Ponderosa pine forest retreat

Ponderosa pine forests in the Sierra Nevada have retreated uphill over the past 80 years.

On the western side of the northern Sierra Nevada Mountains, the lower edge of the Ponderosa pine forest has moved upslope since the 1930s. These elevations, mostly below 3,300 feet, no longer experience below-freezing nighttime temperatures in the winter as they did before 1950. The Ponderosa pine extends to the lowest elevation in the mixed conifer forests of the Sierra Nevada Mountains.

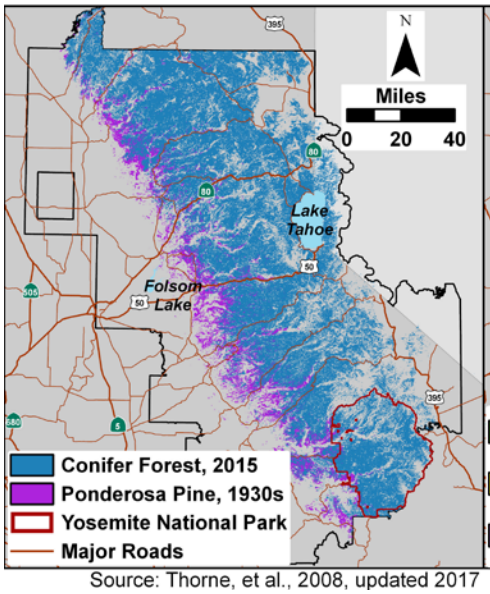
Climate is an important factor that defines plant and animal ranges. Globally, range shifts have been observed among animals and plants, and have been associated with warming temperatures. These redistributions can disrupt ecosystems. For example, a change in dominant vegetation can affect the availability of pine nuts and trees that serve as food and habitat for wildlife.

Photo: Monty Rikard

What does the indicator show?

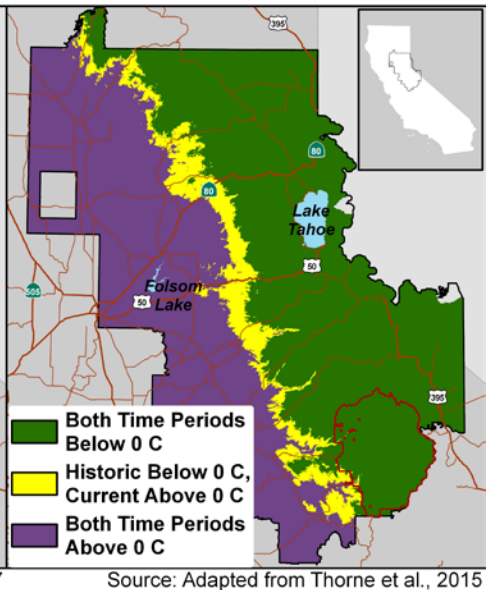
As shown below on the left map, the lower edge of the Ponderosa pine forest has contracted upslope since the 1930s. Ponderosa pines historically occupied the area shown in purple and in blue. Today, they no longer occupy the area shown in purple. Instead, oaks and other hardwood trees and chaparral have expanded into this area. Above this elevation, however, conifers continue to dominate (shown in blue). The elevations from which Ponderosa pines have retreated fall within the area that no longer experiences freezing nighttime temperatures in the winter (yellow areas in the map on the right).

Ponderosa pine forest retreat in the Sierra Nevada Mountains since 1934



Source: Thorne, et al., 2008, updated 2017

Change in winter temperatures between 1921-1950 and 1988-2015



Source: Adapted from Thorne et al., 2015

Why is this indicator important?

Plant and animal species are adapted to specific ranges of climatic and environmental conditions. With warming conditions and limited water availability from reduced snowpack, plants experience increased water stress. One of the ways that plants respond to this is by shifting to higher elevations. The uphill retreat of Ponderosa pines and the accompanying transition to oak-dominated and chaparral vegetation are consistent with the predicted forest response to climate change.

The shift in vegetation from needle-leafed to broad-leafed trees and chaparral is a significant ecological change, with potential impacts on wildlife. Birds, mammals and other species that rely on acorns and oaks for food and habitat will find more favorable conditions, while species that depend on pine nuts and pine trees will find fewer resources. Changes in the amount of shade and the physical structure of trees and shrubs could affect the temperature of microenvironments in the area. Furthermore, the change in the nature of the vegetation could also increase wildfire risk.

The lower edge of the Sierra Nevada snowpack is associated with the conifer belt. The upslope retreat of conifers in this area is a clear biological signal that conditions are changing, serving as a sign of the changes in elevations of the Sierra Nevada that can support a snowpack.

Ponderosa pines are stately trees with a distinctive orange-brown bark arranged in large vertically oriented plates along the tree trunk.

Photo: US Forest Service

For more information about this and other climate change indicators, visit:
https://oehha.ca.gov/climate-change/report/2018-report-indicators-climate-change-california