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Living in Southern California Forests

Gary Nakamura, University of California Cooperative Extension, May 2003

Introduction

Recent, extensive tree mortality in the forests of southern California has drawn homeowner and public attention to their unhealthy condition, the risk of wildfire, and what should be done about it. This publication is for the forest homeowner interested in the condition of their forest, how to maintain it in a healthy condition, and the treatments being proposed to reduce tree stress, mortality, and fire hazard.

Fig. 1a—Lake Arrowhead—December 2002

Fig. 1b—Pine mortality, Lake Arrowhead

What type of forest do you have?

There are many different forest types in southern California, resulting from different climatic and soil conditions interacting with natural and human disturbances over time.

Climate determines the characteristics and distribution of southern California forests, and climate varies with elevation, latitude, and distance from the Pacific Ocean. The higher up in the San Bernardino, San Jacinto, or San Gabriel mountains you travel, the more moist and cool the conditions become and vegetation and wildlife habitat change accordingly. Annual precipitation increases with elevation from less than 10 inches in the coastal plains to over 40 inches in the mountains. (Figure 2). Conifer forest occurs at about 30 inches precipitation, much of it falling as snow at 5500 ft and above. (Fig. 3 – Elevation map)

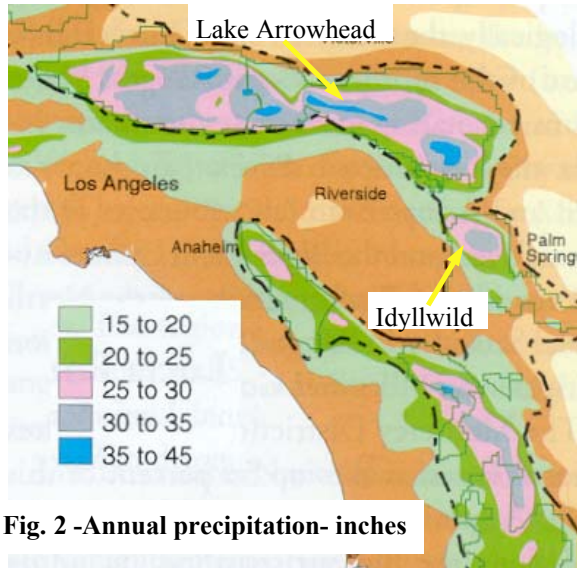

Fig. 2 -Annual precipitation- inches

With increasing elevation, grasslands on the outskirts of San Bernardino or Hemet become brush-dominated chaparral, which in turn becomes big-cone Douglas-fir and hardwood forest, ponderosa pine-mixed conifer forest,

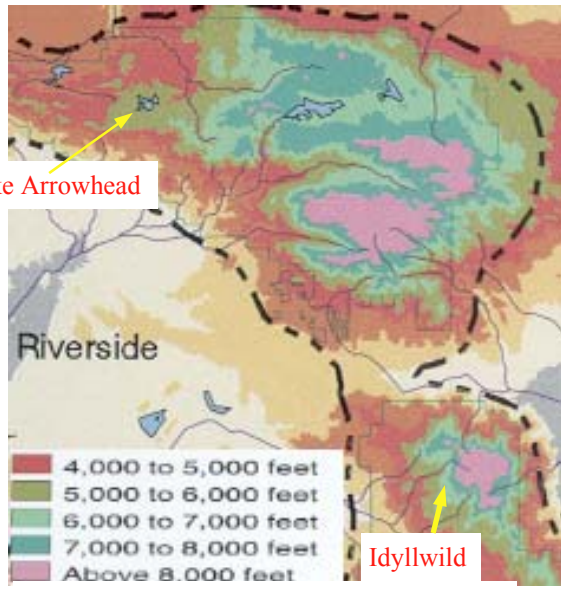

Fig. 3—Elevation

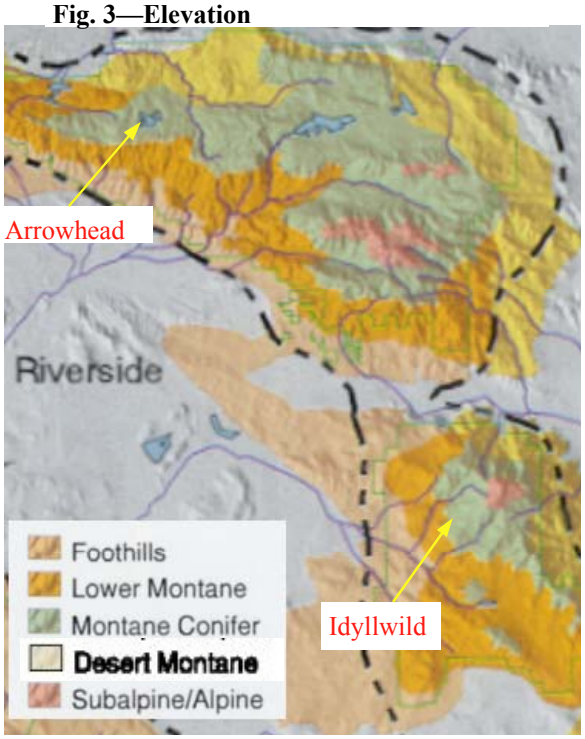

Fig. 4—Vegetation types

and subalpine true fir forests at the highest elevations. Continuing over the mountains, you descend into pinyon pine-juniper woodlands in the desert rainshadow of the mountains. (Fig. 4– Vegetation type map)

Grasslands: Grasslands with interspersed oaks originally stretched throughout the inland southern California valleys. Most were converted to agriculture – citrus groves- and now homes and cities. Those grasslands that remain have been highly altered due to introduced European annual grasses which outcompeted the native wildflowers.

Foothills: Dominated by chaparral and coastal scrub, also oak woodlands and riparian hardwood forests grow along streams, between 800 and 3,000 ft elevation.

Lower montane forests: Bigcone Douglas-fir, Coulter pine, canyon and coast live oak, and black oak are the primary tree species on lower mountain slopes between 3,000 and 5,500 ft.

Mixed conifer forest: From 5,500 – 8,500 feet in elevation, the vegetation changes to a mixed conifer-pine and white fir forest, with pine dominant at the lower elevations and fir at the higher. Precipitation is about 30 inches annually, much of it falling as snow.

Snow melt during the spring recharges soil moisture allowing tree growth to occur well into the summer drought period. The mixed conifer community is dominated by ponderosa pine, Jeffrey pine, sugar pine, white fir, and incense cedar with a large array of shrub and herb species.

Sub-alpine zone: In the sub-alpine higher elevations, 8,500 to 11,000 ft., the mixed conifer community gives way to communities dominated first by lodgepole pine, limber pine, white fir, and western juniper.

Desert montane: The arid slopes on the desert side of mountains (rainshadow) are occupied by sparse pinyon-juniper woodlands, semi-desert chaparral, sagebrush, and desert scrub.

Plant growth, disturbance, and forests

Trees, shrubs, and herbaceous plants (forbs) all require water, sunlight, air, and nutrients to grow. Most of the water a plant uses is to cool its leaves. Only 3% of the water is used in processes like photosynthesis and incorporated into sugars and cellulose, the rest is evaporated from the leaves to cool them. A large tree can use hundreds of gallons of water on a hot, dry, windy summer day. Sunlight is the energy captured by the leaves and used to turn water, carbon dioxide, and nutrients from the soil into sugars, protein, cellulose which make up the plant tissues and structures. Air supplies the carbon dioxide and oxygen for respiration. Most important is supplying oxygen to the roots. Above ground plant parts usually have adequate oxygen. The soil supplies nutrients, most importantly nitrogen, phosphorous, potassium, calcium, magnesium, and small quantities of other elements.

Plants are always competing for these growth factors. In California's Mediterranean climate, water is usually limited during the growing season. Most of the precipitation occurs in the winter and runs off. All the water plants have for growth is that retained in the soil, so the depth, texture (sandy, clayey, rocky), and organic matter content determines how much water will be available to plants. Protecting the soil from erosion and compaction is important to maintaining its waterholding capacity. Sunlight may become limiting for forest understory plants, grasses, wildflowers, shrubs, and tree seedlings, as trees grow tall and shade them. Air is usually not limiting except possibly to plant roots. Thus wet meadows prevent deeper rooted trees and shrubs from becoming established and maintain a shallow rooted grass and forb vegetation. Nutrients are rarely limiting in forests to the extent that plants die; nutrient problems usually show up in slower growth or fewer plants per acre. Trees exhibit different tolerances to shade, drought, and fire and these differences result in different forests over time and across the landscape.

In addition to the plant growth factors, disturbance can greatly affect forest ecosystems. Wildfire is an important natural disturbance in California's Mediterranean climate, just as ice storms and hurricanes are natural disturbances to Southern US forests. Wildfire can and does affect the location, structure, and composition of forests. Wildfires have been successfully suppressed in California forests for the past century. This has led to a build up of forest vegetation or forest fuels that would otherwise have burned up in natural wildfires. As forests have become more dense, there is greater competition for growth factors, particularly water. During droughts, competition for the limited water will make trees more susceptible to insect attack and mortality. The 1999 – 2003 drought in Southern California has resulted in unprecedented tree mortality. Even the most drought resistant trees like ponderosa and Jeffrey pine are succumbing to drought and insects taking advantage of the weakened trees. The drought mortality is nature's way of thinning the forest, leaving fewer trees to compete for the limited water.
(**Tree descriptions, page 12-14**)

Tree species in order of increasing shade tolerance

California black oak—*more sun*
Ponderosa pine
Lodgepole pine
Incense cedar
Sugar pine
Bigcone Douglas-fir
White fir—*more shade*

In order of increasing drought tolerance
White fir—*least tolerant*
Sugar pine
Bigcone Douglas-fir
Incense cedar, Lodgepole pine
Ponderosa pine
Jeffrey pine
California black oak—*most tolerant*

In order of increasing fire tolerance
Sugar pine, White fir—*least tolerant*
canyon live oak, black oak
Incense cedar
Lodgepole pine
Ponderosa pine
Bigcone Douglas-fir—*most tolerant*

Human disturbances: Human land uses are a form of forest disturbance. Human disturbances include setting fires (as Native Americans once did), forest harvesting, agriculture, summer irrigation and development of roads and residences, commercial and industrial centers.

Ponderosa and Jeffrey pines, and to a lesser extent bigcone Douglas-fir, are experiencing foliage damage from ozone air pollution. Other species appear considerably more tolerant of ozone. When drought and ozone damage coincide, trees become more susceptible to insect mortality.

Removal of periodic wildfire by effective suppression is a disturbance to forests that have adapted to such fires, as we now believe many California forests have. e.g. Coulter pine regenerates best following a wildfire that kills the vegetation that will compete with its seedlings for moisture, nutrients, and light. Removing fire as a disturbance has reduced the regeneration of Coulter pine.

History of southern California forests: Before European settlement, California's forests were used primarily for the subsistence needs of native peoples. These needs included food, shelter, and raw materials for tools, basketry, and cooking and warming fires. A main food staple was the oak acorn, abundant in forests and woodlands. Although most California Indians did not practice intensive agriculture (except perhaps for cultivation of tobacco), evidence suggests that they did actively manage forests to meet their subsistence needs. Many tribes set fires to reduce fuel accumulations, clear brush from the forest floor, maintain prairies and grasslands, promote the growth of grass and shrub shoots for game animals, and enhance food production.

Southern California forests today
Forest use and development over the last 150 years have created today's southern California forests.

The mixed conifer-pine forests around Lake Arrowhead and Idyllwild resulted from human disturbance, logging and human-caused fire, around the turn of the 20th century. Most of the larger pine trees, 24 inches diameter, 100 ft tall, are about the same age, 100 years old. The Talmadge Mill was operating in 1870 in Little Bear Valley, now under the waters of Lake Arrowhead. It and many other mills continued into the mid 20th century. (Fig. 5). Trees regenerated following the harvesting, primarily the pines and black

Fig. 5—Talmadge Mill, Little Bear Valley, c. 1885. Today under Lake Arrowhead.

oak which are adapted to full sunlight conditions following wildfire or clear cut harvesting. Eventually the more shade tolerant white fir and incense cedar regenerated in the understory. Effective fire suppression in the 20th century allowed the fir and cedar to survive, creating dense forests, where in the past frequent wildfires would have killed and cleared them, creating more open, widely spaced forests. Current dense forests are unnatural, and perhaps unsustainable in light of droughts, insects, and fire. (Figs. 6 and 7)

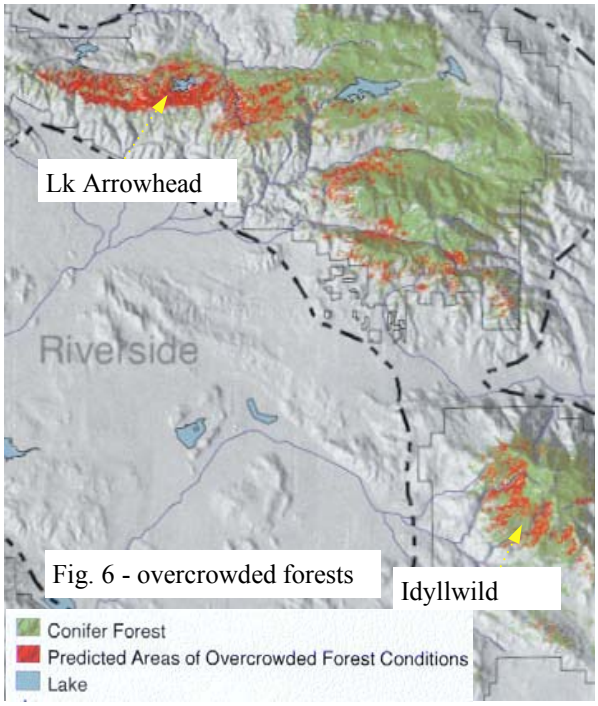

Fig. 6 - overcrowded forests


Fig. 7—Idyllwild, 2002

Thus, forests which have survived wildfires for hundreds of years have now grown too dense and produce fires which are catastrophic in size and severity, relative to pre-fire suppression fires. Homes and other developments in the forest complicate the reintroduction of fire as a natural disturbance to the forest. (Fig. 8)

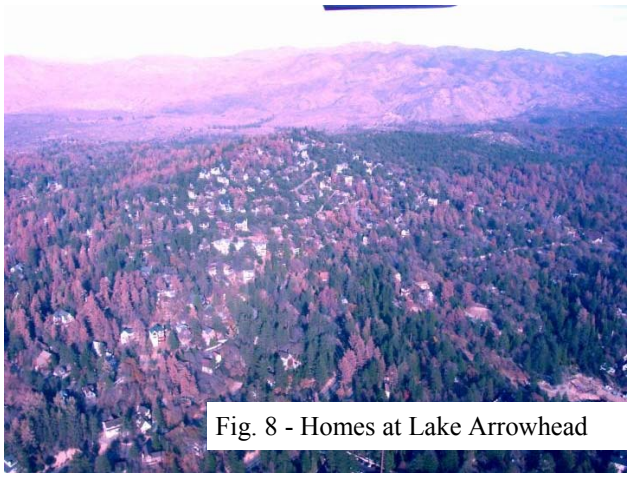
Fig. 8 - Homes at Lake Arrowhead

Areas of high ecological significance

Southern California forests are home not only to thousands of people but also hundreds of animal and plant species. The mixed conifer forests of the San Bernardino and San Jacinto mountains are areas of critical habitats for rare and vulnerable species, of high ecological integrity, and locations with unique ecological associations. Thus effective protection and management is particularly important for these forests.

The North Fork, San Jacinto River near Pine Cove and Idyllwild has high-quality mixed conifer and bigcone Douglas-fir forest that are habitat for some of the last remaining mountain yellow-legged frog populations in southern California. They also have spotted

owl pairs and the southernmost population of southern rubber boa snakes. Concentrated recreation use, expanding development on private lands in Pine Cove and

Fig. 9- Area of ecological significance

Idyllwild and catastrophic fire threaten this area (Fig. 9). The mixed conifer forests at Lake Arrowhead and Big Bear are key habitat for California spotted owl, San Bernardino flying squirrel, southern rubber boa, flammulated owl, and many other species. The large spotted owl population is critical to the continued viability of this species in southern California. Catastrophic wildfire due to eighty years of fire suppression and fuel build up is the primary threat to these forests. (Fig. 10)

Planning for forest property development

Living well in the forest means learning to conserve the forest around us while developing our homes, roads, and gardens. Trees growing on your property add to its aesthetic, wildlife habitat, and commercial value. Protecting trees during the development process can maintain these values. (Fig. 11)

Fig. 11

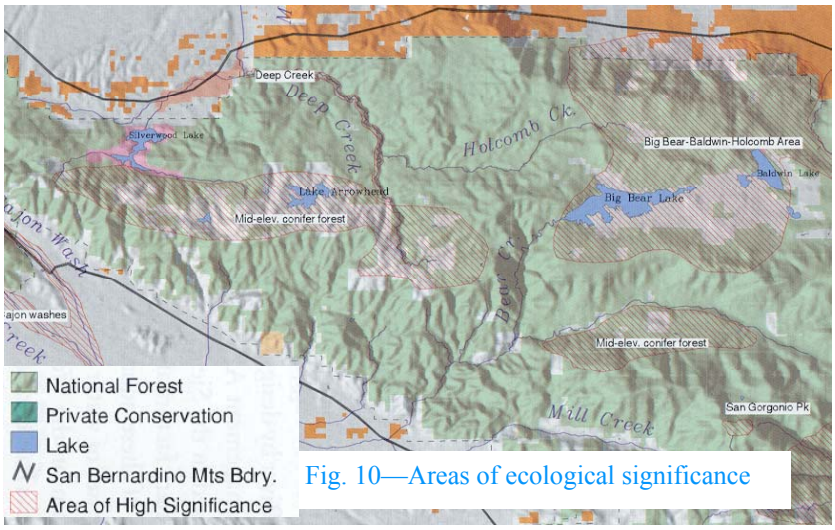

Fig. 10—Areas of ecological significance

Protecting trees from removal in appropriate locations. Replacement of mature trees by newly planted saplings takes many years. Retention of trees is possible in many cases when planned for ahead of time.

Protecting tree roots from grading and trenching. Root damage can reduce tree vigor and lead to mortality in the coming years. (Fig. 12)

Protecting trees from changed moisture conditions that occur due to building downspouts, drains, septic systems, and irrigation. Plan ahead to locate irrigated landscaping and remove trees which are intolerant of it.

Protecting trees from sediment deposition. Property development often involves movement of large quantities of soil. Trees need to absorb oxygen

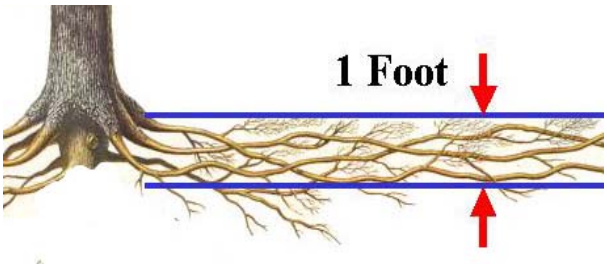

Figure 12 - Most of a tree's roots are in the surface foot of soil and are therefore very susceptible to damage. A few large roots, sinkers, explore deeper soil and fractured rock for late season water.

through their roots and most cannot adapt to excess soil conditions.

Protecting trees from erosion. New drainage facilities such as ditches and swales may undercut tree roots leaving them susceptible to toppling or disease.

Insect and disease problems

Southern California mixed conifer trees are susceptible to a number of insect and disease problems. The best way to minimize these problems on your forested land is to keep trees healthy and minimize stress. Those

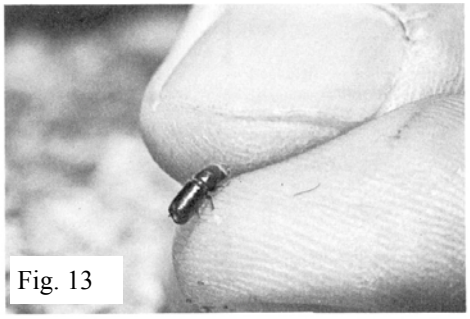

Fig. 13

Seen here is an *Ips* bark beetle, one of many engraver beetles of pine.

undergoing stress such as drought, excessive moisture, competition from other trees, air pollution, and soil compaction have fewer energy reserves for natural defense against injury.

The current multi-year drought (1999-2003) is the primary cause of tree mortality. The bark beetles are simply taking advantage of trees weakened by drought or root disease in some instances. Bark beetles are a natural and important part of forest ecosystems, and trees are attacked every year and the few weak ones succumb. When trees are healthy and vigorous they are able to pitch the beetles out, literally drowning the beetles in pitch, creating pitch tubes on the bark. (Fig. 14) Under drought or other stress, trees produce insufficient pitch to drown the beetles and they successfully colonize and kill the trees.

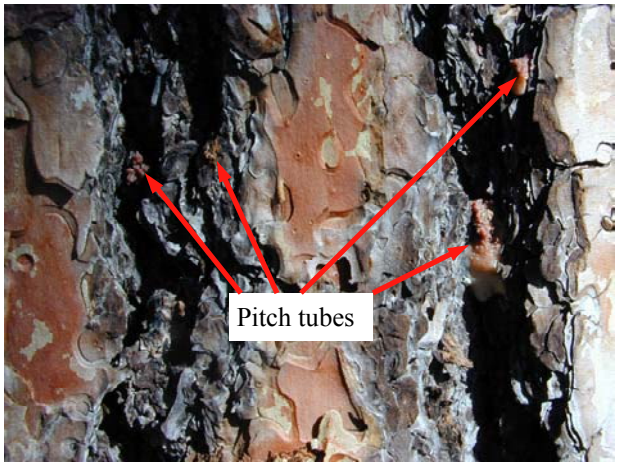

Fig. 14—Pitch tubes on ponderosa pine

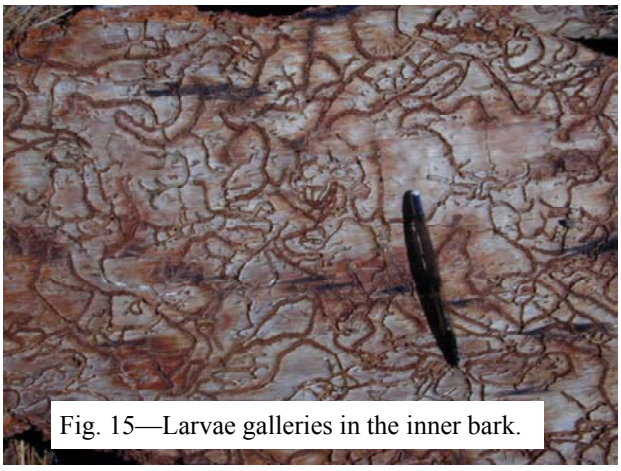

Fig. 15—Larvae galleries in the inner bark.

A beetle that successfully attacks a tree, creating egg chambers in the inner bark, will send out chemical attractants, pheromones, that will attract other beetles to the weak and

susceptible tree, resulting in a mass attack. Larvae hatch and feed on the inner bark (phloem and cambium tissue, Fig. 15) a few weeks after egg laying, disrupting water and sap flow. Beetles also introduce fungi that will grow and plug vessels transporting water and sap, killing the tree.

In drought periods, many trees are stressed and successfully attacked by beetles, building up insect populations to epidemic levels and killing many trees at the same time. These dead trees increase wildfire hazard, and in the absence of fire suppression, will eventually burn, regenerate brush and eventually forests.

Treatment alternatives to minimize tree mortality – irrigation (drought), insecticides (beetles), sanitation-salvage harvesting.

The best defense against beetles is to maintain healthy, vigorous trees by thinning them to reduce competition for nutrients, light, and especially water.

Irrigation might be an option for very special trees, worth the cost and effort A rule of thumb is that a forest will evapotranspire at least 0.1 inches of soil moisture per day during the growing season; more on hot, dry days and less on cool ones. A productive forest soil will hold 6 inches of soil moisture. Mature trees spaced 35 feet apart, about 45 per acre, will use at least 50 gallons each per day or 350 gallons per week. Irrigation is best applied as infrequent but deep (to 18 in.) watering, rather than daily as with a lawn.

Chemical controls are not effective. Insecticide sprayed on the bark will not penetrate to kill the beetles or their larvae. Spraying the bark with insecticide before the beetles attack can be effective, but the whole trunk must be sprayed (usually professionally with spray equipment to get into the tops of large trees) and the insecticides are non-specific, killing beneficial insects as well as the bark beetles. Systemic insecticide applied with injectors isn't effective either, because not enough insecticide gets to the inner bark where the beetles are. Beware of treatments for beetles which sound too good to be true. There is no quick or easy fix.

Sanitation-salvage harvesting of low vigor trees most susceptible to successful beetle attack might reduce beetle populations before they reach epidemic proportions. This was applied with some success in southern California forest recreation areas from 1950 – 1956. The area treated must be relatively large, more than individual trees here and there. 5500 acres had 15 to 30 percent of their tree volume harvested (visually noticeable), resulting in 90 percent reduction in beetle losses over two years.

Minimizing insect and disease problems on your property:

Thin trees. Reducing the competition for moisture, nutrients, and sunlight will leave your forest healthier. Remaining trees will grow faster and be more able to repel insects and disease which are constantly challenging trees and killing the stressed ones.

Treat stumps with sodium borate (borax powder soap) to reduce infection by root disease.

Reduce and dry slash. Remove fresh cut brush and wood to reduce breeding sites for insects. Or dry out recently cut vegetation as quickly as possible by cutting and splitting into small pieces.

Remove diseased trees. Careful disposal of diseased trees is required. Some insects will continue to breed and spread in downed logs.

Sterilize your equipment. Rinsing saws and

hatchets with a bleach solution will reduce the chance that disease will be spread from one tree to another as you work on your property.

Store firewood away from your house. Insects which may breed in firewood should not be encouraged to take up residence in your home's wooden frame.

Store firewood away from living trees. Do not stack firewood from a diseased/insect ridden tree next to a living healthy one.

Dealing with Wildfire

The threat of property damage from wildfires is a very real one in southern California. Wildfire is a natural part of the forest ecosystem. However, human fire prevention and suppression have drastically reduced the annual amount of acres burned in the Sierra. As a result, areas which have not burned for many years have built up fuels which increase the risk that they will experience high intensity wildfires in the future.

Landowners do have some strategies to fight back against wildfire damage. These include reducing the likelihood that your forest or structures will be damaged in event of wildfire and reducing the likelihood of starting a fire yourself.

Reducing your damage from wildfire:
From a long-term perspective, it's not a question of whether a fire will occur in your area, but when. This strategy manages the forest to reduce the amount of fuel available to a wildfire. The goal is to encourage fires to remain on the ground surface and out of the crowns of the trees. These types of fires can be beneficial to the health of your forest in the long run.

Reducing forest fuels involves:

Thinning. Remove excess trees leaving behind the largest and healthiest which are most likely to survive a wildfire.

Fuel breaks. Remove undergrowth by cutting small trees and brush, pruning, prescribed burns, and chipping.

To minimize the chances that your structures will be ignited by firebrands or radiant heat:

Clear a safety zone around your home of at least 30 feet, up to 100 feet depending on slope:

- Rake away dead vegetation or pine needles.
- Raise tree crowns to 10 feet above ground or 1/3 of their height with a pole pruning saw.
- Remove flammable undergrowth and woody debris.
- Remove all dead limbs overhanging your home or garage and any within 10 feet of your chimney

Install a fire resistant roof when you re-roof.

Remove dry needles and leaves from your roof and rain gutters. Install a screen over the gutters.

Cover your attic and foundation vents with wire mesh to keep out sparks.

Screen your chimney with 1/2 inch mesh noncombustible wire screening.

Store combustible materials away from your home.

Identify your home for emergency services with an easily visible street/road address.

Plant fire resistant plants near structures. e.g. ice plant (*Malephora*), mock orange.

Some routine home and yard maintenance tasks can provide the spark to start a wildfire. To reduce your likelihood of starting a wildfire during dry conditions:

Fit spark arrestors on equipment including chain saws, tractors, and lawn mowers.

Avoid driving on dry grass or pine needles which can ignite from the heat of the engine.

Follow local laws that suspend burning during dry periods.

Keep basic fire fighting equipment including shovels, axes, and rakes at hand.

Identify your water sources and preset hoses to fight fires.

Emerging Issues:
Southern California forests face a number of challenging issues in the next 50 years. Wildland fire management, already an issue because of changes in the forest's natural fire patterns, will be complicated by the steady population growth continuing in the forest and increasing demand for recreation.

Development in the southern California forest continues to cause changes in forest structure and wildlife habitat. Increased recreational use of forests can contribute to the spread of exotic weeds along roads and trails.

Clearly, maintaining and restoring southern California forests will require a concerted effort by many individuals, organizations, and levels of government. The individual property owner has a large part to play in maintaining healthy southern California forests for the future.

Sources of Assistance and Information:
Many programs and opportunities are available to forest landowners from public agencies and private organizations. For more information and referrals, contact the ***Forestry Assistance Helpline*** **(1-800-738-8733, or 1-800-PET-TREE).**

California Department of Forestry and Fire Protection (CDF): This is the principal fire fighting agency for private forestlands in California. It also oversees harvesting on private lands and administers cost share programs for forest improvement projects including fuels treatments. Contact the *Forestry Assistance Helpline* for offices.

California Licensed Foresters Association (CLFA) : Commercial timber harvesting in California is regulated by the Forest Practices Act. Registered professional foresters are licensed to prepare timber harvest plans and are a source of information and advice for managing your forest. Contact CLFA at 209 293-7323, www.clfa.org .

County agricultural commissioners: County agricultural commissioners are knowledgeable in topics of insect and weed identification and control. Contact *Forestry Assistance Helpline* above for offices.

Fire Safe Councils*:* Fire Safe Councils are collaborations between local agencies and private citizens, many of which plan community projects to reduce fuels. Website: http://www.firesafecouncil.org

Resource Conservation Districts (RCDs): RCDs help landowners plan for best management of woodlots, wildlife habitat, crop land, pasture and range and water resources. RCDs are governed by a board of local landowners. Contact: California Association of RCDs (916) 447-7237, e-mail:

carcd@ns.net, or website: http://ceres.ca.gov/carcd/index.htm

University of California Cooperative Extension (UCCE): UCCE conducts forest related workshops and conferences, disseminates educational materials, and answer questions. Contact (510) 642-0095, e-mail: forestry@nature.berkeley.edu, website: http://nature.berkeley.edu/forestry.

- ***Forestland Steward Newsletter.*** A free, quarterly publication providing timely information on forest management and issues. Available at http://ceres.ca.gov/foreststeward.
- ***Cost Share and Assistance Programs Directory***. A free directory of federal and state programs for forestry, wildlife, watershed, and fisheries assistance programs. Available: http://ceres.ca.gov/foreststeward/funding.html

USDA Natural Resources Conservation Service: Environmental Quality Incentives Program (EQIP) provides technical, financial, and educational assistance to address natural resource problems, especially agricultural and livestock related problems. Contact: phone book under Federal Government, Agriculture, or http://www.ca.nrcs.usda.gov/

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Photo and figure credits

Fig. 1a, 1b, 14, 15—Gary Nakamura

Fig. 2, 3, 4, 6, 9, 10—adapted from Stephenson, John R.; Calcarone, Gena M. 1999. **Southern California mountains and foothills assessment: habitat and species conservation issues**. General Technical Report GTR-PSW-172. Albany, CA: Pacific Southwest Research Station, USDA Forest Service; 402 p.

Fig. 5 - Robinson, John W. **The San Bernardinos**. 1989. Arcadia, CA. The Big Santa Anita Historical Society. 256 p.

Fig. 7, 8, 11—Kathleen Edwards, California Dept. of Forestry and Fire Protection

Fig. 12 - Lipkis, Andy and Katie. TreePeople .1990. **The Simple Act of Planting a Tree.** Los Angeles, CA. Jeremy P. Tarcher, Inc. 236 p.

Tree drawings, pages 12—14—Brockman, C. Frank. **A guide to Field Identification of Trees of North America**. Illus.by Rebecca Merrilees. 1968. Racine, WI. Western Publishing Co. , Inc. 280 p.

Tree distribution maps, page 14—Watts, Tom. 1973. **Pacific Coast Tree Finder**. Berkeley, CA. Nature Study Guide. 62 p.

Tree Identification
Common Name *Scientific name*
Identification *Distinguishing feature in italics*

Black oak *Quercus kelloggii*

Identification: Leaves differ from all other western oaks. Deciduous leaves are dark green but turn yellow-brown in autumn. *They are deeply lobed, 3" to 8" long and 2" to 5" wide*, and alternate on the stem. Acorns are oblong and 1" to 2" long. Trees are 30 to 80 feet tall with smooth and light brown bark when young, but dark brown with thick, irregular plates and ridges as they age.
Range: Black oak grows from southwest Oregon south through the Coast Ranges and Sierra Nevada to Southern California from 900 to 7500 feet.

Ponderosa Pine *Pinus ponderosa*

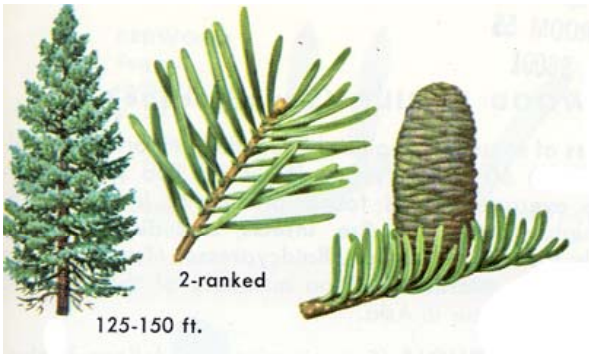
Identification: Needles are 5" to 10"long and in bundles of three, forming tufts at the end of each branch. Cones are oval, *3" to 6" long and 2" to 4" inches in diameter, with outwardly curved spines that make them prickly to handle*. Bark is dark brown and rough textured in young trees and orange-brown with distinctive large plates in mature trees
Range: In California, ponderosa pine is found in the Coast Range, Klamath, Cascades, and throughout the Sierra Nevada, all the way down to San Diego. Its elevation ranges from 500 to 3,500 feet in Northern California and 5,300 to 7,300 feet in Southern California.

Jeffrey Pine *Pinus jeffreyi*

Identification: Needles are in bundles of three and are 7" to 11" long. Cones are *long and oval, 6" to 10" long and lack the spines which make ponderosa pine cones prickly to handle*. Bark is deeply furrowed and reddish-brown when compared to ponderosa pine (which is more orange), with a strong vanilla or pineapple odor.
Range: Jeffrey pine is found primarily in California. It extends north through the Klamath Mountains into southwestern Oregon, across the Sierra Nevada into western Nevada, and south to the Transverse and Peninsular Ranges and into northern Baja California.

White fir *Abies concolor*

Identification: *Flattened needles are 2" to 3" long, blunt at the tip, and twist as they extend from the twig.* Needles give off a citrus smell when broken. Cones are upright, 3" to 5 ½" inches long, oblong, yellow-green to purple, but break at maturity in September to October. Bark is thin, smooth and gray on young trees, with resin pockets. On old trees bark is thick and ashy gray with deep, irregular furrows.
Range: White fir's range extends north through the Klamath Mountains into southwestern Oregon, across the Sierra Nevada, and south to the Transverse and Peninsular Ranges.



Bigcone Douglas-Fir - (Pseudotsuga macrocarpa)

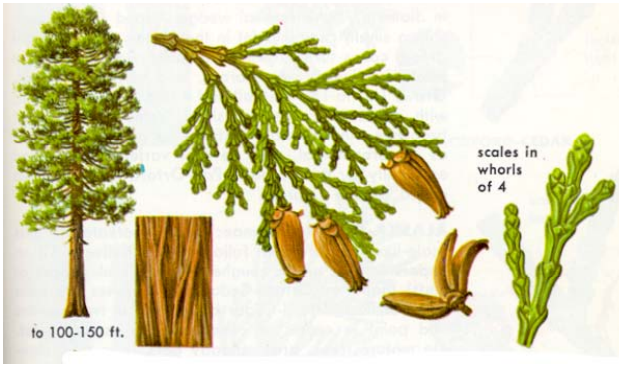
Identification: *Needles single, 1 to 1½" long, sticking out in all directions on a branch like a bottlebrush. Cones are dark brown, 4 to 7 in. long*. Mature bark thick and furrowed, black to reddish brown. Bigcone Douglas-fir will refoliate following fire damage.

Range: Southern California lower montane forest, 3000 to 5500 ft.

Incense Cedar: *Calocedrus decurrens* sometimes called *Libocedrus decurrens*

Identification: *Short overlapping scales cover flattened branchlets*. A set of four leaves is much longer than it is wide. Woody cones are about 1" long. *Bark is flaky when young but platy, furrowed, and reddish-brown when mature*.

Range: Incense cedar can be found throughout California's mixed-conifer forests, from northern Oregon southward through the Siskiyou, Coast Range, and the Sierra Nevada down to the Sierra de San Pedro Martir in Lower California.



Sugar pine *Pinus lambertiana*

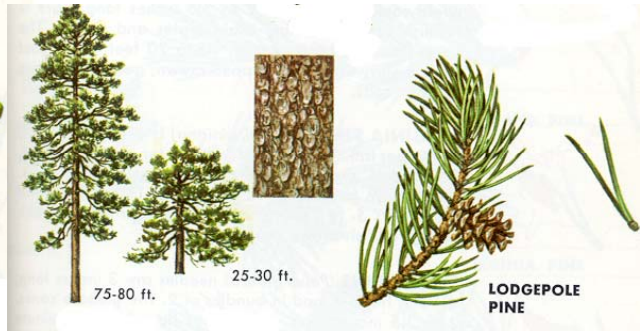
Identification: *Needles are 5 in a bunch*, 2" to 4" long, blue-green and sharp. *Cones are large, 10" to 18" long and longer, cylindrical, and hang from branch tips*. Bark is thin, grayish-green and smooth on young trees and reddish, narrow, broken with scaly ridges separated by deep furrows on old trees. Sugar pine is the tallest American pine growing to over 200 feet tall. The cylindrical trunk is free of branches for much of its length, and topped by an open crown composed of a few long, nearly horizontal, branches, with long cones, mostly solitary, hanging from the tips.

Range: Sugar pine ranges from Santiam Pass in the north-central Cascade Mountains in Oregon, southward through the Sierra Nevada Mountains in California and western Nevada, and into northern Baja California at elevations between 2,000 and 9,000 feet.

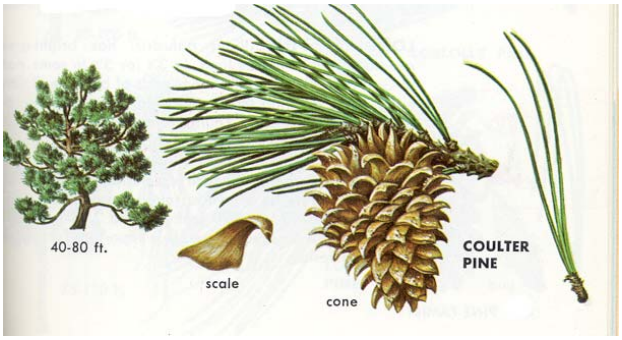
Lodgepole Pine *Pinus contorta*

Identification: *Needles occur in pairs and are 1" to 2 ½" long with sharp ends*. Cones vary from short and cylindrical to egg-shaped, 1½" to 2" long with sharp, flat scales on the ends and often occur in clusters. Bark is thin and scaly and colored orange-brown to gray.

Range: The Sierra lodgepole or tamarack (var. *murrayana*) is found throughout the Sierra Nevada in the Klamath Mountains and farther south in the Transverse and Peninsular ranges.

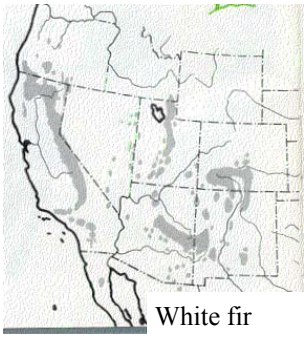


Coulter pine - (Pinus coulteri)
Identification: Needles are in bundles of three, 6" to 12" long., and stout, green to bluish green. *Cones are symmetrical, oblong, 10 to 14" long, and often occur in whorls of 4 around branches*. *Cone scales have large, sharp, flat claws. Cones are serotinous, requiring fire to melt the resin and open the cone*. Bark is thick, fissured, and has yellowish plates.
Range: Contra Costa county to Baja California, 500 to 7,000 ft elevation. Typically grows on dry, south-facing slopes and is tolerant of serpentine soils.



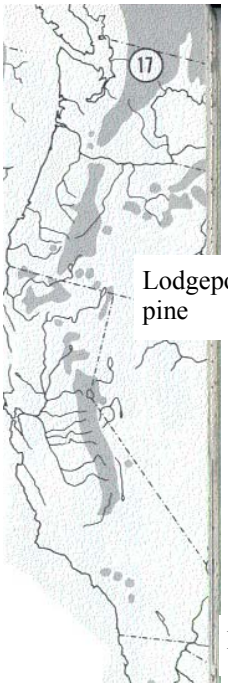
Tree distribution maps


Big cone Douglas-fir


White fir


Incense cedar


Jeffrey pine

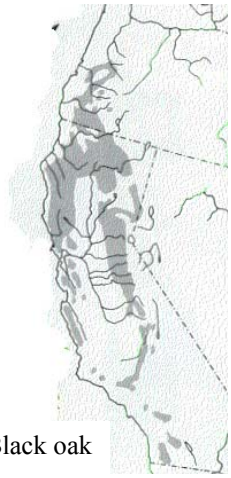


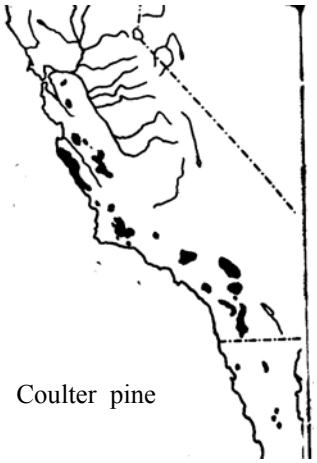
Lodgepole pine

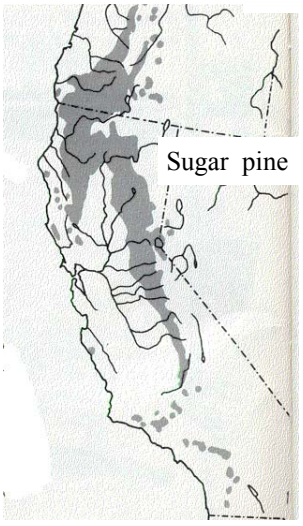

Ponderosa pine

Lake Arrowhead

Idyllwild


Black oak


Coulter pine


Sugar pine

SoCalForestPrimer6
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