. The older I get, the thicker my bark gets, and the better I am can survive fire. I have other special talents that help me survive fire too. Pieces of my bark are likely to fall off if they start to burn. My needles do not catch fire easily because they contain a lot of water.

My seeds like fire. They germinate best in areas where fire burned off the *litter* and *duff* that covered the soil. My seedlings grow well in sunny openings created by fire.

Surface fires used to burn many parts of my homeland frequently. They killed the small trees that grew in my shade. That made it hard for the flames to reach up to my needles and buds. These fires also burned up the dead needles and fallen branches on the ground before they got too deep. That kept fires from getting hot enough to kill my cambium and roots.

Nowadays, fires burn less often, so many of my forests have more trees and deeper shade than we had in the past. My seedlings do not grow well in shade. They are skinny and weak, and they grow more slowly than the seedlings of shade-loving species like white fir.

I am more vulnerable to fire than I was a hundred years ago. Today's forests may have more *ladder fuels* and deeper duff than in times past. If a fire comes through forests that have not burned in a long time, it may become a *crown fire* or burn long and deep, killing my cambium and roots. I cannot survive this kind of fire.



Jeffrey pine cones.

Image courtesy of Christopher L. Christie © 2004.

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# Mariposa lily

(*Calochortus species*)



Mariposa lilies (*Calochortus leichtlinii*) with flowers and buds, Ansel Adams Wilderness, California. Image courtesy of Jane S. Richardson, 2013.

“Mariposa” is the Spanish word for “butterfly.” My scientific name, *Calo-chortus*, is a Greek phrase that means “beautiful grass.” Both names fit me well because I have beautiful flowers and thin, grass-like leaves. You may think that my flowers look like tulips, but I am most certainly not a common garden flower! I am much more interesting than that.

There are nearly 100 different species of mariposa lilies, and we grow throughout the United States, Canada, and Mexico. More than half of mariposa lily species live in California. We grow in open grassy meadows, shrublands, oak woodlands, and forests. We can grow in places that are hard for other plants

to grow in, even though we look very delicate. We thrive on steep, rocky slopes. We often grow in places with hot, dry summers and cold winters.

**How do I grow and reproduce?** I am a perennial, which means I can live for many years. I start out as a tiny seed, and then I sprout a tiny green shoot. When I am young, I look very plain, like a blade of grass, but I am very busy underground, growing my bulb. This is formed by special underground leaves, like those of an onion. I use my bulb to store energy that helps me survive cold winters, hot summers, and even wildland fires. By the end of the summer, you will not be able to find my aboveground parts. They wilt and disappear. You won’t find my aboveground parts after a fire either, but I am still there. You can find my bulb if you know where to dig!

It took me several years to get strong enough to produce flowers. In the first year that I bloomed, I grew a single stem with one flower. Now that I am older, I produce many flowers. My flowers produce seeds, and I shed them in the fall. My seeds germinate in early spring when the soil is moist.

When my leaves and flowers dry up at the end of summer, my bulb and roots also take a rest. My bulb remains dormant underground. It can stay hidden in the soil for several years, waiting patiently for the perfect time to sprout. Scientists are not sure why I sometimes stay hidden for a year or more. Do you have any guesses?

**Much loved:** Bees, butterflies, and beetles enjoy my sweet nectar. Deer sometimes graze my leaves. A little grazing is fine with me, but if they eat my flowers, I won’t make any seeds! Cattle, sheep, and horses can cause serious problems if too many of them eat us.

## Fond of Fire

I like every kind of fire. I like fire so much that some people call me a “fire follower.” I do not mind if my leaves and flowers burn because my bulb is protected deep in the soil. I sprout from my bulb in the first spring after fire. Because light and nutrients are plentiful after fire, I can produce even more flowers than before. Look for my beautiful flowers in the first few years following a wildland fire!



Mariposa lily flower.  
Image courtesy of Kim Pierson.

## Food Facts

Mariposa lilies are edible. Many California Indians cultivated them for food. Bulbs were harvested with digging sticks and usually eaten right away since they do not store well. Some tribes used fire to help mariposa lilies spread. Thousands of them grew in dense patches after fire, and meadows were filled with their delicious bulbs. Today, native Californians still eat this tasty, healthy food.



Mariposa lily bulb.  
Image courtesy of Jack Elliot, 2015.

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# Mountain lion

*(Puma concolor)*

I am a mountain lion, but you may know me by another name, like cougar, panther, catamount, or puma. I have more than 40 names in the English language alone! I am the most widespread large cat in North America.

I am famous for my power and my hunting skills. Some Native American cultures believe I have special powers and can share my great hunting skills with members of their tribe. Even though I can be fierce, I have a lot in common with domestic house cats. I purr, I have long claws, and I sleep a lot!

**What do I look like?** I am tan all over, much like the African lion, but I have white under my belly. Some mountain lions are reddish or silvery-grey. My tail is long and heavy and has a black tip. I am about 1.8 meters long from the tip of my nose to the tip of my tail, and I weigh about 50 kilograms. Males look just like me, except they are larger. They are about 2.1 meters long and weigh about 65 kilograms. That makes us about the same size as some adult humans.

**Where do I live?** Mountain lions used to live all over North and South America, but now we only live in the western United States, western Canada, and Mexico. A few mountain lions still live in southern Florida. I can live in forests, shrublands, grasslands, and deserts. I am not too picky about where I live as long as I have plenty of room to roam and hunt. I also need lots of good places to hide while I stalk my prey. Thick brush and big rocks are great hiding places.

**Deerlicious!** I am a carnivore, which means that I only eat meat. Deer are my favorite food. I usually eat one deer about every 10 days. If there are not enough deer around, I will eat other animals like coyotes, raccoons, elk, skunks, and porcupines. Even though I can eat over 10 kilograms of meat in one meal, a deer is too much food to eat all at once. Once I get full, I save the rest of my meal. I cover it with dry leaves or grass to hide it from other animals and to preserve it so I can eat it later. I do not want bears or wolves to steal my meal!

**How do I hunt?** I stalk my prey at dawn and dusk, when the sun is low in the sky. I also hunt at night. I can see and hear very well at night, so my prey had better be very careful. I lurk in the shadows and sneak slowly and quietly toward my prey. When I get close enough, I POUNCE and try to snatch my meal! I can jump as high as 5 meters and 13 meters forward. I can also run very fast, up to 80 kilometers per hour. Sometimes I can even catch a pronghorn, the fastest land animal in North America. But I can only run that fast for short distances, and then I get too tired.

I roam my large territory looking for tasty animals to eat. I follow my prey wherever they go. When deer move down the mountain in winter, I follow. When they move back up the mountain in spring, I follow.

**My kittens:** When I was 2 years old, I had my first kittens. You can also call them “cubs.” They were born with bright blue eyes, spots on their fur, and rings on their tails. By the time they were 16 months old, they looked more like me. Their spots and rings had faded, and their eyes had turned yellow.

I can have 2 to 4 kittens about every other year. I raise my kittens all by myself until they are about 18 months old. My kittens’ fathers do not help at all! It is hard work. I have to move them around often to keep them hidden from predators like bears and wolves. My kittens start eating meat when they are only 6



Mountain lion's face.  
Image courtesy of Itshears.

weeks old, so I have to hunt often to keep our bellies full. I need to kill a deer about every 3 days! After my kittens have lived with me for about 18 months, they find their own territory. Sometimes they have to travel more than 400 kilometers to find a territory that is not already claimed by another lion.

**A solitary life:** I live alone unless I am with a mate or my kittens. I usually avoid other mountain lions even though our territories may overlap. I mark my territory and communicate with other mountain lions by leaving signs like scrapes, scratches, scat, and urine. I will probably stay in the same territory my entire adult life.

**Am I in trouble?** People kill more than 3,000 mountain lions in the United States every year. We are hunted, hit by cars, and killed if we get too close humans or livestock. We are also in danger when our habitat is converted to towns, cities, or farmland. If there is not enough space for our prey to live, we will not have enough food to eat.

Some people think we are dangerous to humans and livestock, but we rarely hunt them. We try to avoid people and are rarely seen. You would be very lucky to see one of us! In fact, over the last 100 years, mountain lions have attacked less than one person per year in all of the United States and Canada combined!

Even though we rarely attack humans, we can still be very dangerous. If you live, work, or play in areas where we live, stay alert! If you see us, do not approach and do not run away. Stand up tall and make yourself look big by raising your arms or opening your coat. Slowly wave your arms and speak loudly. Throw things at us and fight us off if we come too close.

**Mountain lion conservation:** Mountain lions require huge territories and lots of large prey. A mountain lion may need more than 10 times as much territory as a black bear. If humans preserve enough habitat to

support mountain lions, countless other species that share that habitat will also thrive.

## Fire Facts

Adult mountain lions can escape from fires. Kittens may not be able to escape. If a fire is moving fast and the mother cannot move all of her kittens quickly, they could be killed by fire.

Fires create open areas where new shrubs and plants can grow. Deer populations often increase following fires because there are more plants that deer like to eat. More deer means more prey for mountain lions! Mountain lions especially like to hunt along edges of recent burns where deer and other animals hang out. Sometimes mountain lions may even change their territories to take advantage of recently burned places.

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# Mountain whitethorn

(*Ceanothus cordulatus*)

I live in Oregon, California, Nevada, and Baja California Norte. I am most common in the mountains between 600 and 3,400 meters. You can find me in shrublands and forests, but I am most common in *chaparral*. I especially like dry, open areas.

**A thorny situation:** I am an evergreen shrub. That means that I keep my leaves all winter. I grow low to the ground, especially when I grow at high elevations. I am often wider than I am tall. I can be more than 4 meters wide, even when I am only 0.6 to 1.5 meters tall! One of the reasons I am so wide is that my branches can produce roots wherever they touch the ground. This happens a lot at high elevations, where snow pushes my branches to the ground. I can form dense shrublands that are difficult to walk through and nearly impossible for trees to grow in. If trees manage to grow above me and shade me, I do not grow as well.

I grow sharp thorns at the ends of my dense, whitish branches. This gives me one of my common names, whitethorn. My thorny, sprawling branches provide good cover for many kinds of animals. Birds, mice, woodrats, and chipmunks hide under me. They also eat my fruits, leaves, and twigs. Mule deer cannot hide under me, but they love to eat my leaves and twigs.

**Summer snow:** My white flowers grow in small, dense clusters at the end of my branches. They bloom from May to August. You may notice their strong scent when you are nearby. The insects that pollinate my flowers are attracted to this scent. When my petals fall, they can make the ground look like it is covered with snow! Maybe that is why some people call me “snow bush.” Each of my fruits contains many hard, round seeds. I can produce as many as 4,500 seeds each year. My fruits and seeds fall in late August and September. They are sometimes carried away by birds, rodents, or ants.

My seeds do not germinate right away. They have a hard covering that protects them and keeps them dormant in the soil and *duff*. Heat cracks the seed covering, which lets water in. That lets the tiny plant

inside start to grow. My seeds usually germinate in late May or June. I started producing seeds when I was only 4 years old. I can live for 40 years when I grow in a sunny place. I may not live as long in the shade.



Mountain whitethorn bushes provides food and hiding places for small animals.  
Image courtesy of Jean Pawek.



Mountain whitethorn produces lots of flowers.  
Image courtesy of Jean Pawek.

## Fire Facts

Fire helps mountain whitethorn reproduce. Different kinds of fires help them in different ways. Fires that are not too hot, like *surface fires*, help them sprout from their lignotubers. *Severe fires* create enough heat to crack their seeds open. The seeds are small, but they can survive temperatures hotter than boiling water! Thousands of seeds are likely to survive fire. The seedlings grow well where fire has burned off the *litter* and duff.

**Ligno-what?** I am good at growing back after my branches have been damaged because I have a special woody growth at the top of my roots. It is called a "lignotuber." If my branches are damaged, or even if I am completely *top-killed*, my lignotuber can sprout new stems. If my lignotuber is too damaged, I cannot sprout and I die.



Fire burning through mountain whitethorn.  
Image courtesy of Michael Yager.



Mountain whitethorn bushes provides food and hiding places for small animals.  
Image courtesy of Jean Pawek.

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# Mountain yellow-legged frogs

(Southern mountain yellow-legged frog, *Rana muscosa*  
and Sierra Nevada yellow-legged frog, *Rana sierrae*)



Southern mountain yellow-legged frog on a rock.  
Image courtesy of Gary Nafis.

There are two species of yellow-legged frogs that look alike and live in the same type of habitat. Scientists used to think we were all the same, but now they know we are different. That is why they gave us separate names—the Sierra Nevada yellow-legged frog and the southern mountain yellow-legged frog.

**Can you tell us apart?** Scientists can tell us apart by our DNA. Without that information, it is hard to tell us apart. Both species have light brown backs covered with black or brown spots. These spots help us blend in with the rocks and streams where we live. The underside of our back legs and sometimes our entire bellies are yellow or slightly orange. Sierra Nevada yellow-legged frogs almost always have shorter legs than southern mountain yellow-legged frogs. Our calls sound different too, but people do not hear us very often because we call underwater.

**Where do we live?** Most of us live high up in the mountains. Sierra Nevada yellow-legged frogs are found only in the central and northern Sierra Nevada. Southern mountain yellow-legged frogs live in the southern Sierra Nevada and the mountains along the coast of southern California. We used to be common in the mountains of both California and Nevada. Now we live only in California, and there are not many of us left.

**We love water.** We are never more than a meter or two from it. You might find us basking near sunny riverbanks, meadow streams, small pools, and lake edges. We

especially love high mountain lakes and slow-moving streams. We need deep water that does not dry up in summer or freeze in winter. When winter comes, we dive down deep to the bottom of a lake to wait out the cold.

**Our life cycle:** We are amphibians, so we spend part of our life in water and part on land. I hatched from my egg into a tadpole in early spring. Living underwater was easy for me because I had gills to help me breathe. I was brownish and had gold flecks on my belly. Our tadpoles are some of the largest in North America. They are often more than 10 centimeters long.

Mountain yellow-legged frogs that live at low elevations can change from tadpole to adult frog in one season because summers are long. But most of us live high in the mountains where summers are short. There we grow slowly, and it can take up to 4 years to change from a tadpole into a frog! During metamorphosis, we lose our gills and develop lungs so we can breathe on land. After metamorphosis, it can take another 4 years for female frogs to mature enough to lay eggs. That means we have to stay safe for a long time before we can reproduce! It is a good thing that we can live up to 20 years.

**Part of the food web:** When I was a tadpole, I ate algae. Now as a frog, I eat tasty aquatic insects. Unfortunately, many animals, like garter snakes, birds, coyotes, and bears try to eat me!



Mountain yellow-legged frog habitat-high elevation  
Sierra Nevada stream and lake.  
Image courtesy of Ilana Abrahamson.

**Are we in trouble?** YES! A long time ago, mountain yellow-legged frogs were common in high mountain streams and lakes. But now there are few of us. You cannot find many of us in the Sierra Nevada. It is even harder to find us in southern California. There may be fewer than 100 adult southern mountain yellow-legged frogs left there!

Many things make survival hard for us, including drought, diseases, habitat loss, and pollution. But the worst is nonnative fish! Long ago, fish did not live up high in the mountains. They could not swim up the waterfalls to get to our mountain streams and lakes. But people have brought trout to the high mountain lakes so they can go fishing. Trout are bad for us. They eat our food, and they eat us when we are tadpoles and also when we are adult frogs! In lakes full of trout, we cannot safely use the deep water where we can survive hot summers and cold winters.

## Fire and Frogs

Fires change the forests surrounding streams and lakes. These changes affect the streams and lakes and the animals that live in them.

Fires do not often burn in the mountains where Sierra Nevada yellow-legged frogs live. Summers are short there, so the forests do not always get dry enough to burn. Fires are more common in the coastal mountains of southern California, where some of the southern mountain yellow-legged frogs live. Because there are so few southern mountain yellow-legged frogs in the coastal mountains, fires can have a big impact on them.

Scientists do not know for sure how fire affects mountain yellow-legged frogs. Tadpoles and frogs probably survive fire because they live in or near water, but fires can make their habitat difficult to live in for a little while. Large, severe fires – like crown fires - remove many of the plants along streams and rivers. That means the water has less shade, so it may get too warm in the summer. Those plants used to hold the streambank and surrounding soil together. When they are gone, flooding is more likely, and this changes the shape of the streambed. Tadpoles and frogs may not be able to adjust to the changes.

Small surface fires may have little effect on mountain yellow-legged frogs. If small fires happen often, they burn many patches of fuels across the land. That makes it hard for fires to get big. In that way, small fires may actually help protect mountain yellow-legged frogs!

## Super Skin!

Frogs do not just WEAR their skin; they DRINK it and BREATHE through it! Frogs do not drink water through their mouths like people do. Instead, they absorb it through their skin. Frogs have lungs to help them breathe, but they also absorb extra oxygen from the water through their skin. Pollution is very dangerous to frogs because their skin absorbs harmful pollutants from the environment. Even the chemicals used to put out forest fires can be dangerous for frogs.

All frogs shed their skin regularly, and most of them eat their old skin for extra nutrition—yum!

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# Mule deer

(*Odocoileus hemionus*)



Male mule deer drinking water.  
Image courtesy of Robert Sivinski, CalPhotos.

**Tricky maneuvers:** I am a mule deer. How can you tell? My ears! I have long ears, almost like a mule's. This gives me my common name. I move my ears independently and constantly. This helps me hear potential dangers. When I am frightened, I do not run like other deer do. Instead, I bound up and away. All 4 of my feet jump up and land at the same time—like a pogo-stick. This is called “stotting.” With this trick, I can turn very fast, so I can escape even the most skilled predator. With each leap, I can jump as far as 5 meters ahead. I can reach speeds of 60 kilometers per hour! But I can only do this for short distances before I get too tired. I have to outrun my predators. They include coyotes, mountain lions, bobcats, and American black bears. Eagles try to eat my young.

**Bigger is better:** Mule deer weigh between 60 and 130 kilograms, about the weight of human adults. Females, like me, are smaller than males. Only males have antlers. They grow new ones each year and they shed them each winter, after the breeding season. That is because they don't need to impress us females with their antlers after the breeding season—at least not until next year. I choose the largest male with the biggest antlers to mate with.

During late fall, winter, and early spring, I usually hang out with other mule deer in a large group. Groups can have more than 100 mule deer! I leave the group and go out on my own when it is time for me to have my babies in the late spring and summer. My babies are called “fawns.” I usually have 1 or 2 fawns at a time, but I can have triplets. They stay with me until the next spring, when I leave them to have more babies.

**A hiding agenda:** For the first 2 months of their lives, I keep my fawns hidden while I am out eating. I hide them in dense trees and shrubs. At first, they feed only on the milk that I provide. When they are 2 weeks old, we begin to eat plants together. I stop nursing them in fall, when I breed again. My young can have fawns of their own when they are only 1 or 2 years old. Mule deer can live up to 14 years in the wild.



Mule deer often live in large groups.  
Image courtesy of Addison Mohler,  
U.S. Fish and Wildlife Service.

**My home:** I can be found in many kinds of habitats, including forests, woodlands, shrublands, and grasslands. I like to find many kinds of habitat close together. That gives me lots of food and cover to choose from. I prefer to eat grasses and wildflowers.

If they are not around, I will browse on shrubs and trees. I like to eat the plants that grow in open areas, but I only feed in open areas if cover is close by. That way, I can quickly escape and hide when I am frightened. Some mule deer stay in the same area throughout the year, but I like to migrate in the spring and fall. I spend summers high up in the mountains where the vegetation is sweet and tender. I spend winters at low elevations where there is less snow and food is easy to find.



Mule deer herd on a snowy slope. Image courtesy of David Heffernan, U.S. Fish and Wildlife Service.

## Fire Facts

Mule deer can usually escape from fires, but large, fast-moving fires can trap and kill them. Fires can make habitat better or worse for mule deer. In areas where there is already plenty of cover, fires can improve the habitat by creating open areas for feeding. But if an area has only a few places to hide, fires can make the habitat worse by removing that cover. Big, severe fires – like *crown fires* - create big openings that mule deer are afraid to use because there is no place to hide. The best habitat results from fires that create a patchwork of small burned and unburned areas close to each other. Mule deer use the same areas year after year. If a fire improves their habitat, they will probably stay around, stay healthy, and produce many fawns in the years that follow. But they may stay around even if a fire reduces their food and cover. If they do not move away, they could go hungry for many years and find it hard to hide from predators.

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# Northern goshawk

(*Accipiter gentilis*)

I am one of the largest forest-dwelling hawks in North America. I can be almost 70 centimeters long, and I can weigh nearly 2 kilograms. Female northern goshawks, like me, are larger than males. My short, broad wings and long tail make me agile, so I can chase my prey even where vegetation is thick and hard to see through.

You can find me throughout the forests of North America, Europe, and northern Asia. Some of us migrate, and some live in the same area all year. I like to hunt and nest in forests with dense tree crowns. I hunt in shrublands and open areas too.

**Fierce defender:** I build bowl-shaped nests out of twigs, bark, and other plant parts. I am not fussy about the kind of tree I use, as long as it is large in diameter. Either hardwoods or conifers will do. I may use the same nest year after year, or I may alternate among several different nests.

I keep the same mate year after year. Our partnership is an important one. I incubate our eggs, while my mate brings me food. I defend my nest fiercely. I will attack you or any other animal that gets too close. Attila the Hun, a fierce warrior who lived more than a thousand years ago, wore an image of a northern goshawk on his helmet because we represent fierce strength. I guard my territory even against my own kind. I won't let another northern goshawk build a nest within 3 kilometers of mine!

I lay 1 to 5 eggs in my nest each spring. I incubate my eggs for about a month. When my chicks hatch, they are covered in soft, white down that keeps them warm. It takes about a month to grow the long, tough feathers that they need for flying. Chicks move from nests to nearby branches when they are about 1 month old. Soon after, they learn to fly. But they need me and my mate to feed them for another month or two, until they can hunt on their own. My chicks grow up fast. They can have chicks of their own when they are only 2 or 3 years old. Goshawks

may live up to 19 years!

**Oh my gosh:** My common name is pronounced as if the words "gos" and "hawk" are separate, without the "sh" sound. It comes from the Anglo-Saxon words *gōs*, meaning goose, and *hafoc*, meaning hawk. My name does not mean that I LOOK like a goose. It means that I am good at KILLING large prey, like geese! Some of my favorite prey are grouse, crows, and woodpeckers. I also love to eat rabbits, snowshoe hares, and squirrels. Hawks, owls, American martens, fishers, wolverines, coyotes, bobcats, and northern raccoons are among the many



This northern goshawk has a band around its leg. That means it is helping with someone's research! Image courtesy of Norbert Kenntner.

animals that want to eat me. So far, I have managed to get away. Hawks and owls sometimes try to use my nests. They may force me to move away and build a new one.

**Persistent predator:** I am very persistent in chasing prey animals. When they try to escape into dense vegetation, I follow them. One goshawk I know chased a snowshoe hare for more than 45 minutes until it finally ran into an open area where my friend got it! I occasionally hunt by flying along forest edges and across openings, but I usually hunt from a hidden perch. I wait silently, then ambush my prey by maneuvering through the forest vegetation or by crashing straight through it! I capture and kill my prey with my sharp talons. Even though I am agile and a great flyer, it is hard for me to hunt in young, dense forests. There is just not enough space for me to maneuver.



Adult northern goshawk watching us.  
Image by Terry Spivey, USDA Forest Service.

## Fire Facts

Northern goshawks can easily escape fires without getting burned. They do not mind *surface fires* at all. However, *torching* or *crown fires* can burn their nest trees and nests. If a nest is burned during the spring or early summer, before young northern goshawks can fly, the fire will kill the young.

Northern goshawks need a variety of habitats. They like large forests. They need some big trees, and they often like to be near water. They need open areas too. Fires can harm northern goshawk habitat or improve it. Right after a big fire, the habitat may be poor because small prey animals cannot find the plants, dead trees, and downed wood that they need for food and shelter. A few decades after fire, when forests are growing back and are very dense, hunting can be difficult for northern goshawks. But fires can improve habitat for northern goshawks by creating a complex patchwork of forest types and openings.

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# Ponderosa pine

(*Pinus ponderosa* var. *pacifica*, var. *ponderosa*, and var. *washoensis*)

I am an evergreen tree. My scientific name is *Pinus ponderosa*. *Ponderosa* is a Spanish word meaning "large, heavy, PONDEROUS." I think ponderosa is a good name for me because I can get very big.

There are 5 kinds of ponderosa pines, and 3 of them live in California and Oregon. We have lots of common names because there are so many different kinds of us. We are sometimes called Pacific ponderosa pine or Washoe pine, but most people call us ponderosa pine or yellow pine. Please do not confuse me for "interior ponderosa pine." That is a tree that lives that lives farther to the east of me.

**Where do I live?** I mostly grow in the western coastal states: California, Oregon, and Washington. But you can also find me in Idaho and Montana. I like warm, dry forests. In California, I grow in hot, low-elevation forests where few evergreen trees can survive. I often grow with white fir, incense cedar, sugar pine, and California black oak. When I grow up high with Jeffrey pine, we may fool you. We look a lot alike! One way to tell us apart is by our cones. My cones are smaller than Jeffrey's, and mine are more prickly. To help them remember, some people say, "Gentle Jeffrey, prickly ponderosa."

**What do I look like?** I am often the tallest tree in a forest. The tallest ponderosa pine lives in southern Oregon and is nearly 82 meters tall! My trunk can be more than 2 meters wide. It usually grows very straight. My needles grow in clusters of 3, and they are 13 to 25 centimeters long.

My bark gets very thick as I get old. It is yellowish and has deep, dark furrows. That is why people sometimes call me "yellow pine." I think my bark looks like puzzle pieces that fit neatly together. The pieces often flake off, especially when they get hot in a fire.

I grow many thick roots. Some of them grow 2 meters down into the soil. Others may reach 30 meters out from my trunk under the soil.

**How do I reproduce and grow?** I am a conifer, which means that I put my seeds in cones. My cones are big, brown and woody, with large, sharp prickles. My seeds have a paper-like "wing" that helps them float a little way in the wind after they fall out of the cone. The wings help, but my seeds are fairly heavy, so they cannot float very

far. Some birds, like the Clark's nutcracker, carry my seeds away and bury them in underground caches. The caches are their year-round food supply. If the birds do not come back, the seeds can germinate right there!

I have growing points inside my bark (in my cambium), at my very top, and at the tips of my branches and roots. But I cannot sprout a new plant from my roots. I reproduce only from seed. My seeds germinate best if they are in soil that doesn't have a big mess of *litter* and *duff* on top. My seedlings grow very fast in sunlight. By the time they are 7 years old, they can make their own cones and seeds. I can continue making cones and seeds for hundreds of years. Even after I stop reproducing, I can live a long time. I am looking forward to my 600th birthday next year!

**My calendar:** I begin to grow new wood in spring. At the same time, the buds that I prepared the summer before begin to grow. In about a month, they will open and my new needles will unfurl. My roots and trunk will continue to grow all summer, while my branches make new buds that will hold next year's fresh needles.

My new cones are pollinated in late spring. More than a year later, in the fall, the seeds in these cones are finally ripe. The cones open. Wind shakes the seeds loose, and they float to the ground.

**Am I useful?** Fungi use the nutrients stored in my trunk. Many kinds of insects eat my cambium. Female pine beetles tunnel into my cambium to lay their eggs. When



Mature ponderosa pine.  
Image by Scott Roberts,  
Mississippi State University.

the larvae hatch, they eat their way out, growing as they go. A plant called mistletoe grows on my branches and sinks its roots into my branches and trunk to get nutrients.

Rabbits and mice eat me when I am very young. Squirrels and birds eat my seeds. Squirrels eat the cambium on my twigs. I provide hiding places for deer. If deer are very hungry, they may eat the buds and needles of my seedlings.

When I get large, the wood in my trunk may begin to rot. Then woodpeckers can excavate holes in my trunk and nest inside. A family of woodpeckers only uses a hole for one year, but other animals move in after the woodpeckers move out. Pileated woodpeckers and California spotted owls are some of my favorite guests.

People use my long, thick, straight trunks to build their homes. My needles, roots, and stems can be used for basket weaving, and my pitch can be used as glue.

**What does fire do to me?** I like fires. My thick bark is the key to my survival. By the time I am 10 years old, my bark may be thick enough to protect me from most surface fires! The older I get, the thicker my bark gets, and the

## Life After Fire

My seeds grow well in the sunny openings created by fire, especially if the fire also killed off some of my neighbors— shrubs, grasses, and other trees— that use a lot of moisture. When I am in sunlight, I usually grow faster than the firs that grow nearby.

If my homeland does not burn for many years, I may not produce healthy young trees. Some of the forests where I live now seem odd because the big trees are all ponderosa pines and the small ones are mostly white firs. In places that haven't burned for a long time, many small trees grow in my shade. There, almost any fire can climb into the tree crowns and kill even the biggest, oldest trees – including me!

easier it is for me to survive surface fires.

Surface fires used to burn the places where I lived every 10 years or so. They didn't get hot enough to cook my roots or cambium, but they did kill the ladder fuels beneath me. Those are the low branches and the small trees that grew in my shade. That made it hard for the flames to reach the leaves and buds in my top, torching my crown or becoming a crown fire. Torching would kill me. Surface fires also cleaned up the dead needles and fallen branches on the ground before these fuels got deep. This kept fires from being so hot that they could kill my cambium or roots with their heat.

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# Quaking aspen

(*Populus tremuloides*)

How could you possibly NOT notice me? I have found a way to draw attention to myself even in the slightest wind. I simply never stop moving. Even when everything around me is quiet—the grass unmoving, the air mostly still—my leaves tremble and make a gentle, rustling sound. I do that with a neat trick. Each leaf has a flat stem that shakes in response to the slightest breath of air.

Even if you have not noticed my constant motion, you surely have noticed me in the fall. My leaves become bright yellow and stand out against the dark



Quaking aspen trunks.  
Image by Terry Spivey,  
USDA Forest Service.

green background of evergreen trees in my neighborhood. I do that because I am a deciduous tree, shedding my leaves in the fall and growing new ones each spring.

My trunk is slender and white. I grow 10 to 15 meters tall. Where the branches break off from my white trunk, they leave round, gray scars that look like big eyes. My leaves

are 4 to 7 centimeters long. They are almost round, but they have a pointy tip like the “spades” in a deck of playing cards.

**Where do I live?** I am a circumboreal species. That means I live in northern lands all around the world. I am not stuck living only in the north, though. I occur from Alaska all the way down into Mexico. I like cool, dry summers and snowy winters. I grow best in places where the soil is moist. In the Southern

Cascades and the Sierra Nevada, I usually grow in small groves. In the Rocky Mountains and the eastern United States, I grow in bigger patches. On the prairies, I live in moist spots and on north-facing hillsides.

**Growing up:** A single aspen tree is not really separate from other aspens growing nearby. Underground, I am connected to many of my neighbors. Most of us have grown from sprouts that came from the roots of other aspens.

**Sucker!** A young aspen growing from the roots is called a sucker. If a fire or avalanche comes by, my trunks may break or die, but next year my roots sprout thousands of suckers. Every sucker has the same genes as the parent tree. No doubt you have heard of identical twins or triplets. The aspen grove where I live is like identical “thousandtuplets.” The special name for my patch of related trees is a clone.

**Making seeds:** Even though I can sprout new trees from my roots, I make millions of seeds each year. In the spring, before my leaves come out, I produce long, slender catkins that hold my flowers. After my flowers are pollinated, I release the seeds in cottony packages that can travel miles on the wind. My seeds live less than a month.

That is a very short time to get settled in a moist, warm location free from other trees and begin to grow. No wonder few seedlings survive!



Aspen leaf.  
Image courtesy of Paul Wray,  
Iowa State University.

My seedlings grow best alongside streams and rivers.

**Am I useful?** Beaver, deer, elk, and grouse eat my bark, leaves, and buds. Many birds nest in my trunk and branches. I am especially proud that all three kinds of bluebirds in the United States use me for nesting.

People use my wood for heating and cooking because it makes few sparks. People enjoy my colorful fall leaves. However, I am most useful to them in a quiet way. I help the soil absorb water from rain and snow, filter the water so it is clean, and store it in the soil.

Native Americans know how to use quaking aspen bark to reduce fever and treat wounds. They can make casts from the bark to help set broken bones.

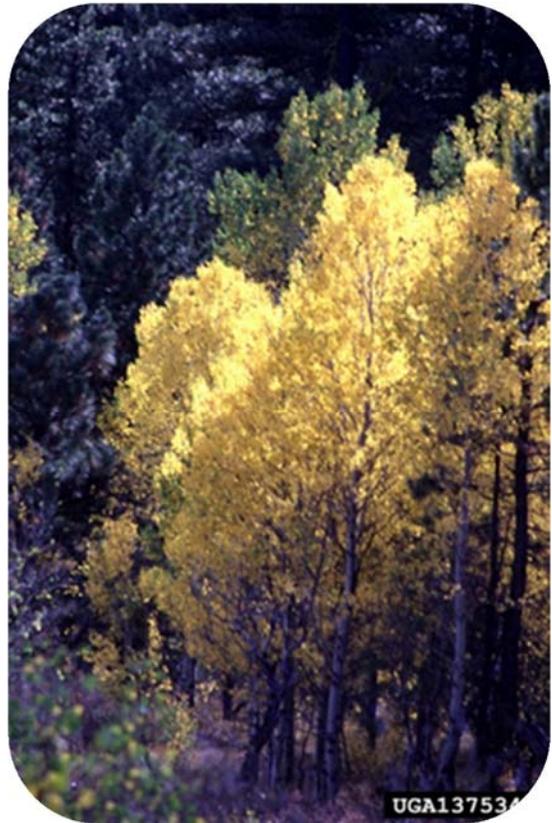
**What does fire do to me?** Most fires pass me by because I live in moist places. But I do like to burn once in awhile. Any kind of fire will do, because most fires only top-kill me. They rarely harm my roots. They give me a chance to grow a new crop of suckers. How invigorating!

## Life after Fire

When I am growing among pine and fir trees, I especially like *severe fires* because they kill most of the conifers in a forest. The conifers have to reproduce from seed, but my huge root system gives me a head start in the new forest. My suckers come up by the thousands, growing 1 to 2 meters tall within a year while conifer seedlings are just getting started. I recover so quickly after fire that people sometimes use *prescribed fires* to get more aspens on the landscape.

## Botanical fact

Quaking aspen is the most widely distributed tree species in North America. In Utah, Minnesota, and Wisconsin, quaking aspen stands cover more land than any other kind of forest.



Aspens in the fall.  
Image by Terry Spivey,  
USDA Forest Service.

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# Ross's sedge

(*Carex rossii*)

**Where to find me:** I live in the western half of the United States and Canada, from Alaska to Ontario and down to New Mexico. I grow mainly in dry forests and meadows. My favorite places are forests with ponderosa pine, lodgepole pine, or whitebark pine, and mountain meadows that dry out in summer. I also grow in moist quaking aspen forests and occasionally in moist meadows. I can grow at sea level and all the way up to 3,800 meters. I can grow in clay or sand, in loose or compacted soils, and in soils that are slightly salty, acidic, or alkaline. One thing I do not like is deep shade. Open sun and light shade are great for me, but I die in deeply shaded forests.

**An edgy plant:** I look like a grass, but you can tell I am a sedge if you remember this rhyme about the stems of grassy-looking plants:

*Sedges have edges, rushes are round,  
and grasses are hollow right up from the ground.*

Sedge stems have 3 sides or edges. If you snip one off and look at the end, it will look like a triangle. Sedge stems are solid all the way through, not hollow like grass stems. My stems and leaves grow from my root crown. That is the place where the stems meet the roots. Sometimes I have short rhizomes that creep horizontally underground and can produce new plants. My roots are shallow, less than 5 centimeters deep. My flowers and fruits grow on a spiky-looking stalk. Wind blows my pollen from flower to flower. My seeds are heavy, so they usually fall near me when they are ripe. I store them in the soil, where they may live for decades.

**Not to everyone's taste:** Many grazing animals are picky eaters. They would rather eat juicy grasses than tough sedges like me. For example, deer and pronghorn would rather eat grasses than my leaves and stems. However, elk and mountain goats sometimes munch on my leaves, and bears eat my leaves in early summer, when my leaves are young and tender. Bears leave me alone later in summer, when my leaves toughen up.



Ross's sedge plants. Image courtesy of Paul Slitcher.



Ross's sedge grows in dry meadows and Sierra lodgepole pine forests. Image courtesy of Jon Sullivan.

## Fire Facts

I really like fires that create open, sunny places. That is where my seedlings and sprouts will thrive. Fires burn off my leaves and stems, but I do not worry about that. After most fires, I can sprout from my root crown or rhizomes. I can also grow from seeds after fire.

When I am living in a shady forest, I like fires that are severe enough to kill the trees and give me more sunlight. Fires help us grow in big patches and spread throughout a big area.



Ross's sedge seeds.  
Image courtesy of Aaron Authur.

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# Sierra gooseberry

(*Ribes roezlii*)

I am a shrub that can get about a meter tall. My branches and berries are covered with sharp spines. I live mostly in California, but you can also find me nearby in Oregon and Nevada. I grow best in open forests, oak woodlands, and chaparral. Hot, dry weather is fine by me. I love places with little moisture, and I can happily go for weeks or months without rain.

My name seems odd because geese are unlikely to go anywhere near my spiny branches! Our word “gooseberry” comes from a Dutch word that means “crossberry.” This may describe the clusters of spines on my branches, which are in groups of 3 so they look a little like a cross. My leaves are shaped like a hand with short, round fingers. Memorize this shape, and you will spot me everywhere. You can remember probably me best by my spines. I am covered with them! Even my fruits are prickly, so good luck if you want to eat my tasty berries. Another good way to recognize me is to look closely at my branches. My flowers and berries grow in a row dangling beneath the branches.

**How do I grow and reproduce?** I am a perennial, which means I can live for many years. Each spring I grow new green leaves. Each autumn my leaves turn red and gold, and then they fall. If someone cuts or bites off my branches, or if a fire burns off my top, I just grow brand new shoots.

I cannot make berries and seeds until I am at least 2 years old. Wind pollinates my flowers, so I can make seeds without the help of bees and butterflies. My spiny fruits are good hitchhikers. They can catch a ride on any furry animal that passes by. They can also get a ride INSIDE an animal! American black bears, mule deer, rodents, cattle and birds eat my berries, but they cannot digest my seeds, so they pass on through. I think of their “waste” as a package of my seeds mixed with a lot of fertilizer. My seeds can also travel in the water that runs off hillsides after a rain.

People like to eat my berries too, although they are a bit tart. People often sweeten them and cook them into syrup, which is delicious with ice cream.

My seeds can survive in the soil for many years

before they germinate. They wait until conditions are just right before they grow. Fire provides perfect conditions. First it helps crack open the hard coats on my seeds so water can get in and they can begin to grow. Then it makes sure there is plenty of sunlight on the ground so my seedlings can grow fast. I cannot grow well in the shade of old, dark forests.

**Home for an unwelcome visitor:** I am one of the plants that can be a host for the fungus that causes white pine blister rust. The rust does not hurt me at all. In fact, it is even hard to tell if I have been infected. You have to turn my leaves over and look very closely to see the orange spots formed by the fungus. In late summer, wind carries white pine blister rust spores from my leaves to nearby sugar pines and whitebark pines. The spores then infect the needles and branches of the trees. To these pines, the fungus is deadly.



Sierra gooseberry plant.  
Image courtesy of Becky Howard.

## Life after Fire

My top and branches sometimes survive surface fires that creep along the ground, but I will grow back slowly if the fire injures me. If the fire top-kills my branches and leaves, my roots are still likely to survive. After fire, I can sprout new stems from my root crown. That is the place, right at the surface of the ground, where my stems meet my roots. My sprouts and seedlings are among the first plants to show up after fire, especially if the fire was severe enough to create big, sunny openings. If fires do not burn for a long time, or if they are not hot enough to create openings, my habitat gets too shady and other plants take my place.



Sierra gooseberries have lots of spines.  
Image courtesy of Barry Breckling ©2009.

## Historical Fact

White pine blister rust arrived in North America more than 100 years ago, and people have been trying to stop its spread ever since. They even tried to remove all of the gooseberry and currant bushes from the Sierra Nevada! In the 1930s and 1940s, Civilian Conservation Corps members dug or pulled out gooseberry bushes over more than 300 square kilometers of forest and shrubland. They thought that destroying these host plants would stop the spread of the rust. But it was impossible to dig up every gooseberry bush, and white pine blister rust continues to spread to this day.

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# Sierra lodgepole pine

(*Pinus contorta* var. *murrayana*)

I am a tree. My scientific name, *Pinus contorta*, means "twisted pine." Underneath my bark, my trunk twists like a corkscrew. There are three kinds of lodgepole pine. Just as my name says, I am the only kind that grows in the Sierra Nevada. When I grow up, I am anywhere from 28 to 50 meters tall. If I grow close to other pines, my lower branches usually drop off, leaving needles only on my top branches. My needles are about 5 centimeters long and grow in bundles of two. My cones are about as long as my needles.

**Growing up:** I grow very fast in sunlight. I can start from seed right after a big crown fire and be 6 meters tall by the time I am 20 years old! My growing points are inside my bark (in my cambium), at my very top, and at the tips of my branches and roots.

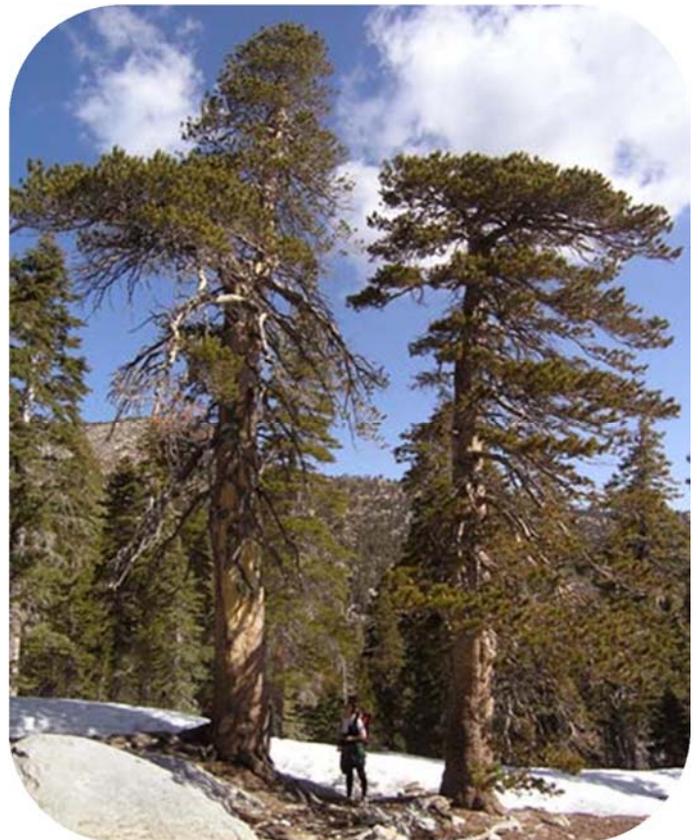
**How do I reproduce?** I am a conifer, which means I put my seeds in cones. My cones are brown, small, and woody, with tiny, sharp prickles on them. My seeds are small and brown, with a paper-like "wing" that helps them float on the wind when they fall out of the cone. I begin making cones and seeds when I'm between 4 and 8 years old. My new cones are pollinated in spring. More than a year later, in summer, they finally open and drop their seed. They may travel 50 or 60 meters before they land. You may have heard that lodgepole pine cones are serotinous and need heat from a fire to open them. That is true for many of the lodgepole pines that live in the Rocky Mountains, but not for me.

**Am I useful?** Many kinds of insects eat my cambium. Female mountain pine beetles tunnel into my cambium to lay their eggs. When the beetles' eggs hatch, the larvae eat their way out, growing up as they go. The beetles bring fungi in with them. The fungi use up the nutrients stored in my trunk, and that makes it harder for me to grow. A plant called mistletoe grows on me. It is a parasite, which means it cannot make its own food. It sinks its roots into my branches and trunk to get nutrients. That also makes it hard for me to grow.

*Crown fires* kill me, but they make me into good habitat for different kinds of animals. Within hours after a crown fire, many kinds of beetles show up to

feed on my burned wood and lay their eggs in it. Wasps follow right away, laying THEIR eggs in the beetles! Woodpeckers follow to eat the insects living under the burned tree bark. One kind, the black-backed woodpecker, almost always nests near a forest burned recently by crown fire.

I provide hiding places and shelter from storms for deer and bears. Western gray squirrels, deer mice, chipmunks, and small birds eat my seeds. Grouse eat my needles for winter food.



Old Sierra lodgepole pines make people look small.  
Image courtesy of C. J. Earle.

People have used my wood to build and heat their homes for thousands of years. I earned my name because Plains Indians cut young lodgepole pines to support their tipis. Lodgepole pine logs are often used to build homes and furniture and to make plywood and paper. Sometimes Native Americans ate my cambium layer and used my sap for medicine.

### What does fire do to me?

If a *surface* fire burns through light fuels, I may survive, and my seedlings will grow well in the new openings. But my bark is too thin to protect my cambium well from the heat of fires. Many surface fires are too hot for me. They not only kill my cambium, but they also damage any roots that are growing near the soil surface.

Crown fires kill me for sure. You may think that I do not like fires, but that is not true. I like all kinds of fire because they create the perfect habitat for my seedlings. My seeds will float into burned places from nearby unburned places, starting a new generation of lodgepole pines. My seedlings grow especially well where fire has cleared the *duff* from the ground.

My seedlings do not grow well in shade. Firs grow very well in shade, and they gradually “take over” the forest where I live unless a fire clears them out. Where the forest stays open and sunny, I can live a long time. One lodgepole pine in Yosemite National Park is more than 600 years old.



Most of the trees in this forest are Sierra lodgepole pines.  
Image courtesy of Ilana Abrahamson.



Inside a forest of Sierra lodgepole pines.  
Image courtesy of Ilana Abrahamson.

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# Sticky whiteleaf manzanita

(*Arctostaphylos viscida*)

If you take a walk in the foothills, you can spot me easily. I am a pretty shrub with pink or white flowers and red fruits. I stand out on a hillside because my whitish-green leaves contrast with my cinnamon-colored bark. I am evergreen, so I keep my leaves year-round. My light-colored leaves reflect the sun, which helps keep me cool. They are also thick and leathery, which keeps them from drying out. My bark is slippery-smooth, but I usually have a sticky coating on my leaves, flowers, and fruits. My flowers and fruits are sweet and edible, but your hands will get sticky if you pick them. My fruits look and taste like tiny apples. In fact, manzanita means “little apples” in Spanish. My flowers and fruits make a tasty jelly, and people can make cider from my fruits.

**Animals, please eat me!** I flower in late winter. That is earlier than most plants in the foothills, so hungry hummingbirds, butterflies, and bees are grateful for my nectar. Sometimes I attract so many bees that you can hear them buzzing around me from across a canyon! Black bears, coyotes, and raccoons eat my fruits, and so do fruit-loving birds like wild turkeys and mockingbirds. I am glad they do. They cannot digest my seeds, so the seeds come out in their droppings. This helps disperse my seeds to new places. A traveling bear can disperse my seeds 50 kilometers away from where it ate my fruits.

**My home:** I grow in chaparral, oak woodlands, and mixed-conifer forests in California and Oregon. Open, sunny spots are my favorite places. When I grow in the shade, my branches die back. I start to look spindly and weak.



Whitish leaves and sticky fruits.  
Image courtesy of Richard W. Spjut.



Cinnamon-colored bark.  
Image courtesy of Jean Pawek.

## Fire and Me

I am a messy plant, which makes me a great fuel. I make a lot of *litter*. Even though I do not shed my leaves every fall, my old leaves do fall off after a few years. The dead leaves do not decay easily, so they build up in the litter. My bark peels off and adds to the litter. All of this litter is very fluffy, so it burns easily. My standing plant parts also burn easily. When I am old, I have many dead, dry branches intertwined with my live ones. My live branches and leaves contain flammable chemicals. My leaves and dead branches grow close together. Their spacing is perfect for circulating oxygen during a fire.

When I catch on fire, I die. Some manzanitas sprout after fire, but not me. You might think I don't like fire, but I love it! You see, I can reproduce only from seeds, and I need fire's help to reproduce. My seeds have very hard seed coats that keep them from germinating. The seeds can lie dormant in the soil for many years. The seed coats have to be split open before they absorb water and start to grow. The heat from fire cracks them open. The hotter the fire, the better for me. So even though fire kills me, I need it to continue my life cycle!

Recently burned places are my favorite places to grow. After fire, it only takes 3 or 4 years before my new plants are able to make flowers and fruits, and drop their seeds in the ground. Once my seeds are in the ground, I am ready for the next fire.



This seedling is growing in a burned area.  
Image courtesy of Becky Howard.

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# Sugar pine

(*Pinus lambertiana*)

I grow in the mountains of Oregon, California, western Nevada, and Baja California Norte. I am most common at middle elevations on the western slope of the Sierra Nevada. I can grow with many different kinds of trees. My most common neighbors include ponderosa pine, white fir, Douglas-fir, and incense-cedar. At higher elevations, I grow with Jeffrey pine and California red fir. At lower elevations, I grow with Coulter pine, knobcone pine, and bigcone Douglas-fir. I also grow with many kinds of oak trees.

**Among the giants:** I am the world's largest kind of pine tree. I can grow more than 60 meters tall and more than 3 meters wide. It takes me a long time to get that big though. I grow slowly when I am young, especially compared to other pines, like ponderosa pines. As I get older, I grow faster. I can live 500 years or more, longer than most of my neighbors except the giant sequoia.

I produce the longest cones of any conifer on earth! My cones average about 30 centimeters long, and



Sugar pines.

Image courtesy of Ilana Abrahamson.

they can be longer than 60 centimeters—that is longer than your arm! It takes 2 years for me to make these huge cones. In the first year, my young cones are upright and less than 5 centimeters long. They receive pollen in June or July. Then they grow fast. By the following

summer, they hang down on stalks at the tips of my branches. They release my seeds in late summer and early fall. One of my cones may hold more than 150 seeds. I was not able to produce these amazing cones when I was young. I became a good cone producer when I was about 150 years old.

My seeds are large and kind of heavy, so they usually fall close to my trunk. Small mammals and birds eat them. Sometimes these animals hide my seeds in caches so they can be eaten later. I like that. If those hidden seeds do not get eaten, they may grow into new trees. My seeds can germinate on bare mineral soil or in *duff*, in full sunlight or in dense shade. My seedlings grow slowly if they are shaded, but they are still faster than seedlings of ponderosa pine, which don't like shade at all.

**How sweet it is!** I get my common name from the resin that leaks out from my wounded bark. This resin hardens into sweet, white lumps that Native Americans and early settlers chewed like gum. "The sugar," John Muir said, "is to my taste the best of sweets—better than maple sugar. It exudes . . . in the shape of irregular, crisp, candy-like kernels . . . Indians are fond of it, but on account of its laxative properties, only small quantities may be eaten." The sweet taste is actually not from a true sugar, but from a sugar-alcohol.

**Tree of many uses:** My wood makes valuable lumber. I am also an important source of food and shelter for small mammals and birds. Deer mice, chipmunks, Douglas squirrels, and gray squirrels eat my seeds and young seedlings. Native Americans used to eat my seeds as well. Woodpeckers and owls like to nest in holes in the trunks of very old or dead sugar pines.

**Blister rust:** I am a "5-needle pine." That means I have 5 needles in each bundle that attaches to a twig. All 5-needle pines are vulnerable to the fungus that causes white pine blister rust. Many sugar pines have been killed by blister rust, particularly in

Oregon and northern California. Infected seedlings and young trees die quickly, while older trees may take many years to die. Scientists have found some sugar pines that are not vulnerable to blister rust. They are raising young trees from the seed of these “rust resistant” trees. I hope that I am a resistant one!

## Fire Facts

When I was young, my bark was too thin to protect me from the heat of fires. Now that I am old, I can survive *surface fires* as long as they do not get too hot. My bark is thick, and that protects my cambium from heat. My branches are widely spaced, and that keeps fires from spreading through my crown.

In the past, fires visited my habitat often. They opened the forest canopy and created puddles of sunlight. My seedlings like a mixture of sunshine and shade, so they grew well in the openings. If fires do not burn my habitat for a long time, the forest understory fills with small trees and shrubs. My seedlings and saplings grow poorly in their shade. When these dense forests burn, the fires are likely to kill all of the old trees like me. They may even become huge *crown fires*. The burned places are sunny and hot – too hot for my seedlings to outgrow their young ponderosa pine neighbors.



Sugar pine cone.  
Image courtesy of Ilana Abrahamson.

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# Wavyleaf soap plant

*(Chlorogalum pomeridianum)*

“Wavyleaf” is a perfect way to describe me, because my leaves often have wavy edges, especially when I grow in full sun. My leaves circle around my flower stalk. I have small white flowers that open in the evening and close in the morning. Bees visit my sweet-smelling flowers in the evening to sip on my nectar and harvest my pollen, and moths visit my flowers at night.

The biggest part of me hides underground. My bulb grows as wide as an adult’s fist. It is white and starchy like a potato but covered with thick brown fibers. Some people think my bulb is a root, but it is really a super-thick stem wrapped in special leaves. My roots attach to the bottom of my bulb. As they grow, they pull my bulb deeper and deeper beneath the soil. When I’m really old, you might have to dig 30 centimeters down to find my bulb.

My leaves start growing in fall, and I flower in spring. My flowers don’t all bloom at once. They open from the bottom to the top of my flower stalk, and each white flower stays open for only one night. My leaves often dry out in summer, but my flower stalk stays green until my seeds fall in August. Then I go dormant until late fall.



This wavyleaf soap plant is growing in a burned place. The edges of its leaves show why it is named “wavyleaf.”  
Image courtesy of Becky Howard.

**Open house:** I like sunny spots. You can find me in California and Oregon. I live in grasslands, chaparral, oak woodlands, and conifer forests. When I grow in a forest, I like to have a lot of room. I do not like my plant neighbors too close.

I start growing from seed. After my first year, I grow new leaves from my bulb. If a mule deer or some other animal eats my leaves, I sprout new ones from my bulb. When I’m about 6 years old, I flower and make seeds for the first time. My seeds do not live very long in the soil. I might make hundreds of seeds in wet years but not even make flowers in dry years. I don’t usually flower at all when I’m growing in shade.



Flowers and buds.  
Image courtesy of Barry Breckling.

## Fire and Me

Fire almost never harms me. When fires burn in late summer and fall, my seeds have fallen and my leaves have dried up, so there is not much left of me aboveground to burn. Even if they do burn, that only *top-kills* me. My bulb is protected from fire because it is buried deep in the soil. Since my roots pull my bulb deeper into the soil as I grow, the older I am, the more protected I am from fire.

Fires create open, sunny places, which I love. After fire, I put on a flower show! The first year after fire, I often produce a huge seed crop. The next year, I usually have more seedlings than I had before the fire.



This bulb is nearly as long as the person's hand.  
Image courtesy of Jim Conrad.

**Indian uses:** Foothill Indians had many uses for my bulbs. They roasted them in fire pits and then ate them for dinner. My name gives a clue about another of my uses. I make soap! Indians crushed and rubbed my bulbs to make a soapy lather for bathing and laundry. My crushed bulbs were also used for fishing. When Indians threw the crushed bulbs into pools, the bulb juices oozed into the water and stunned the fish. The fish floated to the top of the water. Then it was easy to grab them or catch them with a net. The fibers covering my bulbs can also be used to make ropes, brooms, and brushes.

**Wildlife:** Mule deer, rabbits, and ground squirrels like to eat my leaves and flowers, but they do not like my bulbs. Unless my bulbs are cooked, they taste like soap, just like my name says. So even though my bulbs are big and starchy, animals usually leave them alone.

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# Webber's milkvetch

*(Astragalus webberi)*

I am a rare and wonderful plant. There are only about 2,000 Webber's milkvetch plants in the whole world. So far I have been found in only 13 locations, and they are all in Plumas County, California. All of us grow within 40 kilometers of each other. That is a very small home for all the members of a plant species. I grow on shrubby slopes, in California black oak woodlands, and in ponderosa pine forests. I like sunny places with bare soil or soil that has been stirred up. Roadsides, trail sides, and bulldozer tracks are some of my favorite places to grow.

**What do I look like?** I belong to the pea family of plants. If you know what garden peas look like, you can see the family resemblance. My stems may grow straight or flop over, like in the picture. I am covered with satiny-smooth, silvery hairs. The bottom of my stem, called the root crown, often grows near the top of the soil, where you would expect it. But sometimes it is buried 5 or 6 centimeters in the ground. My taproot grows nearly straight down into the soil.

My flowers are white or creamy yellow. I make leathery seed pods that look like tiny balloons. Like balloons, they contain a lot of air as well as tiny, hard seeds. When the wind blows, the seeds shake around inside the pods. They sound like a baby's rattle. Most of my seed pods fall to the ground somewhere close to me. Eventually they may be buried by dead plants and soil. Later, they will grow into new plants right near me. That is why you usually find many of us growing in the same small patch.



Webber's milkvetch plant with flowers.  
Image courtesy of Steve Matson.

## Helping a Rare Plant

Webber's milkvetch plants are not reproducing very well. Between 1989 and 2008, fewer and fewer of them grew in the wild. Managers want to help, but they do not yet know how the little plants get pollinated or what makes their seeds germinate. They do not know if Webber's milkvetch can sprout after it is burned, either. These are scientific mysteries.

Bees pollinate the flowers of some milkvetches, but scientists do not know if they pollinate Webber's milkvetch. If you see a bee on a Webber's milkvetch flower, be sure to take a photo and tell people about it!

Webber's milkvetch seeds do not germinate easily because they are protected by a hard seed coat. Scientists have found that the seeds will germinate if someone rubs the seed coat with sandpaper. But no one is out there in the forests, rubbing seeds with sandpaper! How do the seeds open in nature? Maybe fires crack them open! Scientists and managers are trying to find out.

We DO know that Webber's milkvetch seedlings need sunny, open places to grow in. Crowded forests make too much shade for them.

## Fire Experiment

Wildland managers did an experiment to find out if they could create good habitat for Webber's milkvetch seedlings. They hypothesized that more seedlings would grow in sunny places with bare soil than in shady places with lots of *litter*. First they picked a place for their "treatment." In that place, they removed some trees to increase the sunlight, and they used a *prescribed fire* to get rid of the litter.

Next, they picked a similar place for their "control area." This place had lots of shade and litter, and they didn't change it at all. Then they watched both areas closely to see what would happen.

Webber's milkvetch seedlings loved the new openings in the treatment area. The more light and bare soil there was, the better they grew! They even liked soil that had been stirred up along the edges of the treatment area.

Meanwhile, almost no seedlings showed up in the control area, which still had lots of shade and litter. Perhaps the managers' hypothesis was right, but they will want to test it more to know for sure.

Managers were careful not to cut trees or burn close to adult Webber's milkvetch plants. Why do you think they wanted to protect the adult plants?



Webber's milkvetch flowers.  
Image courtesy of Steve Matson.

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# Western gray squirrel

(*Sciurus griseus*)

**Shadows.** I am a western gray squirrel. You can recognize me by my gray fur and long bushy tail. I earned my scientific name because of my tail. My genus name, *Sciurus*, comes from 2 Greek words that mean “shadow” and “tail.” Maybe someone thought that my bushy gray tail made good shade in the sun!

I live in Washington, Oregon, California, and western Nevada. I am the largest tree squirrel living in these places. We weigh about 520 to 940 grams. That is about the same as a pineapple. We are active throughout the year. We do not hibernate like our cousins, the ground squirrels. There is a good chance you will see me in the forest because I stay awake during the day and asleep at night, just like you do.

**It’s all about seeds:** I like all kinds of forests, but oak and pine forests are my favorites. In the foothills of California, you are to eat during winter. I also eat green leaves, berries, buds, bark, sap, fungi, and even some insects.

**Tree holes and dreys.** You are most likely to find me where oak trees grow. I like to life in the foothills. Higher in the mountains, you will find me where oak trees are mixed with conifers. I like oaks for their acorns, but I eat all kinds of seeds. I like the seeds of Douglas-firs, ponderosa pines, sugar pines, firs, and spruce trees. I eat them throughout summer and fall, and I cache them usually have 2 or 3 babies at a time. My babies are born in the spring or summer. I like to have my babies in a tree cavity. Most of these cavities were made by woodpeckers. When my babies get too big for the hole, I move them to a “drey” where they have more room. A drey is a pile of sticks and bark that I build high in a tree.

My babies grow up fast. They can have babies of their own when they are only 10 or 11 months old. I may live as long as 11 years. That means I could meet some of my great-great-great-great-great-great-grandchildren!

I use dreys only for raising my babies, but I use tree cavities all the time. I like to rest in them. Northern flying squirrels and Douglas squirrels try to use these cavities too. Sometimes they force me out, and I must find another place to rest.

**Doing the Cha Cha.** I scurry along the ground to explore and look for food, but I never go too far from



Adult western gray squirrel eating a seed.  
Image courtesy of Joseph V. Higbee.



Three young western gray squirrels.  
Image courtesy of Matt Vander Haegan.

a tree. I climb trees and hide in their holes to escape predators. Hawks, owls, eagles, northern goshawks, bobcats, martens, fishers, and coyotes try to eat me. When I am startled, I might stamp my foot, flick my tail, and bark to tell intruders that they are not welcome in my territory. Perhaps you have heard my bark. It sounds like “Cha-cha-cha.”

## Fire Facts

Trees are important to western gray squirrels for food and for their holes, because the squirrels need the holes for nesting and resting. *Surface fires* are not likely to kill western gray squirrels or harm their habitat, unless they are very hot. But fires that kill a lot of trees, like *crown fires*, remove both food and cover. Western gray squirrels, especially young ones, may not be able to escape fast-moving fires or crown fires.

Many of the foods that western gray squirrels like to eat come from trees that like fire. For example, the squirrels love California black oaks and ponderosa pines. Surface fires create good growing conditions for these trees. After a fire, western gray squirrels often cache seeds in the burned area. They dig up and eat many of these seeds, but they leave some, and these can germinate and grow into new trees.

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# Western wood-pewee

(*Contopus sordidulus*)

**Fifty cents' worth.** I am a small bird. I am about as big as a sparrow, and I weigh about as much as a couple of quarters. I am about 15 centimeters long from tip to tail. I am about 26 centimeters wide from wing tip to wing tip. I am a female, and my mate looks just like me. We are very plain. Our backs are grayish-green. Our only fancy markings are whitish bars on our wings.

**Mating song.** We breed from May to July, but prime time is June. My mate sang a harsh, buzzy “pee-er” song to attract females, and I found it irresistible! I built our nest, but now we both defend it. If intruders get too close, we chase them and attack them. My mate and I will stay together through the whole breeding season. Next year we will find different mates.

**Nests and nestlings.** I made our nest by weaving grasses, lichens, spider webs, and shredded bark together into a shallow cup. I lined it with fine grasses to make it comfortable for my babies, which are called nestlings. I like to build my nest in the fork of a tree branch. I do not care if the branch is alive or dead, but I like it to be at least 5 meters above the ground. I keep my nest well hidden, because predators will eat my eggs and babies if they find it.

I usually lay 3 eggs each year. I incubate my eggs for about 2 weeks. When my nestlings hatch, they are completely helpless. They need my mate and me to feed them and take care of them, but they grow fast. They may be able to fly by the time they are 2 weeks old! Next year, they will have babies of their own.

If I can find enough food and avoid predators, I may live to be 7 years old. If I'm that lucky, I might meet my great-great-great grandchildren!

**Pest exterminator.** I eat mostly flying insects. I love flies, ants, bees, wasps, beetles, moths, and butterflies. I catch everything I eat in mid-air, but I have to watch out for hawks and other birds who

want to catch and eat me! That makes me a real acrobat when I'm flying. I perch on a branch watching for my next meal. When I spot something, I dart out quickly to catch it. I can twist and roll and dive to get my prey. My twisting maneuvers also make it hard for predators to catch me. Then I return to my perch to eat. Mmm ... delicious!

**Open forests.** I spend my summers in western North America and Central America. You can often find me from low to middle elevations on mountainsides. My favorite places are forests and woodlands that have plenty of openings. I also like treetops near the edges of forests, and trees near rivers and streams. I can find lots of insects there!

I spend my winters in tropical rainforests of South America, but people are cutting a lot of trees in the tropics these days. When I leave my northern home in the fall, I'm never sure that I will find trees in my winter home.



A western wood peewee and her babies.  
Image courtesy of Gerald and Buff Corsi © California Academy of Sciences.

## Fire Facts

Western wood-pewees live in both burned and unburned habitats, but they do not usually live in places where most of the trees have been killed by *torching* or *crown fire*. If a fire burns into the treetops, it may destroy the birds' nests, nestlings, and perches, and it may kill many of the flying insects they like to eat. If a fire burns some trees but not others, it can be good for western wood-pewees by opening up the forest and improving habitat for their favorite insects. *Surface fires* may not kill any trees and are not likely to harm wood-pewee habitat.



Western wood-pewees perching on branches.  
Image courtesy of Larry Thompson/www.discoverlife.org

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# White fir

(*Abies concolor*)



The large white firs in the center are shading out the ponderosa pines around them.

Image courtesy of J. E. (Jed) and Bonnie McClellan  
© California Academy of Sciences.

Nowadays, I rule most of the old forests of the West. I grow from central Oregon east to Colorado and south into Mexico. I can be a tall, stately tree. I grow best in the mountains of Oregon and California, especially in crowded, shady forests. I may be 66 meters tall when I am full-grown. At low elevations, I grow with ponderosa pine, sugar pine, Douglas-fir, incense-cedar, and California black oak. At high elevations, I grow with Jeffrey pine, California red fir, and lodgepole pine.

**Growing up:** I grew from a seed. I started making my own cones and seeds when I was about 40 years

old. You will hardly ever find my cones on the ground because they fall apart while they are still on the tree. As they fall apart, they release my seeds, which float a short distance on their “wings.” I like windy weather, which lets my seeds float a little farther than they can go in still air.

My seedlings can grow in full sun and also in deep shade. Their favorite conditions are cool places with a little shade. They do not like hot afternoon sunlight. They grow very slowly in deep shade, but they may eventually grow taller than other kinds of conifers. They grow very quickly once they get taller than the other trees, and their shade makes other the conifers grow more slowly. Some white firs live up to 400 years. I hope I get to be that old.

**Wanted, dead or alive:** Many animals rely on me for shelter and food. Bears, porcupines, and western gray squirrels den in my hollow branches or trunk. A study in Yosemite National Park found that bears denned in dead, hollow white fir trunks more than anywhere else. Black-backed woodpeckers, California spotted owls, and mountain bluebirds also nest in holes in my trunk.

Deer, rodents, and grouse eat my needles in winter and spring. They would rather munch on me than on pines. My new needles are especially tasty. Porcupines and beavers eat my bark. Porcupines are a problem for me because they eat so many of my saplings. Chipmunks, mice, and many kinds of birds eat my seeds.

I am a valuable timber tree. People use my wood to build houses and to make plywood. I also make a top-notch Christmas tree. I have been picked as the official White House Christmas tree several times.

## Fire Facts

I am the most plentiful tree in many western forests nowadays, but it was different back in the olden days, when fire was in charge. Fires can kill me at any age, but I am especially terrified of it when I am young. My seedlings and saplings have very thin bark, so even “cool” *surface fires* usually kill them. I do not like it when the forest burns often because my youngsters never get a chance to grow up. They need at least 20 years without fire to grow bark that is thick enough to protect them from surface fires. Although my bark gets thicker as I age, I am still vulnerable to fires. That is because I do not drop my lower branches as I grow, like some tree species do. I tend to leave live and dead branches close to the ground. These branches can catch fire easily and carry flames up my branches all the way to my very top. This is called *torching*. Torching and *crown fires* kill me, no matter how old I am or how thick my bark gets.

It usually takes a long time for white firs to rule a forest after fire. If a fire is small or patchy, white firs along the edges can disperse seeds out into the middle. Our seedlings grow well there because they get some shade from the edges or from surviving plants in the burned area. Large *crown fires* are the worst for us. They kill adult trees, and our seeds cannot travel very far into a large burned area. If we are lucky, a large fire will miss some white firs, leaving adult trees here and there to disperse their seeds and give a little shade to the seedlings.

I am a lot more common than I used to be because there are fewer surface fires to kill my seedlings and saplings. I just keep producing seedlings that grow up into the canopy with the pines. This is great for me, but the pines are suffering. I take moisture that they need, and I also create a lot of *ladder fuels*, which help fires become bigger and hotter than they used to be.



This prescribed fire is killing white fir seedlings.  
Image courtesy of Ilana Abrahamson.

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# White pine blister rust

(*Cronartium ribicola*)

I am a fungus. I am like a plant in many ways, but I do not get my energy directly from the sun, like plants do. Instead, I get my nutrition from plants. I will tell you more about myself and some of my generous "host" plants, the 5-needle pines and the gooseberry bush.

**Where do I live?** I am native to Asia. Long ago, I spread into Europe. Then in 1910, I hitchhiked on some pine seedlings from Romania to British Columbia. Only about 100 years have passed since I arrived in North America, but I have been busy. My infections have killed many of the 5-needle pines throughout North America. These are the only kind of tree I can live on. You may be asking what 5-needle pines are, since pine trees obviously have millions of needles rather than only 5! The 5-needle pines have lots more than 5 needles, but the needles are attached to the twig in bunches of 5. Sugar pine, whitebark pine, western white pine, limber pine, Great Basin bristlecone pine, Rocky Mountain bristlecone pine, foxtail pine, southwestern white pine, and eastern white pine are the 5-needle pines that live in North America.

**Where do I grow?** A fungus like me has to reach inside a plant for nutrition. I am pretty special, because I need 2 different kinds of plants to complete my life cycle. One kind is a pine tree, and the other is a shrub.

You should suspect that I have infected a pine if the tree has many dead branches. You will have to look very closely to actually see me. Yellow spots on the needles or twigs of a pine signal the beginning of my infection. Later, I make blisters on the outside of the tree's branch or trunk. Eventually, these become big open wounds. Scientists call them "cankers." They are yellowish along the edge, with lots of yellow fluff toward the center. The middle of the canker is dead. As the canker gets larger, it kills more and more of the tree trunk. When cankers kill the trunk most of the way around, the tree dies.

The other plant that I need is a gooseberry or currant bush or some other host plant. People seldom notice me there because I do not kill the leaves or stems. But you can find me easily enough. Just look on the underside of a leaf. I make tiny yellow blisters and brown, thread-like growths underneath each leaf I infect.

**Growing up:** If you described an animal's life from birth to death, you might call it a "story." It might be better to call my life's tale a "spory." Here's why: In late summer, I produce spores from those brown, thread-like growths on gooseberry or currant leaves. The wind carries these



White pine blister rust on a sugar pine trunk.  
Image courtesy of William Jacobi, Colorado State University.

spores to the needles of nearby pines. To get nutrition, the spores develop thread-like strands called "hyphae." These dissolve the needle's protective covering, then grow down into the needle and steal nutrients from between cells.

The hyphae keep on growing— very slowly— from the needle into the twig, through the twig to the branch, then from the branch into the trunk of the tree. This usually takes 2 or 3 years. Wherever I infect a branch or trunk, it swells with yellow bulges, then develops small blisters. After many years, these blisters form the large cankers on my host tree's trunk. Finally, in spring, I produce another kind of spore along the edges of the cankers. These spores are the yellow fluff that I told you about. They can infect gooseberry and currant bushes, so my life cycle is finally complete! This may sound complicated, but I've only told you a little of my "spory." I actually make 5 different kinds of spores to complete my life cycle!

**Am I useful?** Many insects eat me. Squirrels love the sweet liquid that infected wood produces. Sometimes squirrels eat so much wood from around a canker that it stops my infection from growing!

**Hard to Handle.** If I were native to North America, the native 5-needle pines would have ways to survive my infections. But I have been living in North America for less than a hundred years, and very few of the trees that I

have infected can survive. Seedlings and saplings usually die quickly, but big, old trees can be infected for many years before they die.

In California, I specialize in infecting sugar pines and western white pines. In the Northwest, I infect western white pines and whitebark pines. In the Rocky Mountains, I have been especially deadly to whitebark pines and limber pines. In the Southwest, I infect southwestern white pines and limber pines, and in the east I infect eastern white pines. The only North American 5-needle pine have not infected in the wild is the Great Basin bristlecone pine. Not yet, anyway.

## Fire and Me

Fire is no problem for me. When my pine hosts survive surface fires, I can stay in their needles and branches and keep on growing. Then I can infect the young seedlings that grow in the openings created by fire.

When fires kill my host tree or bush, they kill me—but they cannot keep me down for long. Gooseberry and currant bushes often sprout back right after fire, and fire actually helps their seeds to grow! So I will always have plenty of them to live on. Then all I need is a good wind or a small animal to carry my spores to the needles of nearby 5-needle pines.

**What can be done?** People are trying to help the 5-needle pines survive even though blister rust has moved in for good. For many years, people tried to protect the pines by digging up all the gooseberry and currant bushes. But gooseberry plants are tough, and rust spores can travel a long way from plant to plant. Blister rust outwitted their plans and continued to spread.

Here's what people are doing now to help the 5-needle pines: First, they look high and low for pines that can survive blister rust. Perhaps their offspring can survive, too. People collect and carefully plant the seeds from these "rust resistant" pines. Second, people try to provide

the best growing conditions possible for seedlings from rust resistant pines. Sometimes they prepare a "seed bed" by clearing away the firs that would take moisture away from pine seedlings. Wildland managers may use *prescribed fire* to prepare a seed bed. Fires kill many fir trees and help the pine seedlings get plenty of light. Fires also remove some the *litter* and *duff*, so the frail roots of pine seedlings can get to the soil's moisture before they dry out and die. Maybe fire can help the pine seedlings get a head start on growing, before other plants start using most of the water in the soil.

People hope that they can help rust resistant trees to grow on the hillsides and mountains where 5-needle pines have been for thousands of years.

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# Yellow starthistle

(*Centaurea solstitialis*)



Yellow starthistles have sharp spines. Don't touch!  
Image courtesy of Peggy Greb,  
USDA Agricultural Research Service.

**I don't belong here:** I am from northern Africa, southern Europe, and the Middle East. I hitched a ride to the United States in the 1800s, probably mixed with some alfalfa seed, and I have been spreading ever since. In fact, I now live in nearly every one of the United States. I like places that have warm, dry summers and cool, wet winters. I am most common in California because it has the best weather for me. I do not do very well in areas where it rains a lot in summer.

**An annual nuisance:** I usually grow as an annual

plant. That means that I can germinate, grow, and make flowers and seeds all in one year, and then I die. Once in awhile, I live for 2 years, but that is unusual. I can make more than 1,000 flowers in my short lifetime, and each of my flowers can make 30 to 80 seeds. A friend of mine produced nearly 75,000 seeds!

Most of my seeds have short bristles that grab onto anything that touches them—especially animal hair and your socks! My seeds can easily hitch a ride on animals and travel far from me. Most of my seeds germinate within a month, but some wait in the soil for 3 years or more before they germinate.

**Watch out!** My seeds usually germinate in fall. Then my seedlings form a rosette. This looks like bunch of dandelion leaves, all clustered near the ground. The rosettes are ready for a fast growth spurt the next spring.

During the summer, I grow long, straight stems that might be more than a meter tall. These stems hold my yellow flowers. Honeybees and bumblebees are attracted to their bright color and make sweet honey of my nectar. You might be tempted to pick my flowers, but watch out! They have sharp spines, which hurt when you touch them.

I grow a long taproot that reaches down into the soil, where it can find moisture during the hot summer months. My taproot can grow more than 1 meter deep!

**Choking on weeds:** When I grow with other yellow starthistles, we can become so dense that we choke out other plants. That is why people call us weeds.

Birds and mice love to eat my seeds, and a few other animals might eat my leaves in the spring, before I grow spines on my flowers. But fields full of us make terrible habitat for most animals because we leave few other kinds of plants to eat. Horses cannot eat me at all. If a horse eats me, it can develop a disease that kills it!

I like sunny areas with soils that let my taproot to grow easily. That is why grasslands are great for me. I grow really well along roads too, because there is a lot of sunlight and there are not many other plants around. If you drive your car or walk through areas where I live, you may accidentally spread my hitchhiking seeds. I do not grow well in shady places.

**Insect weapons:** I am a very unwelcome guest in the United States. Scientists are trying to figure out how to get rid of me. They have found one method that keeps me under control. They collected insects that feed on me in my Mediterranean home and brought them to the United States. They set the insects loose in big fields full of yellow starthistle. The insects do not kill me, but they lay their eggs on me. When their larvae hatch, they eat my flowers and seeds. This reduces the number of seeds I can produce, so there will be fewer of me next year. This keeps me from spreading quickly into new habitat. Scientists call this a biocontrol method because they are using BIOlogy rather than chemicals to CONTROL me.



Larva of a biocontrol insect.  
Image courtesy of Charles Turner,  
USDA Agricultural Research Service.

## Fire Facts

Yellow starthistles are likely to stick around for a long time, with any kind of fire or without any fire at all. Fires kill yellow starthistle plants, but seeds on the ground will probably survive. If fires happen 2 or 3 years in a row before the plants produce seeds, there may be fewer yellow starthistles the next year. But there are usually plenty of seeds in the soil or delivered from unburned areas, so they will soon recover. Besides, recently burned areas provide a lot of sunlight and bare soil – perfect growing conditions for yellow starthistles.

People have spread a lot of biocontrol insects in places where yellow starthistles grow, and fire could kill many of them. But more will probably move in from unburned places the next year. If the biocontrol insects are successful at their job, fire probably won't interfere.

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