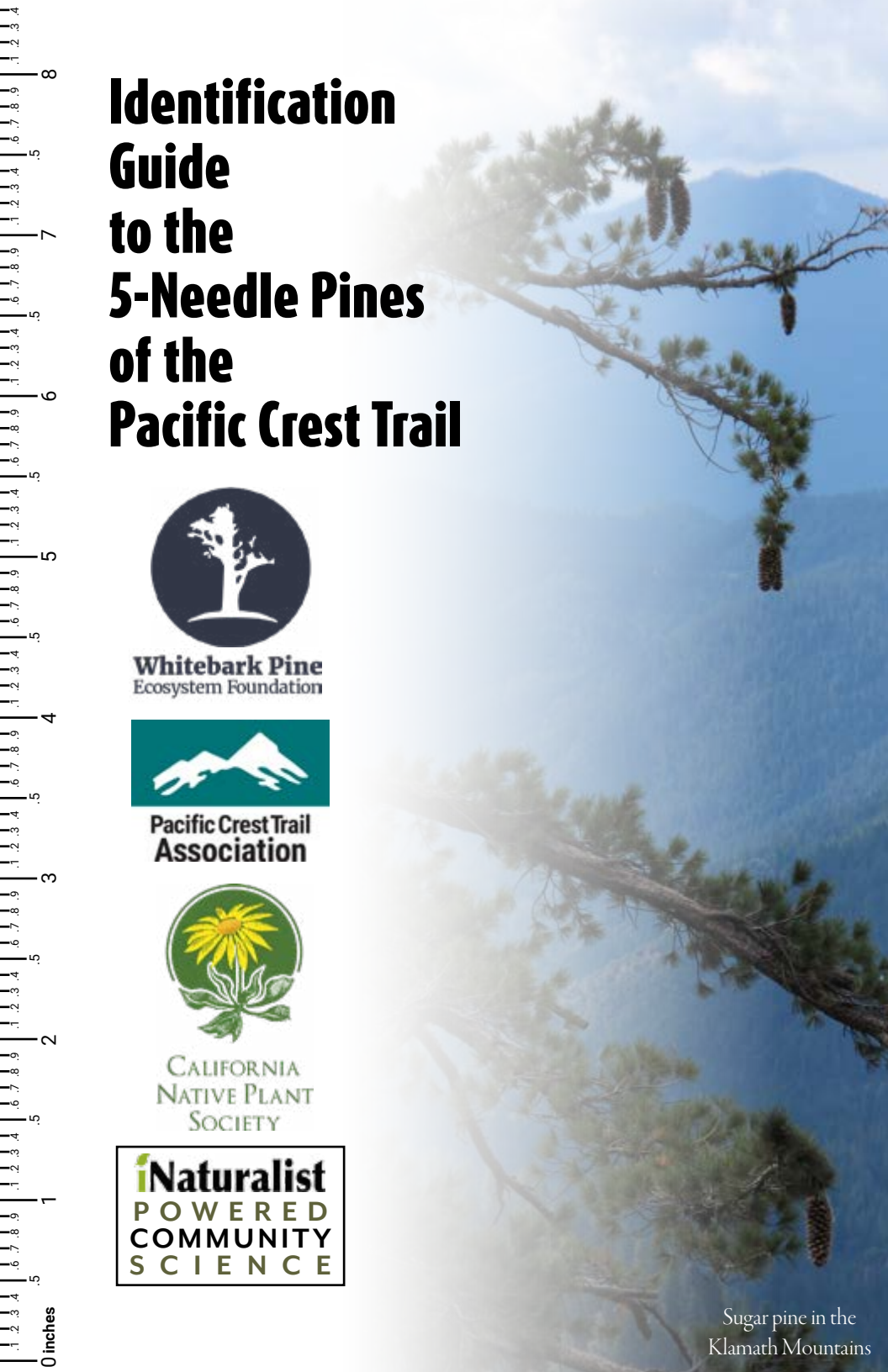
Identification Guide to the 5-Needle Pines of the Pacific Crest Trail

Whitebark Pine Ecosystem Foundation

Pacific Crest Trail Association

California Native Plant Society

iNaturalist Powered Community Science



Sugar pine in the Klamath Mountains

Overview

All is not well with the five-needle pines of western North America. Let's help them. The five-needle pines along the Pacific Crest Trail (PCT), a 2,653 mile route from Mexico to Canada through California, Oregon, and Washington, are the sugar pine, limber pine, foxtail pine, whitebark pine, and western white pine. Crucial to the mountain ecosystems where they live, these trees face an uncertain future, and scientists are trying to learn more.

The forests along the length of the PCT showcase unparalleled conifer diversity—for trail users who are tree aware—and home to about 10% of the world's conifer species. But pines face an uncertain future, and scientists are trying to learn more. You can help and are invited to join an effort to better understand the rapidly changing conditions confronting five-needle pines by contributing your PCT observations.

A Community Science Project

Whitebark Pine Ecosystem Foundation has partnered with the California Native Plant Society and the Pacific Crest Trail Association to raise awareness about the plight of five-needle pines and conduct this community science project. The goal is to get thru-, section-hikers, and everyone who visits to the trail to map and inventory five-needle pines along the Pacific Crest Trail.

By participating, you will help increase awareness of the changes affecting our world while improving connections to nature. Working together to document what's happening is a positive step toward recovery.

Field Equipment

- Cameras specialized for macro photography
- Clip-on lenses for cell phones
- Wi-fi enabled pocket microscopes or similar
- Walking sticks (for plant scale pictures)
- Write in the rain paper
- Pen/Pencil (for scale in needle/cone pictures)

Join the Community

5-NEEDLE PROJECT

1. Join iNaturalist and put the app on your phone. You can upload photos from your phone to the app or from a camera to iNaturalist using your computer at home.
2. Join the "5-Needle Pines Along the Pacific Crest Trail" project.
3. Take pictures of five-needle pines along the PCT. Include the whole tree, bark, and needle close-ups clearly showing the number of needles per bundle and cones (if present). If you don't see cones, look closely around the base of the tree for cone fragments and photograph those (if present). If the tree is showing signs of decline like, top or branch dieback, include a picture of that, too.
4. Add notes to your observation like if Clark's Nutcrackers are nearby or if you see any other animal signs.
5. Upload the photos for each of your tree observations to iNaturalist. Once an observation is uploaded, it is automatically added to the project if it is within 0.5 miles of the Pacific Crest Trail.
6. Do your best to identify trees to the species level – but don't worry, experts and iNaturalist can help with the right pictures.
7. Spend even more time on the trail and add more observations. Thank you!

READ MORE » JOIN THE PROJECT

iNaturalist

Information to Collect

PHOTOS

- Whole tree view [A]
- Needles bundle, make sure it has 5! [B]
- Cones if present [C]
- Bark [D]
- Damaging agents like fungi, beetles, mistletoe, etc.

NOTES

- Habitat description
- Stand-level observations
- Mortality or branch die-back situations
- Do you see signs of animals?
- Anything else that seems relevant.

Threats

All is not well with the five-needle pines of western North America. Climate change and human-caused disturbances are reshaping forests and mountains. Water in the mountains is drying up earlier each season. Snowpack levels are decreasing. Drought conditions and warmer annual average temperatures are driving species typically found at lower elevations upward. Among the five-needle pines, the foxtail and whitebark pines are particularly impacted as different species migrate higher, bringing with them pathogens that the high elevation trees don't have many defenses against.

MISTLETOES

With drought and climate change, mistletoes have more serious impacts.

BARK BEETLES

Bark beetles generally kill larger trees in various sized pockets.

WHITE PINE BLISTER RUST

This rust fungus is rarely seen but symptoms include branch dieback.

Relationships

Justin Garwood

Whitebark pine (*Pinus albicaulis*) is set apart from other 5-needle pines in that its cone does not open at maturity and its seed is "wingless." This is a characteristic of stone pines subsection (Cembrae) within the larger five-needle subgenus Strobus. Whitebark pine is the only stone pine in North America and is solely dependent on Clark's nutcrackers (*Nucifraga columbiana*) for seed distribution and future seedling recruitment. The birds open the cone, collect the seeds, and cache them. Over time, this has developed into a keystone mutualistic relationship. Whitebark regeneration is, therefore, often seen as seedling clumps when young and then collections of multiple trees at maturity due to the unused caches left by the nutcrackers.

A study in Arizona found that the combined caching ability for a flock of 150 birds was several thousand seeds per acre, totaling nearly 4 million seeds per flock, with the combined nutritional value equivalent to 650 pounds of fat. Around 20 percent of these caches go unused and then germinate in the following years. During whitebark pine surveys in the Trinity Alps Wilderness, several unretrieved caches were found in the form of whitebark pine saplings and seedlings on isolated mountain tops including Packer's Peak and Seven Up Peak.

From the southern Sierra Nevada northward, whitebark pines are found. Because of the scarcity of whitebark pine and the fact that seed production does not occur annually, nutcrackers also consume foxtail (*P. balfouriana*) and western white pine (*P. monticola*) seeds—among others. It is rare to hear the nutcracker's robotic squawk and meet the whitebark pine by road—you have to hike a trail and climb a mountain!

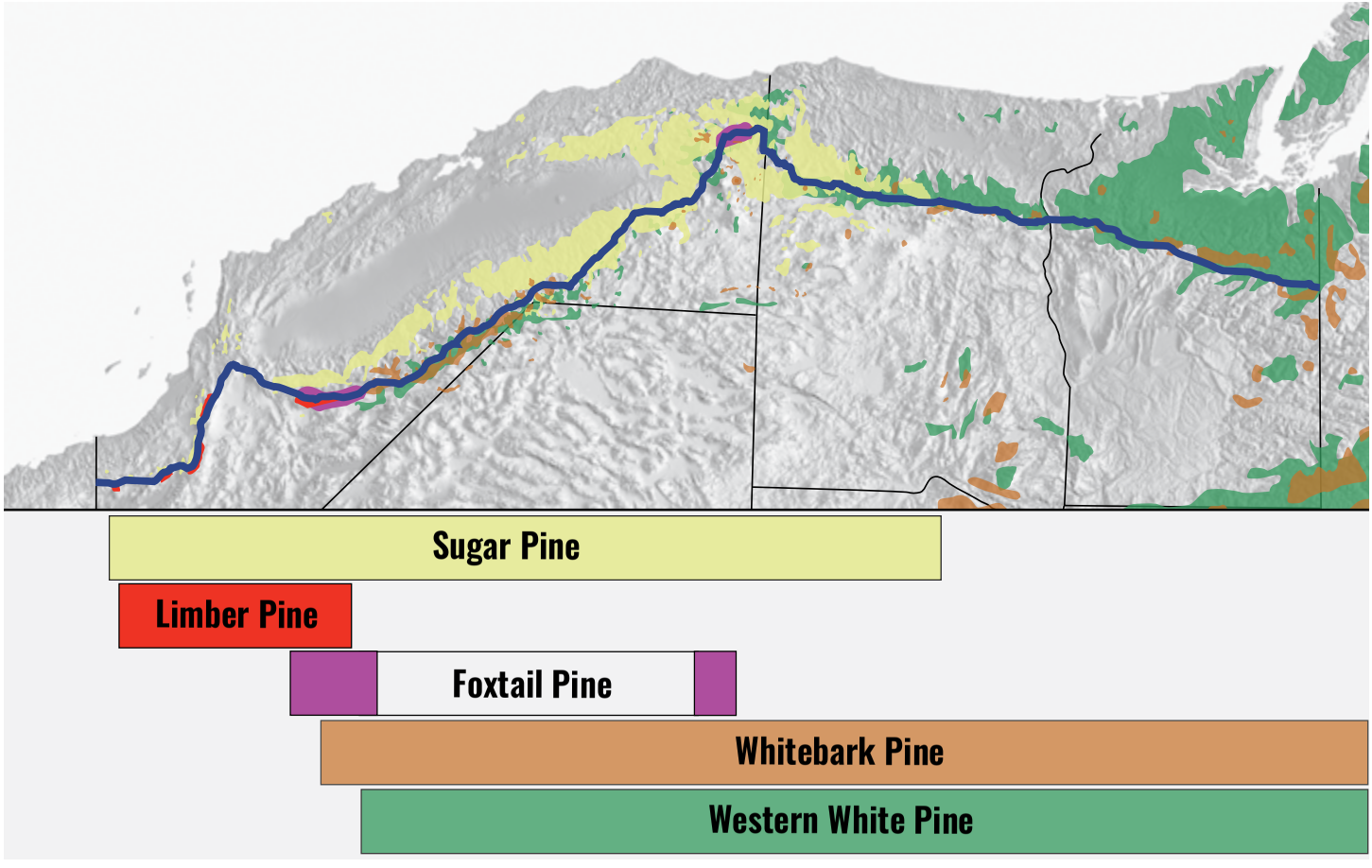
Foxtail pines in Sequoia National Park.

5-Needle Pines of the PCT

Western North America's five-needle pines are among the most beautiful living creatures on Earth. They are also major contributors to the PCT's unique high-elevation aesthetic. A pine tree is a kind of conifer, and five-needle pines along the trail are the sugar pine, limber pine, foxtail pine, whitebark pine, and western white pine. The sugar pine is the world's tallest and largest pine and also creates the longest cone of any conifer. Limber and foxtail pines are among the world's oldest living things and relatives of the ancient bristlecone pine, which can live for 5,000 years. The whitebark pine is, however, the most ubiquitous and iconic high mountain conifer in western North America. It is typically the highest-elevation pine tree found in the PCT's Sierra Nevada and Cascade ranges and often marks the tree line.

Beginning from the southern end of the PCT and moving north, the five-needle pines seen in order of appearance along the trail are sugar pine, limber pine, foxtail pine, whitebark pine, and western white pine. Comparing these species, sugar pines prefer mid-elevations and have the longest needles and cones. Limber pines are only found in the high, arid regions of the Transverse Ranges, Peninsular Range, and southern Sierra Nevada. Foxtail pines make their homes in the high elevations of the southern Sierra Nevada and Klamath Mountains. Whitebark pines stick to the high elevations in the central Sierra and north to Canada. Western white pines live in middle to upper elevations from the central Sierra northward. Western white pines' cones and needles are medium in length, compared with those of the sugar pines and limber pines.

Limber pine along the Pacific Crest Trail in the San Gabriel Mountains.


Sugar Pine
Limber Pine
Foxtail Pine
Whitebark Pine
Western White Pine

whitebark pine

Pinus albicaulis

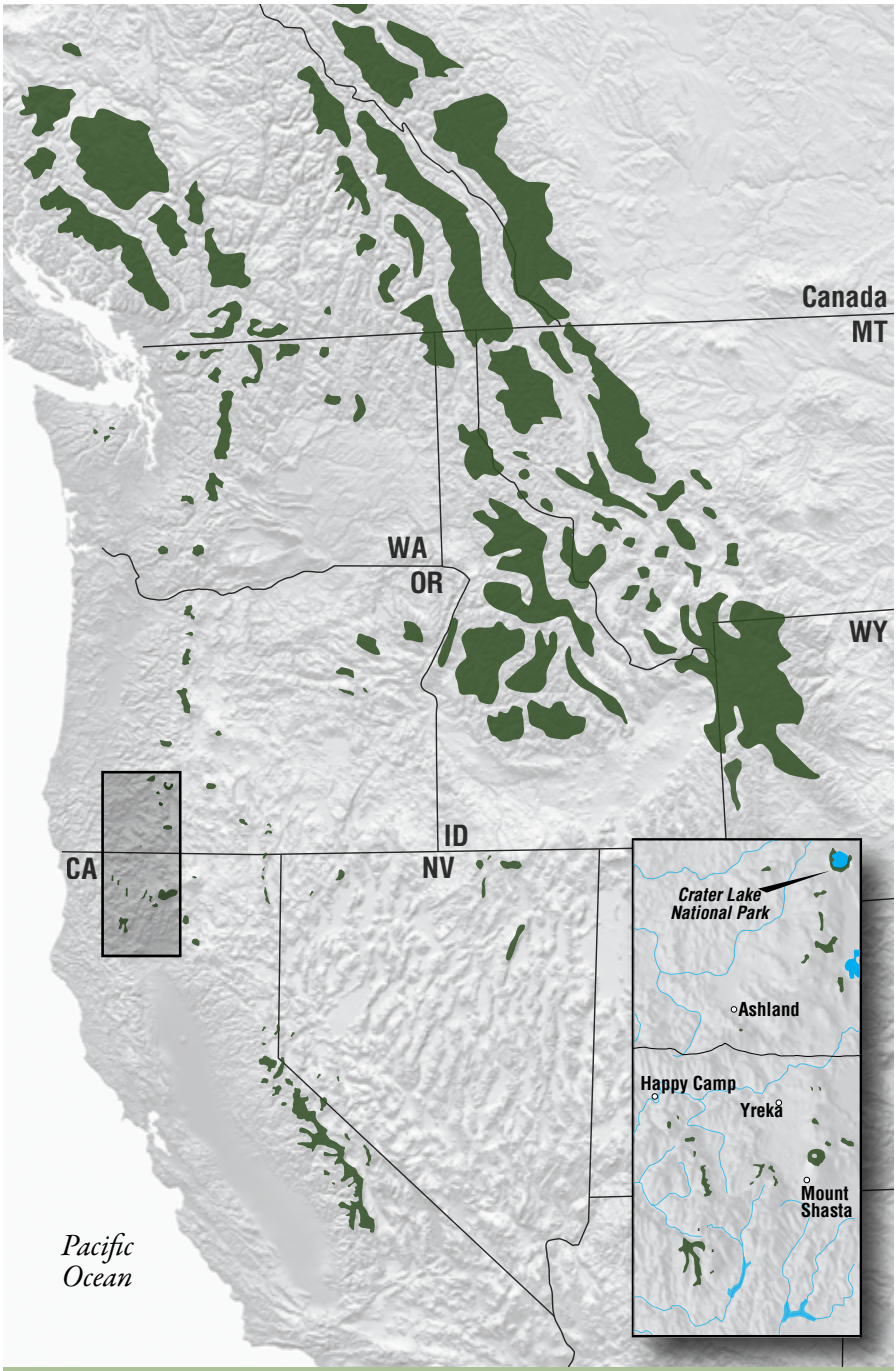
▲purplish, egg-shaped seed cones

◀thinly furrowed, scaly bark

▲ taller trees with thick crowns are more common below ridgelines and mountaintops; here in Oregon's Eagle Cap Wilderness

◀since the mid-1990s, whitebark pines have been dying throughout the West due to white pine blister rust and bark beetle infestations

Tree: to 70' (shorter with increased elevation) and 8' DBH; often multi-stemmed with upswept branches in crown, sometimes single-trunked **Bark**: whitish-gray to whitish-brown, thinly furrowed blocking patterns in older trees (somewhat scaly); new growth is white; sap smells fruity **Needles**: 1.5"- 3.5", yellow-green, stiff, in bundles of 5, wrapped near the stem, some stomatal bloom on all surfaces **Seed Cones**: 2"- 3", purplish, resinous, egg-shaped to spherical and quite symmetrical, do not open on tree at maturity **Habitat**: 6,000'-12,200', subalpine, arid, exposed—only at the upper reaches of highest peaks throughout the western mountains **Observations**: easily seen in the high country of Yosemite, Crater Lake, Mount Rainier, and North Cascades national parks **Remarks**: decorating ridgelines, windshorn specimens are quite charismatic; most susceptible white pines to white pine blister rust, that fungi—coupled with bark beetle infestations—placed whitebark pine on the endangered species list in Canada in 2012



whitebark pine (*Pinus albicaulis*) in western North America*

** based on Little (1971), Griffin and Critchfield (1976), and Charlet (2012)*

limber pine *Pinus flexilis*

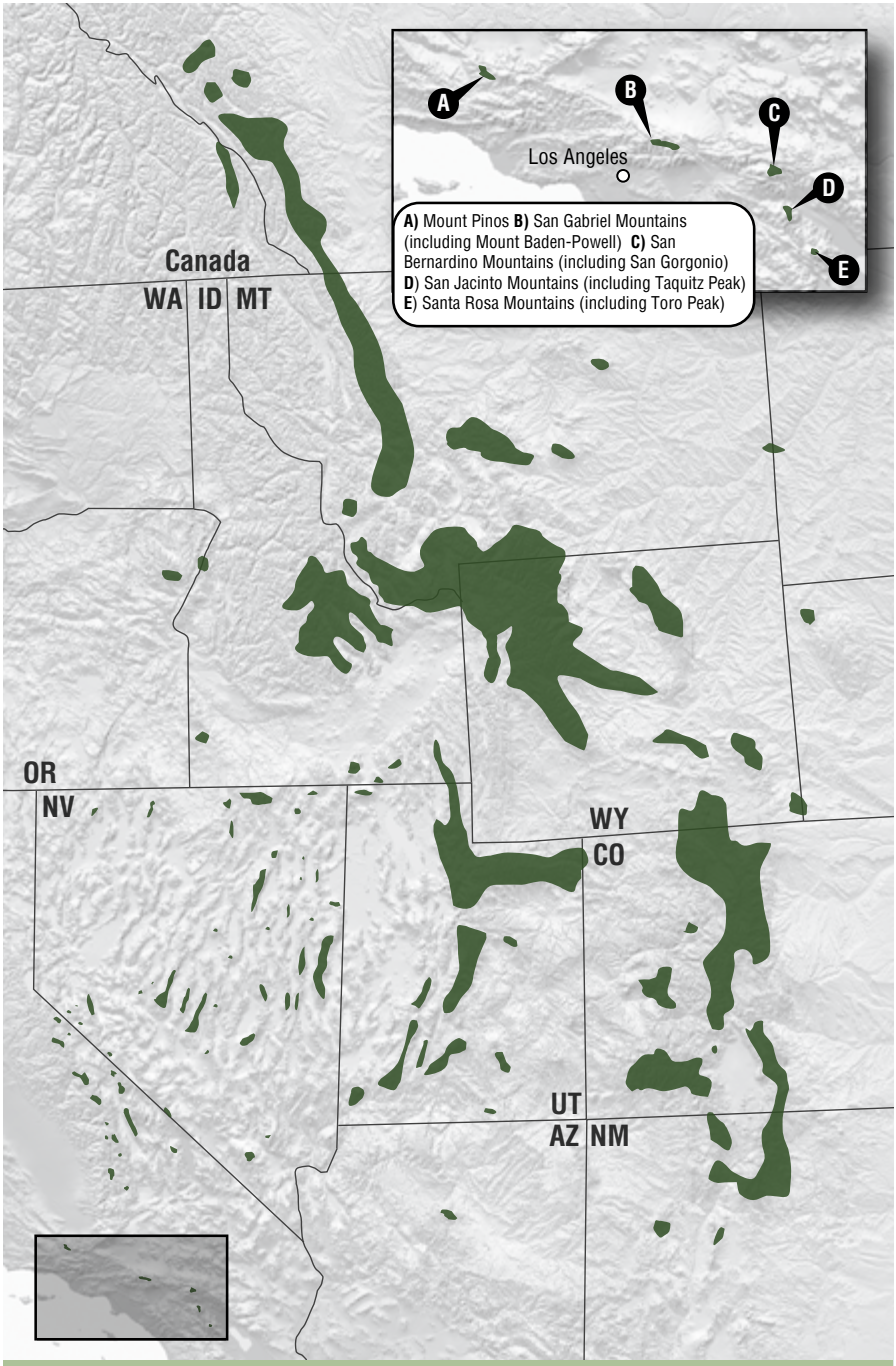
▲ pale yellow seed cones at maturity

▲limber pine bark in foreground, compared to lodgepole pine bark in background

◀gnarled specimen with witches' brooming due to *Arceuthobium cyanocarpum*

▼near the summit of Mount Baden-Powell in the San Gabriel Mtns.

Tree: to 80' (shorter with increased elevation) and 7' DBH; multi-stemmed with upswept branches in crown (similar to western white pine in California); in Rockies, main stem sweeps out in various directions **Bark**: grayish-white when young, becoming brownish-white with thin, interlacing blocking patterns in older trees **Needles**: 1.5"- 3", dark-green, straight, flexible, in bundles of 5 **Seed Cones**: 3"- 6", ripening to pale yellow, egg-shaped to spherical **Habitat**: 4,000'- 11,500', lower in eastern and northern parts of range and higher in southwest; preferring xeric, montane forest upward through subalpine **Observations**: rare along Pacific Slope; in California on Mt. Pinos, Mt. Baldy, Mt. San Gorgonio, Mt. San Jacinto, select canyons in eastern Sierra Nevada, Sirreta Peak, and White Mountains; in Oregon only in eastern portions of the Eagle Cap Wilderness **Remarks**: susceptible to white pine blister rust; can live to 2,000 years



limber pine (*Pinus flexilis*) in western North America*

** based on Little (1971), Griffin and Critchfield (1976), and Charlet (2012)*

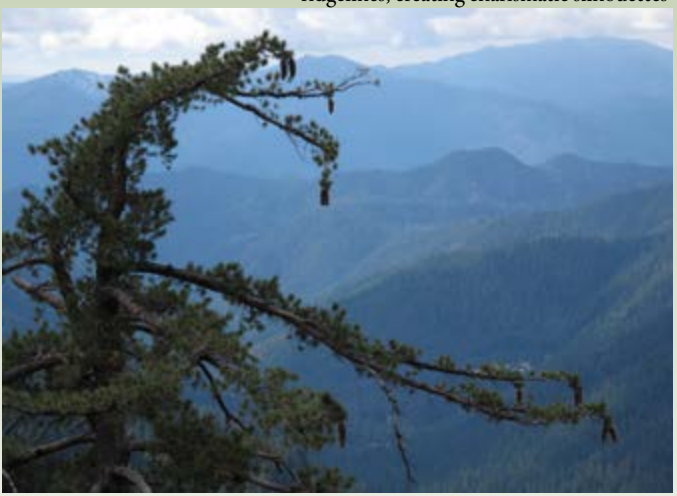
sugar pine *Pinus lambertiana*

▶sugar pine (front) and ponderosa pine (behind) have similar bark; here in the Klamath Mountains

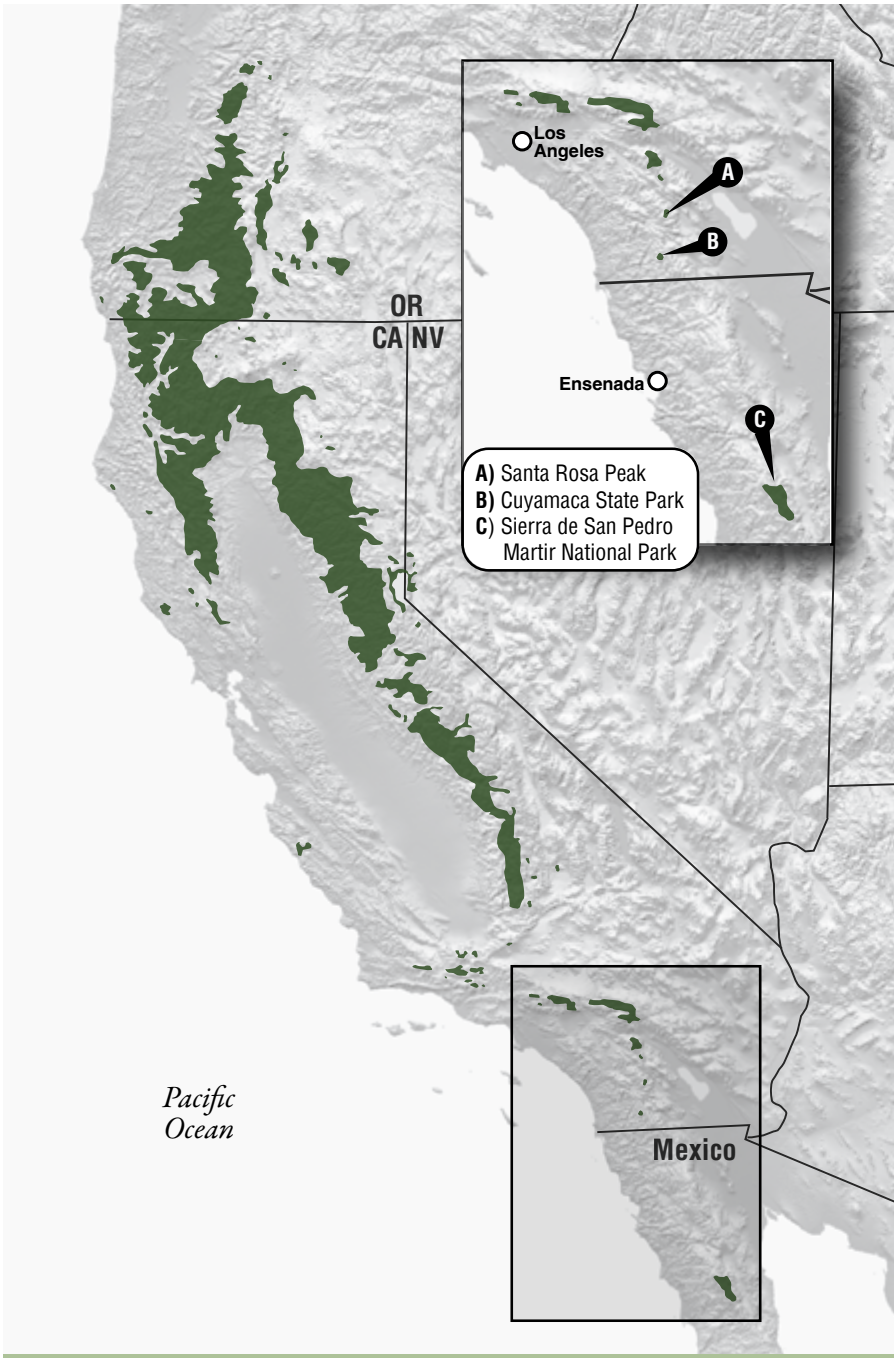
▼this extensive sugar pine-white fir forest occurs in the Sierra de San Pedro Martir, at the southern extent of both species' range

◀large specimens are common with proper soil and climatic conditions

▼branches and cones often dangle from precipitous ridgelines, creating charismatic silhouettes



Tree: to 260' and 11' DBH; crown conical, becoming flat-topped; long branches, often horizontal **Bark**: reddish-brown and narrowly furrowed, flaking in small platelets that collect at the base in mounds; becoming paler with elevation and exposure **Needles**: 3"-4", growing in clusters of 5, blue-green; white stomatal bloom on all sides, including 2 distinct lines on the underside **Seed Cones**: 10"- 20", thicker scales than the western white pine and average 6" longer, yellow-green maturing to yellow-brown; quite sappy; present on tree year-round **Habitat**: 1,500'- 9,000', montane forests, ridgetops, and steep hillsides, generally drier habitat with ample sunlight **Observations**: tremendous specimens in mid-elevations of Yosemite National Park; also found in Klamath Mountains, Transverse Ranges, southern Cascades, Sierra de San Pedro Martir **Remarks**: world's largest pine



sugar pine (*Pinus lambertiana*) along the Pacific Slope*

** based on Little (1971), Griffin and Critchfield (1976), and Charlet (1996)*

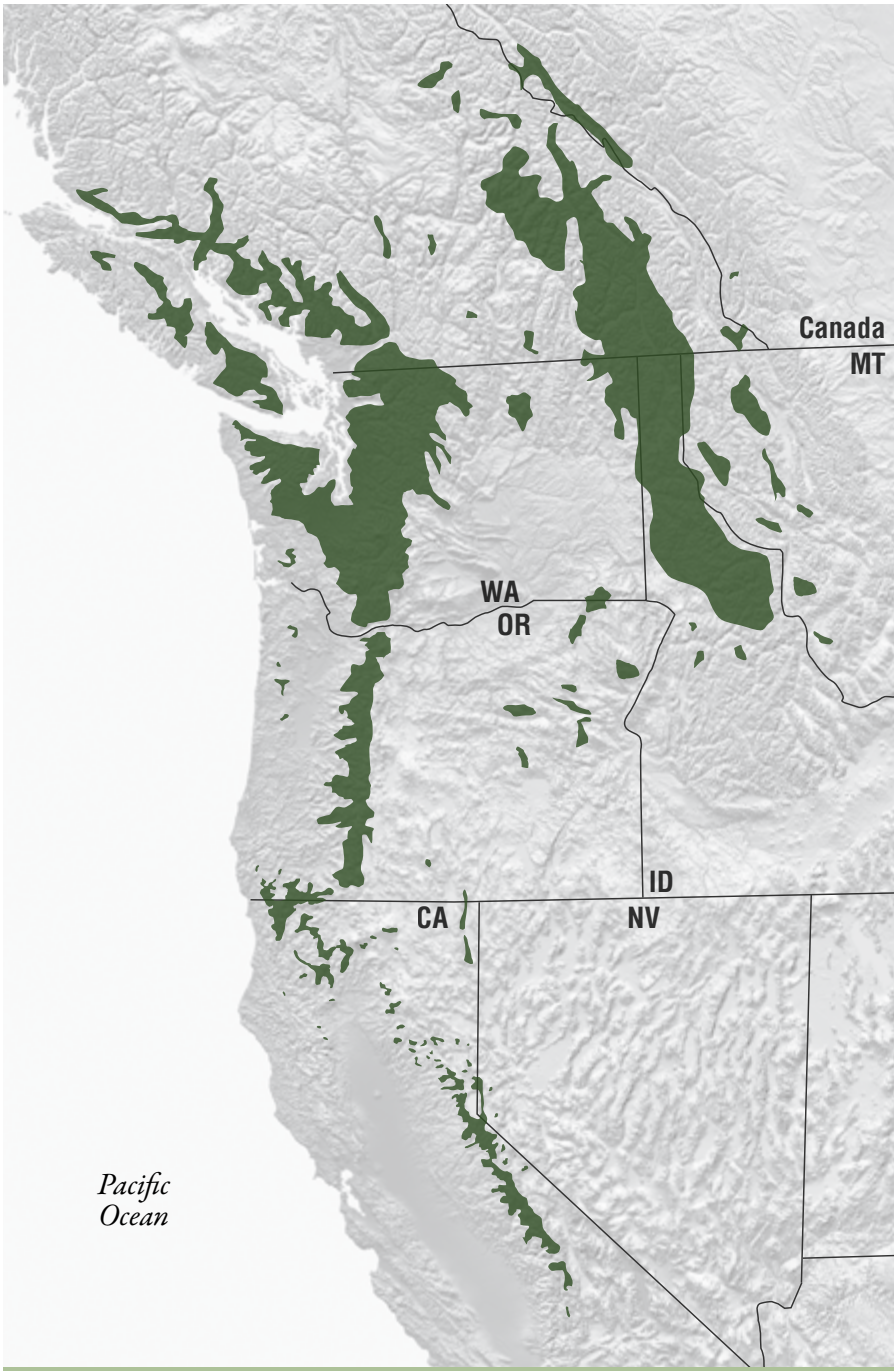
western white pine *Pinus monticola*

◀ cones and bark help distinguish this species

▼ upturned branches at the tops of trees are diagnostic for identification, here in the eastern Sierra Nevada

many trees in the western Klamath Mountains are dying from white pine blister rust and bark beetle infestations; sap and scarring (above, sign of WPBR) and forest mortality (below, sign of BB) ▲▼

Tree: to 180' and 8' DBH; conic crown becoming broad and flattened **Bark**: thin and smooth in younger trees, becoming dark gray to brown, broken into rectangular checkerboard-like pattern (sometimes circular) with deep furrowing **Needles**: 2"-4", 5 per fascicle, bluish-green, underside with faint line down midrib; lacks distinct stomatal bloom found in sugar pines **Seed Cones**: 5"-8", cylindrical, recurved; dark on inner surface of scale, light brown near tip; on tree year round **Habitat**: sea level-9000', gentle, moist slopes, oceanside in north moving upslope and inland southward, associating with many different conifers across range **Observations**: easily found in eastern Sierra Nevada at appropriate elevations, also interior mountains of Washington and Oregon, common above 5,500' in Klamath Mtns. **Remarks**: high mortality across West due to white pine blister rust, bark beetles, and dwarf mistletoe (*Arceuthobium monticola*)



western white pine (*Pinus monticola*) along the Pacific Slope*

** based on Little (1971), Griffin and Critchfield (1976), and Charlet (1996)*

 Conifers of the Pacific Slope

foxtail pine *Pinus balfouriana*

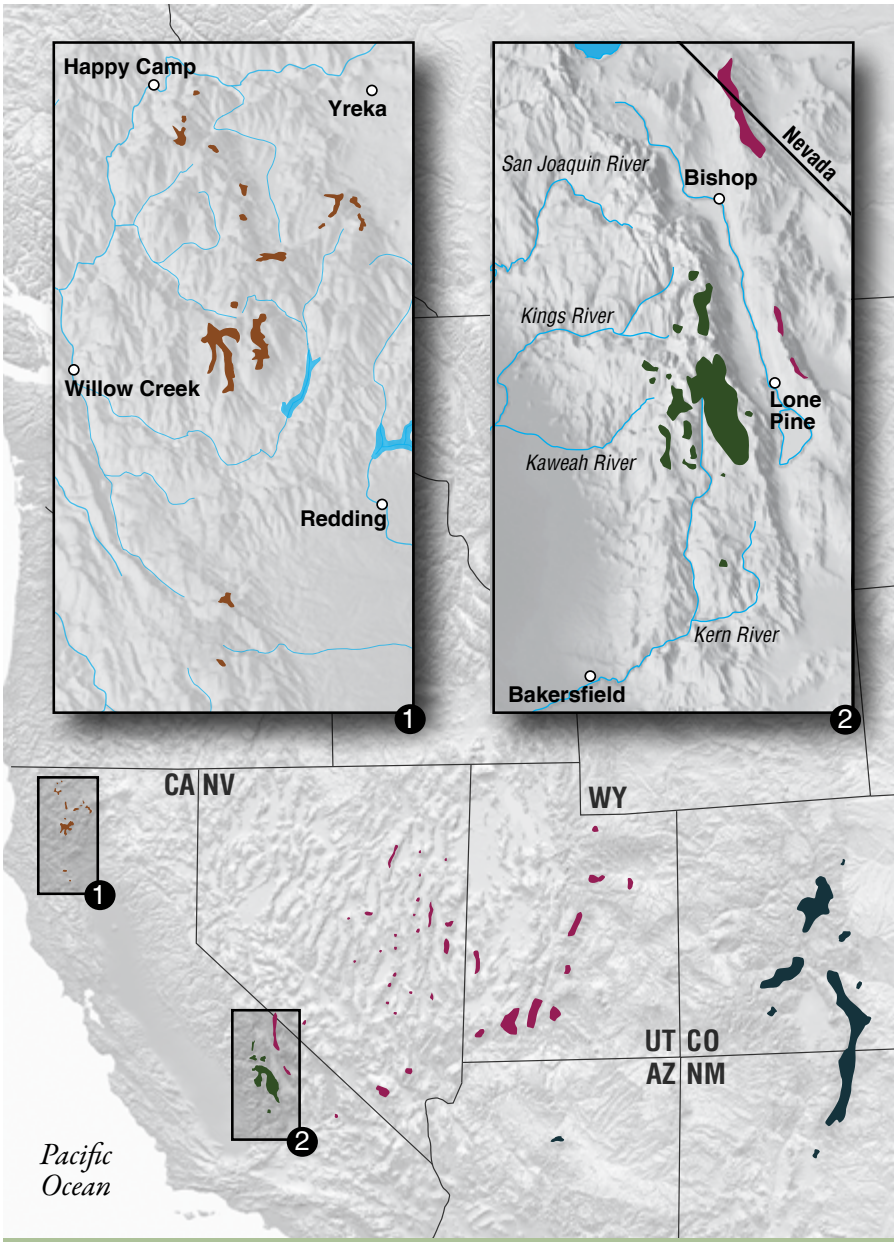
▲groves near Alta Peak looking toward the Mineral King in Sequoia National Park

◀Trinity Alps Wilderness, Klamath Mountains

▼cones dangle at varied angles, decorating the high country's big sky

▼"bottle-brush" growth at tips of branches

Tree: to 100' and 8' DBH **Bark**: light gray (central Klamath) to reddish-brown (eastern Klamath and Sierra Nevada); becoming ridged, furrowed, and breaking into plates with age **Needles**: 1"- 1.5", 5 per bundle, dense clusters that grow from the branches in circular rings, deep bluish-green **Seed Cones**: 3.5"- 5", stout, and tapering to a point, without tips on scales, ripening to brown **Habitat**: dry, south-facing slopes, 6,600'- 11,500', generally exposed, in evenly spaced forests, usually with other subalpine conifers, serpentine outcrops in the Klamath Mountainsor on granite across high elevation plateaus in the Sierra **Observations**: largest pure stand in the Klamath occurs near the summit of Mount Eddy, accessed by a 5-mile hike on the Pacific Crest Trail. In Sierra, Horseshoe Meadow Road from Lone Pine, California will take you into the Last Chance Meadow Research Natural Area, in the western Sierra Nevada via Mineral King to Timber Gap or Wolverton trailhead with a climb to Alta Peak (all these locations are in Sequoia National Park)



Subsection Balfourianae in the western United States*

- **northern foxtail pine** (*Pinus balfouriana* ssp. *balfouriana*)
- **southern foxtail pine** (*Pinus balfouriana* ssp. *austrina*)
- **Great Basin bristlecone pine** (*Pinus longaeva*)
- **Rocky Mountain bristlecone pine** (*Pinus aristata*) - no treatment

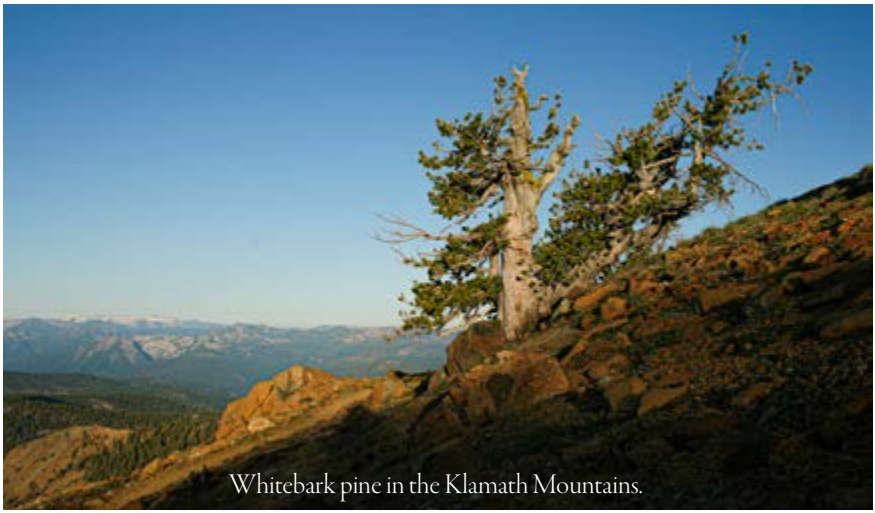
**Little (1971), Griffin et al. (1976) Burns and Honkala (1990), and Charlet (1996)*

The Future of Five-Needle Pines

In many ways, the future looks bleak for five-needle pines. But forward-thinking folks are taking notice and taking action.

Grassroots nonprofits like the Whitebark Pine Ecosystem Foundation have developed rust-resistant breeding nurseries that select more resilient seedlings to become the next generation of five-needle pines. They plant them in forests decimated by high intensity wildfire or bark beetle infestations. Additionally, various efforts to map, count, monitor, and manage whitebark pines are starting up across various national forests and national parks.

By participating in this project you are helping increase awareness of the changes affecting our world while improving connections to nature. Working together to document what's happening is a positive step toward recovery.



Whitebark pine in the Klamath Mountains.

Other Resources

READ MORE » Identification guide to the 5 needle pines of western North America

READ MORE » Whitebark Pine Ecosystem Foundation

Community Science

PROJECT PARTNERS

Whitebark Pine Ecosystem Foundation

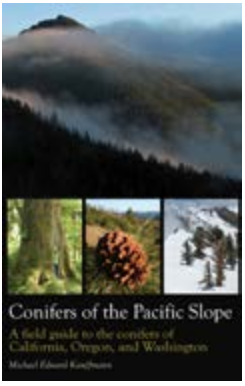
This foundation promotes the conservation of five-needle pine ecosystems by supporting restoration, education, management and research to enhance knowledge and stewardship of these valuable ecosystems (https://whitebarkfound.org).

California Native Plant Society

The California Native Plant Society's mission is to protect California's native plants and their natural habitats through science, education, stewardship, gardening, and advocacy (www.cnps.org).

Pacific Crest Trail Association

The mission of the Pacific Crest Trail Association is to protect, preserve and promote the Pacific Crest National Scenic Trail as a world-class experience for hikers and equestrians and for all the values provided by wild and scenic lands (www.pcta.org).



Content developed and curated by Michael Kauffmann and adapted from his five-needle pine research and book ***Conifers of the Pacific Slope***. *All photos by Michael Kauffmann.*

BACKCOUNTRY PRESS
Humboldt County, CA
WWW.BACKCOUNTRYPRESS.COM