

# MONITORING KLAMATH MONTANE FORESTS FOR EARLY SIGNS OF CLIMATE-DRIVEN SPECIES TURNOVER

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## PROBLEM STATEMENT

Systematic, ground-based monitoring of forest species composition is needed for early warning of changes to high-diversity forest ecosystems in the Klamath Mountains of California and Oregon (Figure 1).

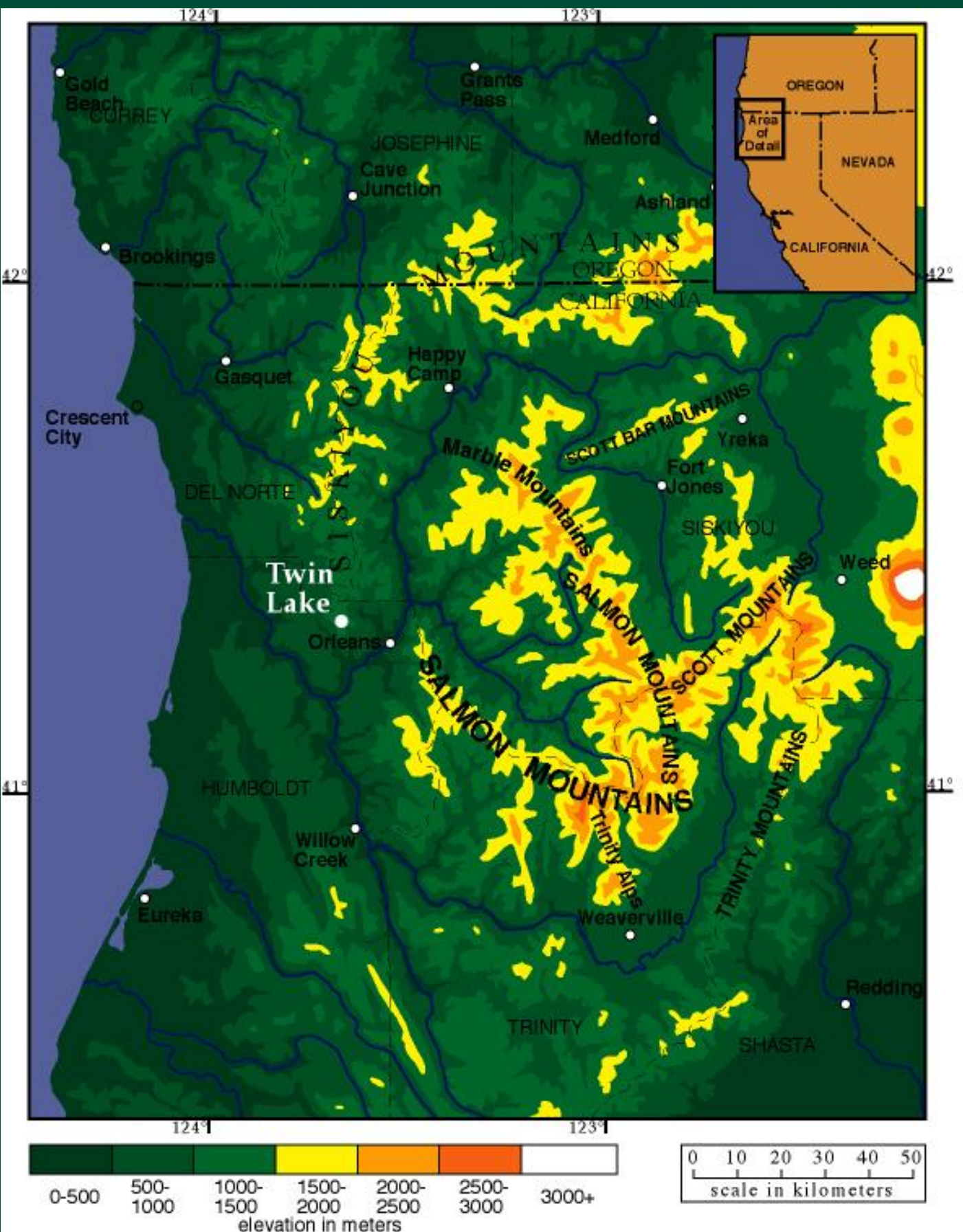


Figure 1: Map of the Klamath Mountains region (left); high-diversity montane forest burned by wildfire in 2017 (right).

## BACKGROUND

The Klamath Mountains include forests with the highest species diversity of conifers in western North America. Pollen records indicate that climate change has driven abrupt species loss and gain (turnover) in the past (Figure 2). Contemporary climate change is expected to produce similar changes in modern Klamath forests.

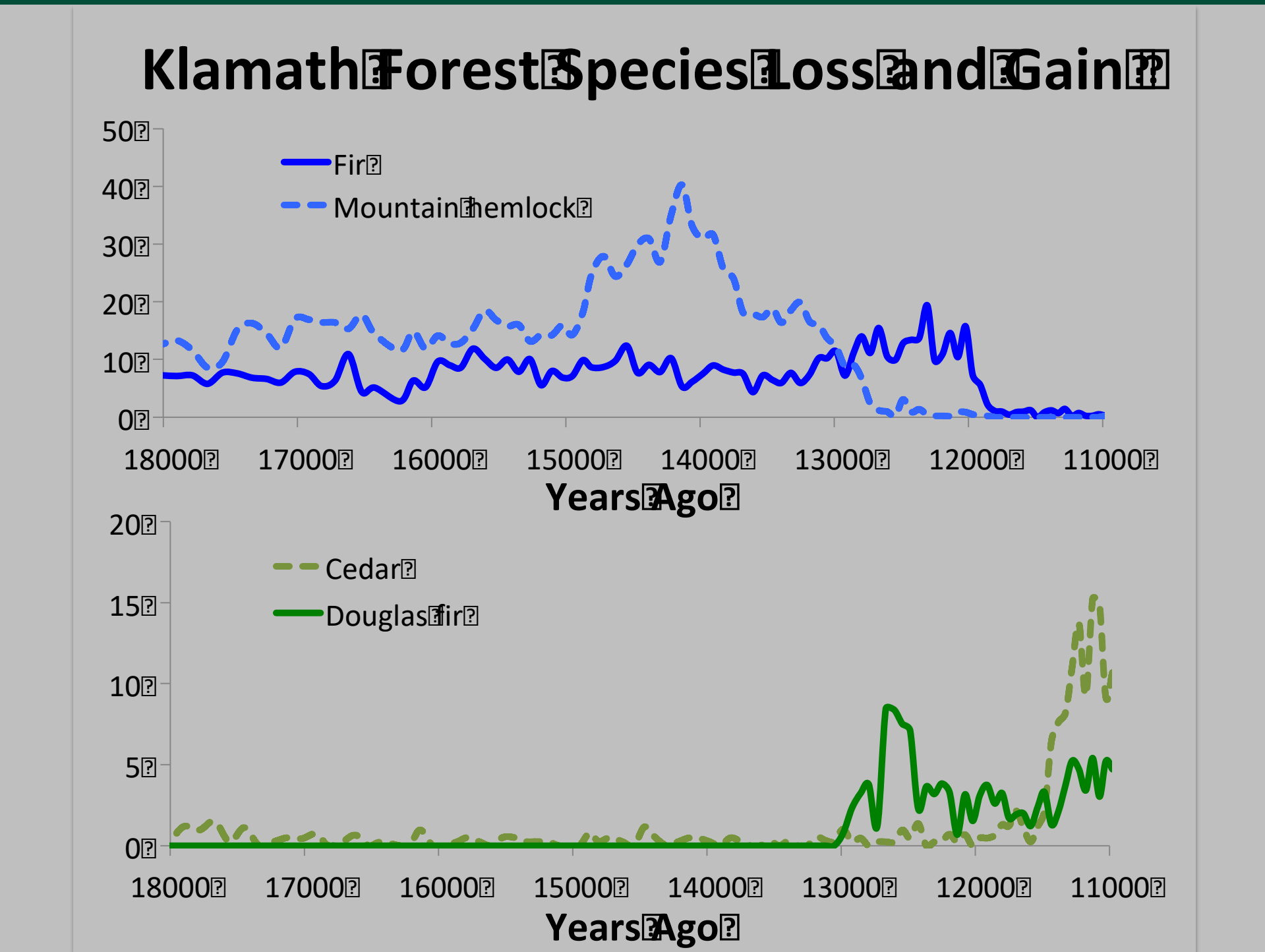


Figure 2: Prehistoric pollen data from Twin Lake, western Klamath

## SUMMARY OF WORK

While remotely-sensed data are important in analyzing large-scale forest change, detecting early stages of species turnover requires ground-based monitoring. Tree species inventories at eighty-two sites visited in 2000-2001 provide a baseline for assessment of species turnover (Figure 3). Forty-four sites were re-inventoried in 2018 and 2019, and a five-year cycle of species inventory is now in place for all sites. So far, the study has found species loss at one site , and new species arrival at three (Figure 4).

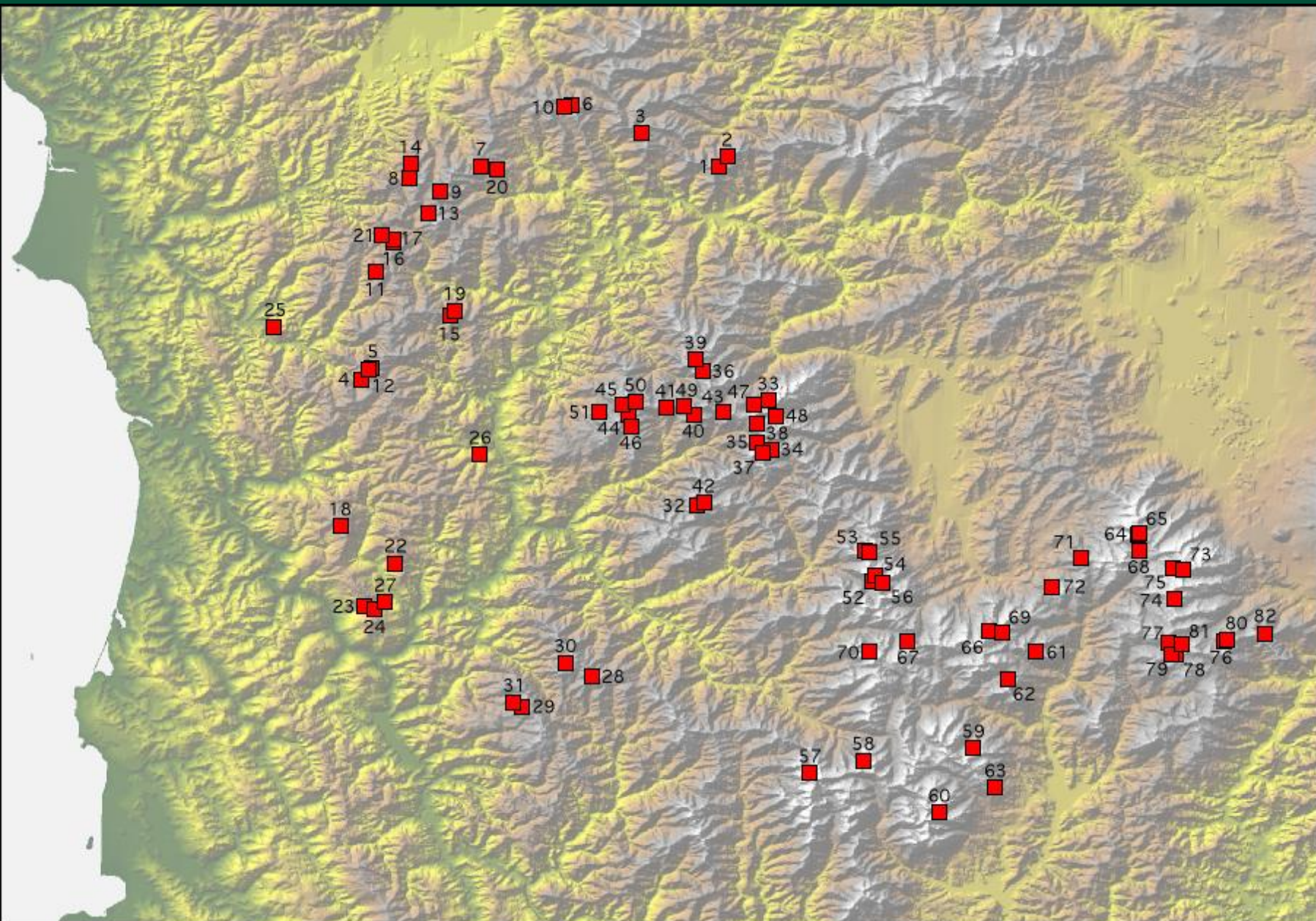


Figure 3: Sites included in the 2000-2001 baseline.

Site#	SpeciesGain/Loss	SpeciesName
29	Gain	WesternWhitePine
40	Loss	MountainHemlock
73	Gain	JeffreyPine
74	Gain	FoxtailPine

Figure 4: Sites with species turnover since 2000-2001.

## IMPACT ON COMMUNITY

Forest species turnover in the Klamath Mountains would be expected to cause large-scale ecosystem disruption and the loss of species diversity in many plant and animal groups. In addition, it can be expected to affect local and regional communities in several important ways:

- Loss of valuable timber species in the region’s five National Forests would impact the local logging industry.
- Recreational use of the diverse forests in two National Monuments and eleven designated Wilderness Areas are vital to the area tourism industry, and forest disruption may reduce visitation.
- Hydrologic changes that accompany species turnover could impact the Central Valley Project, which delivers water to most of California.