LESSON 4

# Fire and California Forests

THE CALIFORNIA FOREST FOUNDATION

*This lesson can be completed in the classroom or at home. Your teacher will explain to you how to participate in assignments and group discussions if you are completing the lesson at home.*

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## Today's Topic: Fire and California Forests

### Introduction to Fire and California Forests

Watch the video, Fire and California Forests, to start your exploration of how wildfires affect California forests. As you watch, think about why wildfires can be beneficial to forests. Also make note of the different ways wildfires can start and why California forests are experiencing more fires now than in previous years. Discuss with your class ways that a forest can be restored after a wildfire.

## Read and Respond

Read the passages below about wildfires, then discuss with your group what you learned. Follow your teacher's instructions about how to be part of these group discussions.

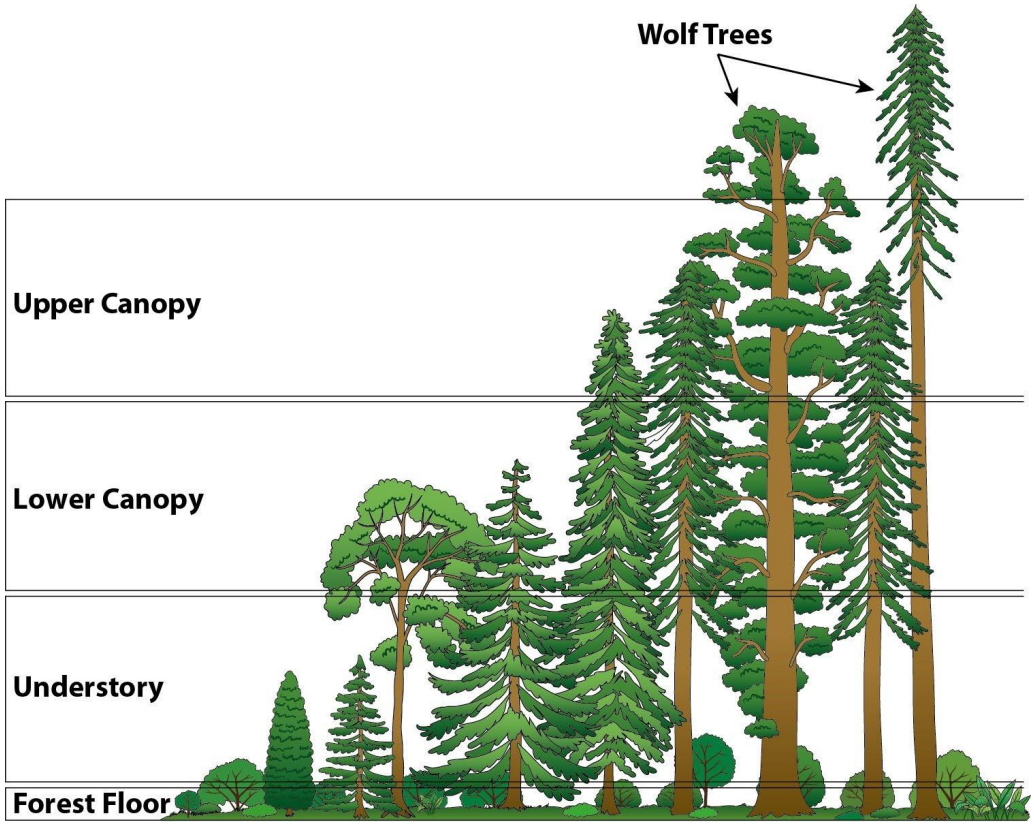
### Fires and Forests

A **wildfire** is a fire that is not planned. When a wildfire occurs in an area of forest that has been well managed, the results are normally less catastrophic than if a wildfire occurs in an area of forest that is not well managed. Fires that occur in unmanaged forests can spread faster and be much more destructive than managed forests due to the amount of fuel that remains.

Fires may not be first on your list of how to keep a forest healthy, but many plant and animal species actually depend on occasional fires to thrive. In fact, frequent, low-intensity fires are a natural part of forest management in California. **Managed burns** are fires that are purposefully set by fire experts and are carefully watched over by them so they help clear out dead matter. This dead matter makes up part of the fuel for larger fires in forests. Sometimes these fires are called controlled burns and are an important part of forest management. Managed burns are one way to prevent out-of-control or large wildfires.

Forest management is more critical today than ever before. An increasing number of **droughts**—periods of time with little to no precipitation—in California have resulted in millions of trees dying. The dead trees burn more easily and quickly than living trees, causing the fire to spread quickly. This places a much greater importance on properly managing forests, including utilizing managed fires to clear out the trees and plants that have died.

Over the past several years, drought and increasing plant diseases have affected the health of trees in California's forests. These dead trees result in increased fuel, making forest management, including the use of fire, a critical component to maintaining healthy forests.




The Layers of the Forest

Each forest in California has layers. The **forest floor** is the lowest layer of the forest. It contains small plants and bushes. It also contains dead and decaying matter such as plants and leaves. The decaying matter makes the soil very rich, which helps new trees and plants to grow. In order for new trees to grow, they need sunlight. In densely grown forests, little sun makes it through to the forest floor.

In California forests, some trees grow higher than the rest. These trees stick out over the other trees. These trees are called the **wolf trees.** These trees are usually larger than other trees in the same area. The smaller trees are newer in the forest. The wolf trees stick out above a layer of tree tops called the **canopy**. This layer is where the tops of most of the oldest and tallest trees are found. Trees in the canopy get the most sunlight and provide shade to all the other parts of the forest.

The layer beneath the canopy is called the **understory.** Here, the tops of plants and new, younger trees can be found.

Wildfires, as well as managed fires, burn the matter on the forest floor and some of the understory. This burning clears the forest floor and makes more room for new plants to grow and live. The burning of the dead and decaying matter releases the nutrients stored in the matter. These nutrients are then returned to the soil to help trees and plants grow. Wildfires also burn parts of the canopy. This can allow more sunlight to reach the forest floor so that new trees can grow. Some trees, such as Lodgepole Pine, need fire in order to reproduce. They keep their seeds in protective pinecones sealed with a thick resin, which is like a strong glue. The seeds remain dormant while in the pinecones. **Dormant** means that the seeds are not starting to grow. It is similar to a long, deep sleep. The heat of wildfires allows the pinecones to open, releasing the seeds. Then, the seeds can grow quickly with the increased soil nutrients and sunlight.

Immature Lodgepole Pine (*Pinus contorta*) Cones
Image Credit: Art Poskanzer

Wildfires, as well as managed fires, also clear out diseased and dead trees, making room for new, healthy trees. In addition, fires remove **invasive species** from the environment. An invasive species is a plant or animal that is not native to the natural habitat of the forest. The invasive plant or animal competes with the native plants and animals for resources such as space, water, and food. Removing invasive plant species from the environment makes more room for native species to thrive.

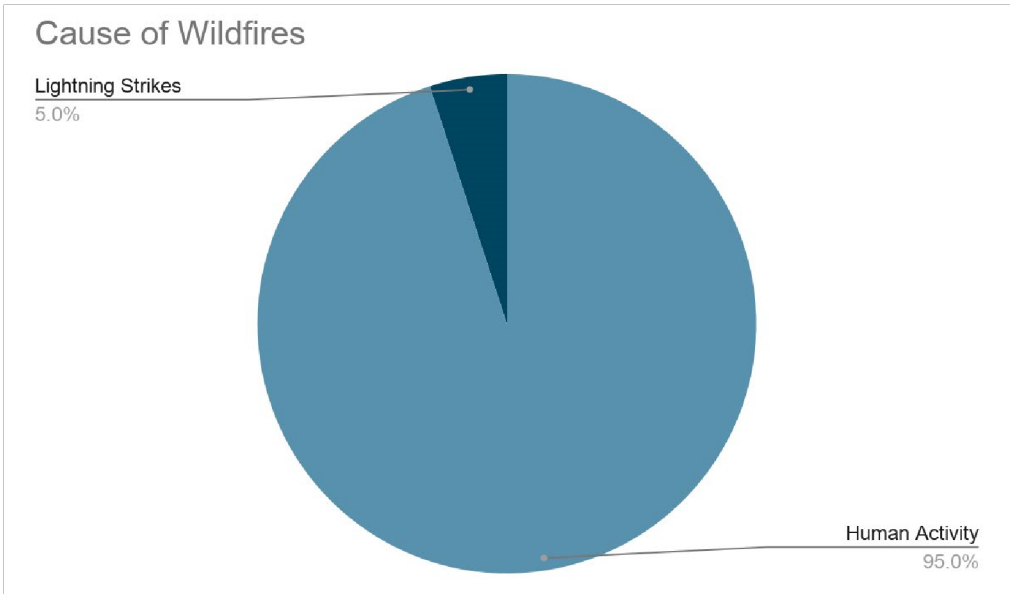
Many animals and birds that live in the forest have adapted to wildfires and survive by burrowing underground or temporarily moving to protect themselves from the fire. The new growths after the fire provide even more shelter and food for the animals.

While occasional fires keep forests healthy, the number and intensity of wildfires have greatly increased in California. More and larger areas of the forests are burning more often, which does not give the forests time to regrow.

## Humans and Wildfires

Over the past several decades, more people in California have been moving closer to or into forests or chaparral. The increase in human population in forested areas increases the likelihood of fires. For example, a spark from a power tool can lead to a wildfire if the spark lands on dry matter of the forest floor. A campfire that is not properly put out can also cause a wildfire. About 95% of all California wildfires are caused by humans, with just 5% starting from

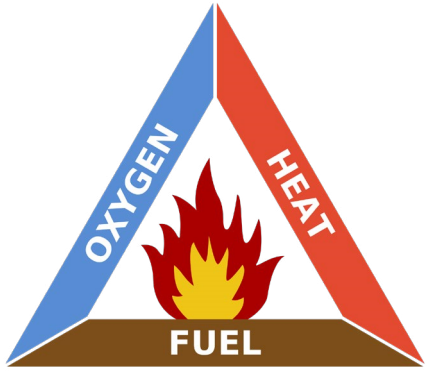
lightning strikes. Other examples of fires started in communities are powerline failures, debris burning, and arson.




Graph of Causes of Wildfires in CA[1]

## Fire Triangle

The **fire triangle** is made up of the three components that allow a fire to burn: fuel, oxygen, and heat.




The Fire Triangle
Image Credit: Gustavb

Fire needs **fuel** to burn just like a car needs fuel to drive. The fuel usually consists of dry material such as dead leaves or brush. Drought conditions—periods with very little rain—in California have greatly increased the amount of dry and dead plants in each layer of the forest, increasing

[1] https://www.pbs.org/newshour/science/californias-catastrophic-wildfires-in-3-charts

the amount of fuel that is available. The smallest spark can grow very quickly when there is enough fuel. One spark that lands on a dry leaf can spread to another and then another. This is called a **chain reaction.** When conditions are exceptionally windy or hot, the chain reaction speeds up and the fire spreads faster.

In addition to fuel, fire needs enough **heat** to be able to **ignite** the fuel and start a fire. Fires also require **oxygen** to keep burning. Fuel, heat, and oxygen all have to be in balance for a fire to occur. If any one of those factors were removed, the fire would be extinguished. And if any of those factors were to increase, the spread of fire could increase as well. Dry conditions and warm temperatures in California are among the reasons that wildfires are increasing. Fuel is the part of the fire triangle that is easiest for humans to change in order to reduce the negative impacts associated with wildfires. Most fires in Southern California are in **chaparral**, which burn naturally every few decades.

Chaparral is a thicket of brush-like plants that are typically less than 2 meters tall and can include bushes and short trees. Urbanization into chaparral areas has increased the number of wildfires.

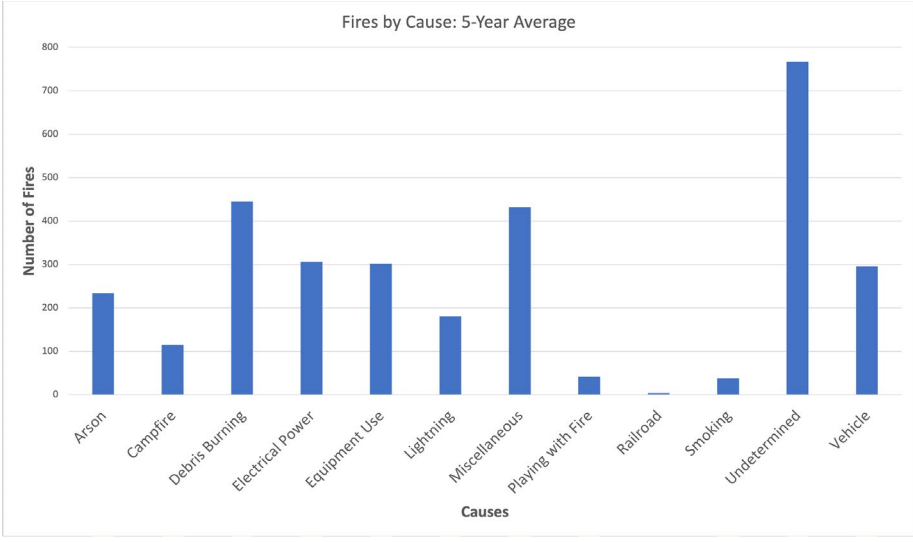
Chaparral

With the population spreading into forest areas, there is an increase in both sparks and fuels. The houses and other buildings being built in the forest are also considered to be fuel.

Smoke from a Wildfire Blocking Out the Sun
Image Credit: Sara Giles, USFWS

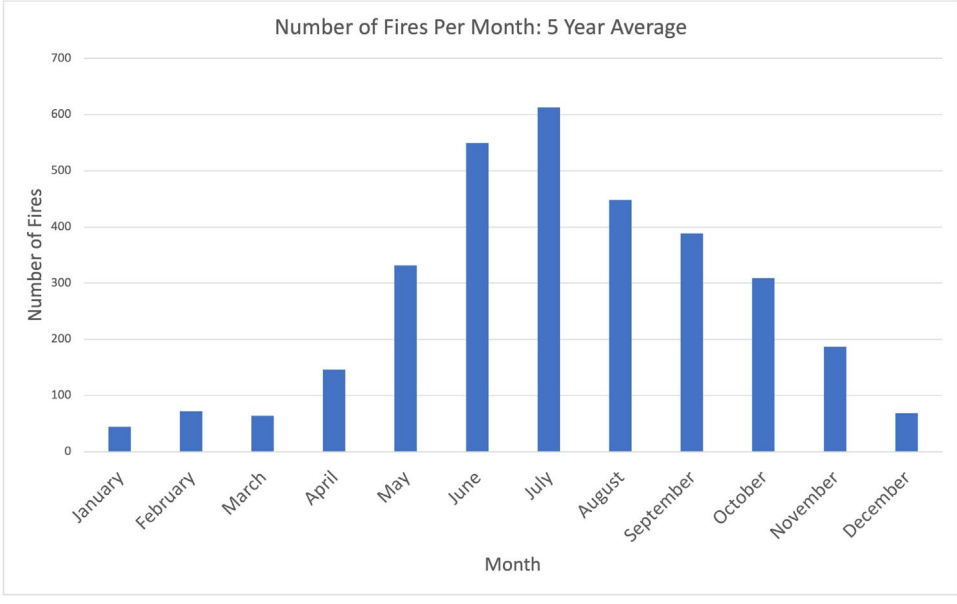
## Looking at trends

As of spring 2021, 17 of the 20 largest wildfires have occurred since the year 2000. Six of those fires occurred in 2020 alone. The typical causes of recent wildfires were related to human activity. The charts below show the average number of fires during a 5-year period based on the causes, month, and area burned, as well as the total acreage burned per year between 2009 and 2019.




Data source: https://www.fire.ca.gov/stats-events/

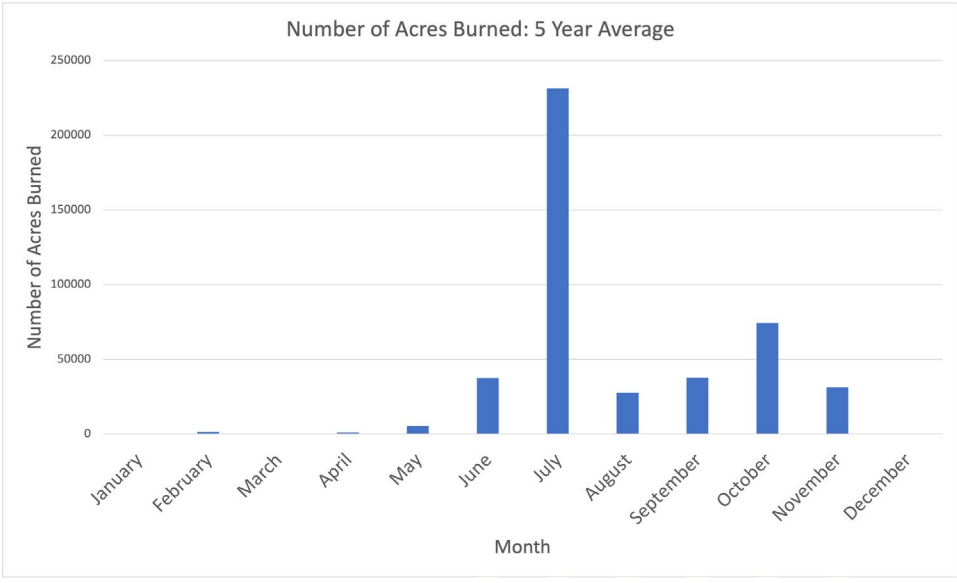
This graph shows the 5-year average (2014–2019) of causes of wildfires in California.




Data Source: https://www.fire.ca.gov/stats-events/

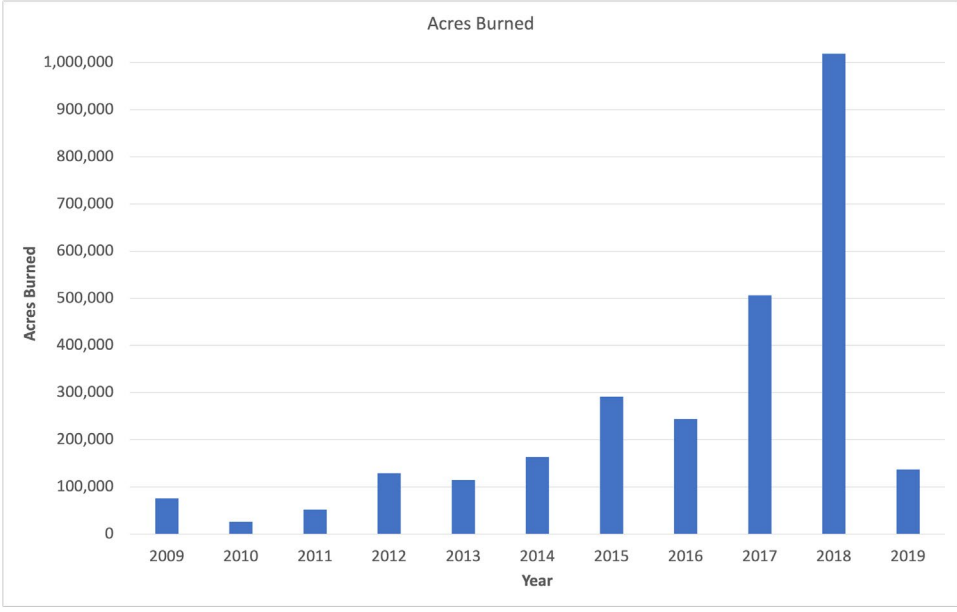
This graph shows the 5-year average (2014–2019) of the number of wildfires per month in California.

Temperatures in California have been increasing over the last several decades. The increasing temperatures also lead to an increase in drought. The fire season typically peaks during the summer and early fall, but the season has been growing longer. Dry conditions plus the increase in population in California's forested areas have increased the number and severity of fires.




Data Source: https://www.fire.ca.gov/stats-events/

This graph shows the 5-year average (2014–2019) of acres burned per month in California.




Data Source: https://www.fire.ca.gov/stats-events/

This graph shows the total acres of land burned per year in California.

## Fire Management

When wildfires begin, the first thought is to put them out or suppress them. **Suppression** means to contain the fires to a particular area so they will not spread and then will eventually be put out. Suppression methods use a number of tools such as water, fire retardant, and fuel breaks. All of these methods remove one part of the fire triangle. Water and fire retardant are sometimes dropped from helicopters or small airplanes, which can remove heat and oxygen from fires. **Fire retardant** is made primarily of water, some fertilizer, and a small percentage of chemicals. Fire breaks are created on the ground by hand and machines to remove fuel so that the fire will not spread. Fire suppression methods are expensive and require a lot of work. However, they are sometimes necessary. When forests are proactively managed, less fire suppression methods are required.

An Airplane Dropping Fire Retardant on a Southern California Wildfire

Image Credit: Staff Sgt. Daryl McKamey, U.S. Air Force

In addition to trying to suppress wildfires when they are already burning, steps can be taken to try to prevent the growing number of catastrophic wildfires in California. This is what is called **fire management.** As you saw before, occasional wildfires keep forests healthy. One of the best ways is by doing prescribed burns.

**Prescribed burns,** also called **controlled** burns, allow the built-up matter on the forest floor to burn and promote new growth. Prescribed burns are very carefully planned before they are

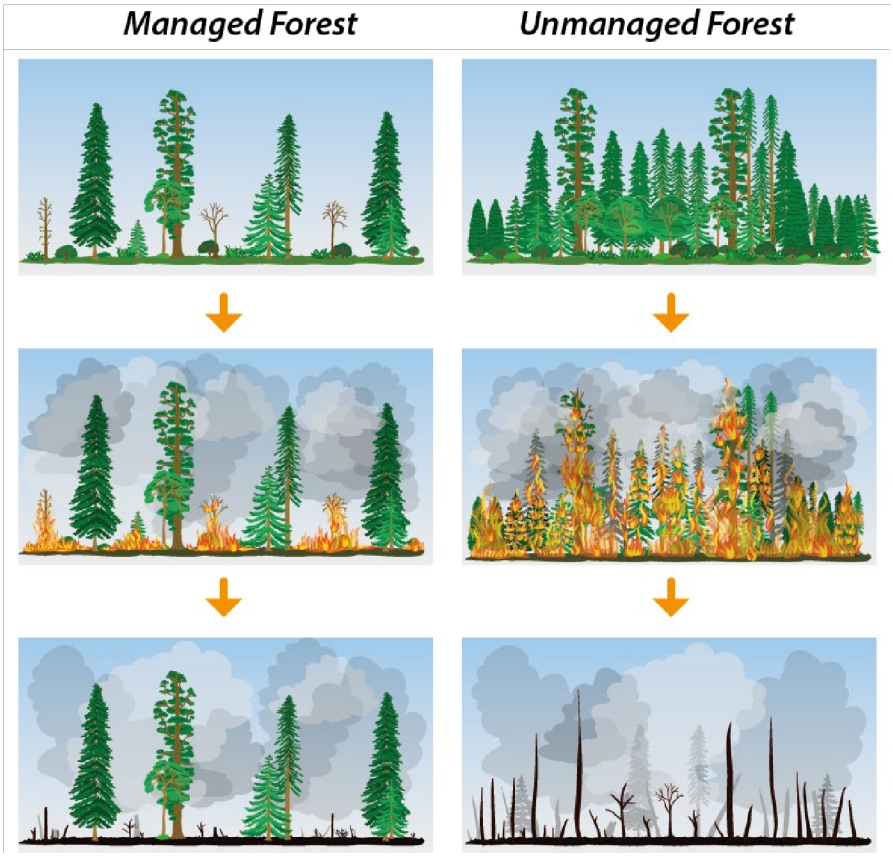
carried out, including waiting for the right weather conditions. These types of fires can clear out the forest floor so that there is little to no dry material left to act as fuel for larger wildfires.

A Prescribed Burn in California

Image Credit: Pacific Southwest Forest Service, USDA

Prescribed burns are also done to create a border around an active wildfire to prevent it from spreading. This is called **backburning**. As the wildfires move closer to the backburned area, the fuel runs out and the fire dies out.

Another way to help control wildfires is by **thinning** out trees. This involves removing dead and diseased trees to leave gaps in between. Sometimes healthy trees are also removed. The oldest trees and the diversity of trees and plants are prioritized so that they are protected when a wildfire moves through. The larger gaps between the trees make it more difficult for the fires to spread from tree to tree.




Wildfire in a Managed Forest Versus Unmanaged Forest

Thinning the forest also creates breaks in **ladder fuels.** Like the steps of a ladder, fire spreads from the forest floor, up to the understory layer, to the canopy (where most of the oldest and tallest trees are), and then to the wolf trees (the tallest trees that stick through the top of the canopy). When the steps in the ladder are broken or moved further apart, the spread of fire slows and the older trees and diversity of the forest is protected.

## Restoration After a Wildfire

After a wildfire, it is important to begin restoration efforts. Even though some trees such as *Pinus contorta* release seeds with the heat of the fire, they and other species sometimes need help to grow quickly.

Wildfires do more than burn trees, bushes, and the matter that is on the forest floor. The ash and debris typically contaminate the water supply, which can impact the regrowth of plants and trees in the forest. The topsoil can also be burned and damaged, which can block the nutrients or water in the soil from reaching plants. And the root system that once held the soil in place is severely weakened, which can lead to dangerous floods and mudslides.

Reseeding quick-growing native plants such as grasses and small plants allow the forest to begin healing as the new trees take time to grow. Continued efforts can also discourage invasive plant species from moving in and competing for the limited resources such as water, nutrients, and space.

A Forest Regrowing After a Wildfire

Image Credit: Hannu

Scientists help determine the types of trees and plants that should be replanted after a wildfire. They begin by looking at the amount of fire damage to the soil, water supply, plants, and trees. They also take into account ladder fuels and the fire triangle to figure out how to best regrow the forest while lowering the chances of another catastrophic wildfire.

## Research

### Who Owns and Manages California's Forests?

More than 30% of California's land is forested. California forests may be managed by the federal government, like Sequoia National Park, but they may also be run by the state, other public entities, or private organizations. There are many forests in California owned by Native American tribes. Some forests are even owned by individual people. Use the data or websites provided by your teacher to fill in how much of California's forests are owned by each group.

_____% of California forests are national forests.
_____% of California forests belong to the State of California.
_____% of California forests belong to Native American Tribes.
_____% of California forests belong to industry (businesses).
_____% of California forests belong to individual people.

National forests belong to everyone—including you! People most often use these areas for recreational activities. Hunting, hiking, fishing, and camping are all activities that people can enjoy in national forests. One-third of the national forests are designated as timberland available for harvesting. Harvesting can improve the health and resiliency of our watersheds. We remove some trees so the ones we leave can thrive. The types and number of trees that can be removed at one time is something that is controlled by the federal government. National forests are managed by the laws and practices set by Congress to "provide the greatest good, for the greatest number (of people), for the long run."[1]

California state-owned forests belong to the State of California. As with national forests, the state uses its forests to provide recreational activities like hunting, hiking, bird watching, camping, fishing, and canoeing. Harvesting can also happen in state-owned forests.

There are several Native American tribes that own and manage California forests. Some of these include the Klamath, Yurok, Karuk, and Hoopa. The ancestors of these indigenous peoples used forests as a source of food and shelter. They would also work to manage the forests to keep them healthy. They would set fires on purpose to promote new shoots on shrubs. This also kept the forest floor clear to reduce surprise attacks from other tribes. The forests remain an important part of Native American tribal heritage and culture. Today, Native American tribes continue to manage the forests using controlled burning.

Some California forests are owned by large companies. The management of these areas is up to the company. Most of the time, management of the forests is done by the owner or a board of directors. A board of directors is a group of people who help make decisions for a company. The company still has to follow rules about how they can use a forest. The California State Board of Forestry sets the rules. These rules state that companies using their forests must have a plan to make sure they do not overuse the forest resources. There are other groups that decide whether or not companies are using their forests responsibly. Companies that own forests usually manage their land for wood products, habitat conservation, water quality, and other activities.

Lastly, some of California's forests are owned by individual people. These people own the land that has the forest on it and may even choose to build their homes there. Many people use

their forests for hunting, hiking, camping, and other recreational activities. Forest owners must be aware of local and state laws that say how the land can be used. Because these areas are privately owned, they are not under the same rules as those owned by large companies.

## Fighting Fire with Fire

Wildfires can be beneficial and catastrophic for forests, but there are many ways that potentially catastrophic fires can be fought with fire. Prescribed burns are often used to help control larger fires and to help maintain the forest. Learn more about prescribed fires by watching "The Story of Prescribed Fire - A Vital Part of Western Landscapes" by the US Forest Service.

As you watch the video, consider the following questions:

- What is the purpose of prescribed fires?
- How has the landscape of the forest ecosystem changed due to fire?
- How did the forest service show that prescribed fires are beneficial to fighting wildfires?
- How are prescribed fires used to keep forests healthy?

Next, use the websites provided by your teacher to research more about the role of prescribed burns in managing California's forests.

Take the ideas from the discussions and what you learned in research to write a letter to your local and state government officials about why prescribed burns are important in protecting California forests and can help reduce the overall cost and damage from large, quick-spreading wildfires. Be sure to include details from your research to convince the government officials why taking steps to keep forests healthy is vital not only to the forest itself, but to the spread of catastrophic wildfires.

## Fire and California Forests Word Scramble

Complete the sentences by unscrambling the underlined vocabulary terms.

1. The lowest layer of the forest is called the _____.
   Vocabulary term: FSROTE ORFLO
2. Almost all major wildfires are due to _____.
   Vocabulary term: AHMNU SCEAUS
3. Together, oxygen, heat, and fuel make up the _____.
   Vocabulary term: IFER NRITGLEA
4. _____ means to smother a wildfire.
   Vocabulary term: PRSUSNOEPIS
5. Firefighters may perform a _____ near the perimeter of a fire to prevent it from spreading.
   Vocabulary term: KNRBBUAC
6. Thinning the understory and forest floor provides a break in _____.
   Vocabulary term: LRDDAE UELFS
7. _____ help manage a forest by removing the dead and decaying matter on the forest floor.
   Vocabulary term: PRCESIEDBR BSUNR

## What Did You Learn?

Answer the following questions to test your knowledge.

1. Which statement explains why wildfires are generally harmful to the forest and human society?

   a. Wildfires spread quickly and can destroy everything in their paths.
   b. Wildfires remove dried matter on the forest floor and put nutrients back in the soil.
   c. Wildfires burn faster in forests with young trees and slower in forests with old trees.
   d. Wildfires remove the native trees, making room for invasive species to thrive.

2. Fill in the blanks. Wildfires can be reduced in severity by using the _____ method to clear away the dead and dry matter and by _____ out the forest by removing dead and diseased trees.

3. How can making a break in ladder fuels help preserve older trees during a wildfire?

_____

_____

4. Which statement(s) about fire suppression are true? Select all that apply.

   a. Suppression is used for slowing quickly moving fires.
   b. Suppression tools include creating fire breaks and dropping fire retardant.
   c. Suppression tools are always used from helicopters or small airplanes.
   d. Suppression removes one part of the fire triangle to put out the fire.

5. The top cause of wildfires in California is:

   a. Lightning
   b. Drought
   c. Humans
   d. Climate

## Apply to Real World

### Group Activity: Discussion

Your teacher will assign you to a group to work on your activity.

[1] https://www.fs.fed.us/greatestgood/press/mediakit/facts/pinchot.shtml