



Vegetation Composition, Structure, and Function

Lassen Volcanic National Park, 2012

Background and Importance

Vegetation defines habitat for most other forms of life, makes up most of the biomass on the landscape, and plays an important role in energy pathways. Changes in vegetation composition, structure, and function will therefore have a profound effect on ecosystems. The vegetation of the Klamath parks contributes to the renowned biodiversity of the region. Climate and fire are major drivers of vegetation change. Fire suppression, climate change, local land-use changes, and non-native species invasions can result in significant changes in vegetation communities. Monitoring vegetation is critical to detecting and understanding status and trends in vegetation as well as other park vital signs.

The Klamath Network (KLMN) Inventory & Monitoring Program measures vegetation composition, structure, and function on selected sampling frames in each of six parks of the network every three years (Odion et al. 2011). Parks are paired to enable sampling to be timed well with plant development and flowering. The monitoring project began in 2011. The first year of monitoring at Lassen Volcanic National Park (LAVO) and Whiskeytown National Recreation Area (WHIS) was 2012.



Vegetation monitoring plot in subalpine vegetation at Lassen Volcanic National Park. NPS photo.

Monitoring Objectives

Following are the vegetation monitoring objectives:

1. Describe the composition, structure, and function of vegetation communities in Klamath Network parks by installing and sampling a network of permanent plots established with a probabilistic sample design in safe, relatively accessible areas.
2. Quantify temporal and spatial change in these factors through the re-measurement of permanent plots.
3. Sample communities of special concern (alpine and riparian) at greater intensities to allow improved statistical sensitivity to ecological change and better identification of emerging threats.
4. Co-locate some vegetation plots with bird and stream sampling locations to provide more comprehensive status and trend data and evaluate interrelationships among biota.

(km) from a road or trail. Across all parks, three types of sampling frames are recognized: 1) Riparian (areas within 20 m horizontally of a perennial stream), 2) High Elevation (elevations above a specific elevation limit in each park), and 3) Matrix (remaining areas).

The field crew established established 18 matrix sites; 14 riparian sites, all co-located with stream monitoring sites; and 10 high-elevation sites, all co-located with whitebark pine monitoring sites. A 20 x 50 m plot was used for sampling all of the sites. A wide range of data is collected from each plot. On each forested plot, vegetation is assessed in four strata, from tree canopy to ground layers. Each plot consisted of ten 10 x 10 m modules, four of which are sampled intensively for species, ground cover, and seedling and sapling data (Figure 1). Other components of vegetation examined include down wood, litter, and duff.

Monitoring Approach

The monitoring sampling frame used was constrained for safety and logistical reasons to exclude areas with slopes greater than 30 degrees, and locations less than 100 meters (m) or more than 1 kilometer

10	9	8	7	6
1	2	3	4	5

Figure 1. The 20 x 50 meter matrix site layout. Each numbered square is 10 x 10 meters. Shaded squares are the four modules where more intensive sampling occurs.

Results

Vegetation Composition

Species richness in the Lassen matrix sampling frame ranged from 4-29 species per 0.1 ha sampling plot (Figure 2). Across all matrix plots sampled, 111 species (113 when counting unknowns) were observed. The riparian sampling frame proved to be very diverse; species richness at the plot level ranged from 47-93 species, with 302 species observed (311 when counting unknowns). Species richness in the high elevation frame ranged from 6-23, with 52 species observed. Non-native species composition ranged from 0-6 % in matrix sites, 0-4 % in riparian sites, and 0 % for all sites in the high elevation frame (Figure 2). We observed one non-native species in the matrix sampling frame and four in the riparian. Only dandelion (*Taraxacum officinale*) was observed with notable frequency in the riparian sampling frame, occurring in 71 percent of the plots. Ten tree species were observed; eight occurred in the matrix sampling frame, seven in the riparian frame, and four in the high elevation frame. Tree basal area composition by site is shown in Figure 3.

No new species were observed at Lassen.

Vegetation Function (Regeneration)

In the matrix sampling frame, red fir (*Abies magnifica*) was the most abundant regenerating tree species in the smallest size class, and white fir (*Abies concolor*) was the most abundant in all other size classes. In the riparian sampling frame, *Abies magnifica* was the most abundant regenerating tree species in the smallest three classes; Lodgepole pine (*Pinus contorta*) was the most abundant regenerating tree species in the largest two size classes. In the high-elevation sampling frame, mountain hemlock (*Tsuga mertensiana*) dominated all size classes. Mean regeneration counts for all tree species combined by size class are provided in Smith and Sarr (2014).



Mountain hemlock new foliage growth.

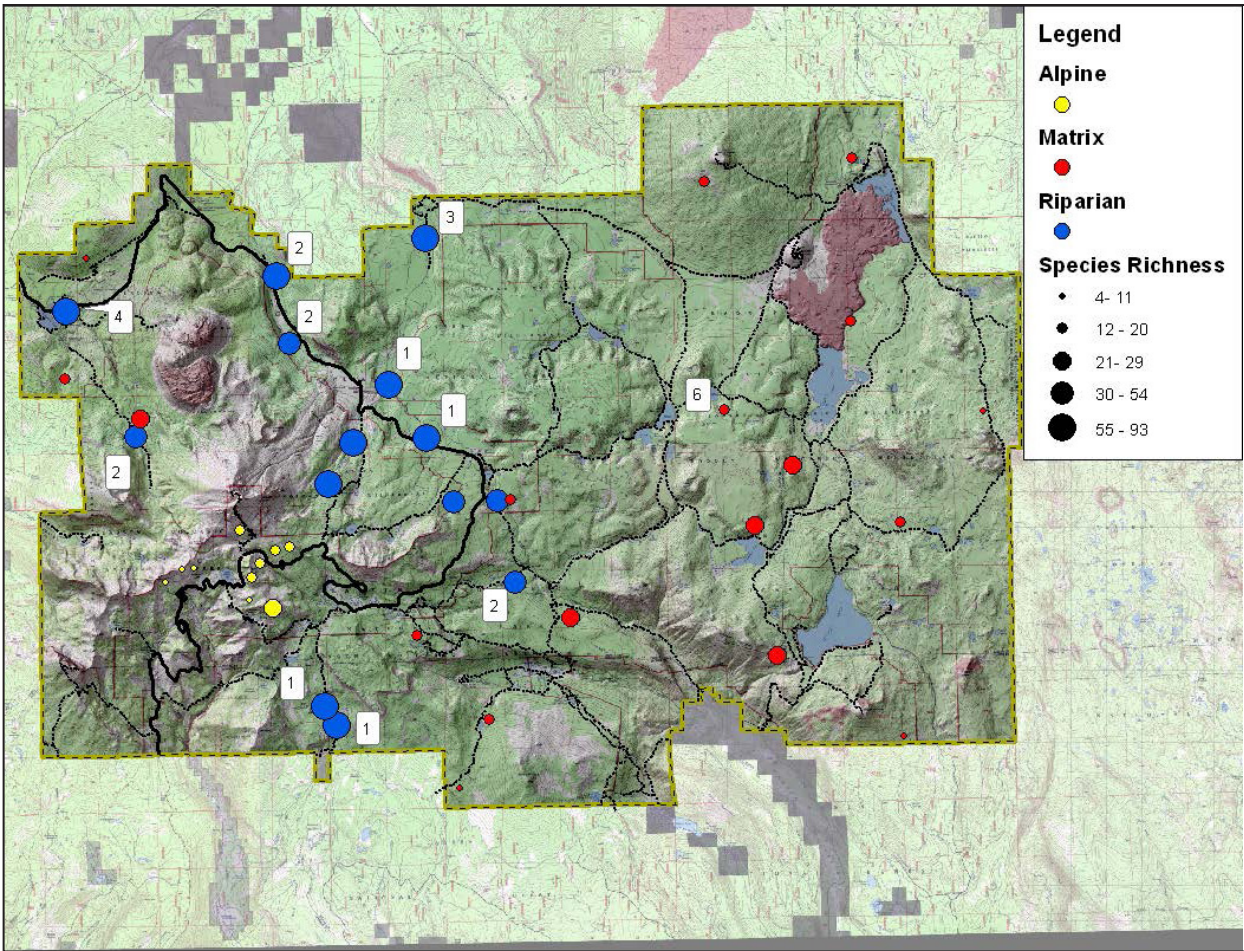


Figure 2. Lassen site species richness from each sampling frame. White labels show percentage of species that are non-native. Sites with no non-native species are not labeled.

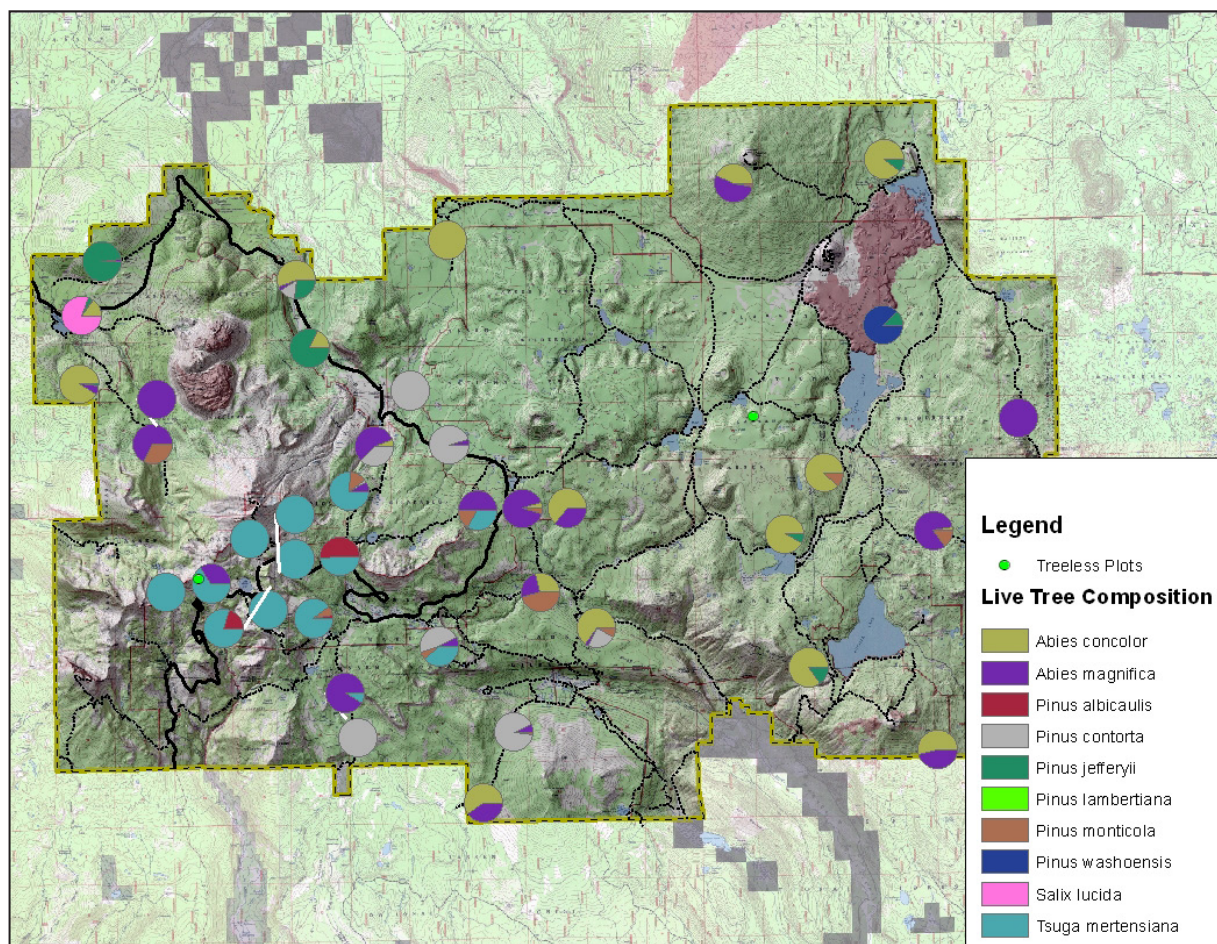


Figure 3. Individual tree (>15cm dbh) species basal area composition of Lassen sites.

Vegetation Structure

Highest values for vegetation cover were largely found in strata 1 (<0.75m) and 4 (>5m). Mean vegetation percent cover in both the high elevation and riparian sampling frames was highest in stratum 1. The matrix sampling frame mean vegetation percent cover was highest in stratum 4 (32.1%), and second highest in stratum 1 (15.7%). Maximum vegetation percent cover values for all sampling frames were highest in stratum 1.

Mean live tree basal area at Lassen was highest in the matrix (43.54 m²/ha), second highest in the riparian (30.97 m²/ha), and lowest in the high elevation (20.68 m²/ha) sampling frames (Table 1). Snag basal area was much lower than live tree basal area. One matrix and one high elevation plot lacked trees. Matrix site mean tree density (342 trees/ha) was higher than for both high elevation (253 trees/ha) and riparian

(244 trees/ha) sites. Matrix site mean snag density (103 trees/ha) was highest, followed by riparian (62 trees/ha), and lastly high elevation (13 trees/ha) sites.

Mean shrub heights were low in all sampling frames, with high elevation sites at 0.02 m, matrix sites at 0.14 m, and riparian sites at 0.52 m. The riparian sampling frame had a maximum shrub height of 2.15m while the other two sampling frames were both less than 0.5 m.

Litter was the dominant ground cover in all three sampling frames. In the high elevation sampling frame, while fine wood/litter was highest (39.6%), rock (37.4%) and bare soil (21.9%) were also substantial components. See Smith and Sarr (2104) for more information about vegetation structure.

Table 1. Basal Area (BA) minimum, maximum, average, and standard deviation for sampling frames. Units are m²/ha.

Sampling Frame	Minimum Basal Area	Maximum Basal Area	Mean Basal Area	Standard Deviation
High Elevation- Live Trees	0.00	64.63	20.68	26.33
Matrix - Live Trees	0.00	105.58	43.54	27.51
Riparian - Live Trees	1.26	66.85	30.97	22.08
High Elevation - Snags	0.13	0.62	0.34	0.26
Matrix - Snags	0.02	3.42	1.32	1.16
Riparian - Snags	0.07	2.82	0.89	0.92

Comparisons with Other KLMN Parks

As this is the second season implementing our Vegetation Monitoring Protocol (Odion et al. 2011) we can only present data on status. Species overlap between the Lava Beds and Whiskeytown was 71 species. This is a much greater overlap in species composition than observed during the 2011 field season, when Redwood National and State Parks and Lava Beds National Monument had only four species of overlap (Smith and Sarr 2013). Only two species are consistent among all four parks: Common yarrow (*Achillea millefolium*) and Goose Grass (*Galium aparine*). Only one species was consistently observed among all six parks: Common yarrow (*Achillea millefolium*) (Smith and Sarr, in review).

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Common yarrow (*Achillea millefolium*), the only species consistently observed among all six KLMN parks.

Logistics

During this first year of vegetation monitoring in Lassen Volcanic National Park, we surveyed 90% of matrix, 70% of riparian, and 100% of high-elevation target sites. The reasons for not meeting our goals at Lassen were beyond our control. The Reading Fire started on July 23rd (near Reading Peak within Lassen) and burned 16,993 acres in the north central portion of the park. Anything inside the perimeter of the Reading Fire was inaccessible, even after the fire was controlled, which included six matrix sites and seven riparian sites. Fires both in the park (Reading Fire) and outside the park boundary slowed our work and prevented us from getting to several sites altogether. Without the issues caused by the fires, we feel confident we would have completed our 20 matrix, 20 riparian, and 10 high-elevation targeted sites.

Management Relevance

Annual reports from this project provide parks information about the status of vegetation community composition, function, and structure. This includes documentation of non-native species locations, plant species newly discovered for the park, and vegetation responses to disturbances such as extreme weather events or fire. Over time, trend data will provide valuable information on spatial and temporal patterns of vegetation change, providing a foundation for resource stewardship activities and research projects that can be directed at better understanding the causes of observed changes.



Lightning-caused Reading Fire, 2012, in Lassen. The KLMN vegetation monitoring may help provide information about vegetation change associated with fires and other disturbance events.

References Cited

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More Information

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<http://science.nature.nps.gov/im/units/klmn/monitor/vegetation.cfm>