National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science
Klamath Network

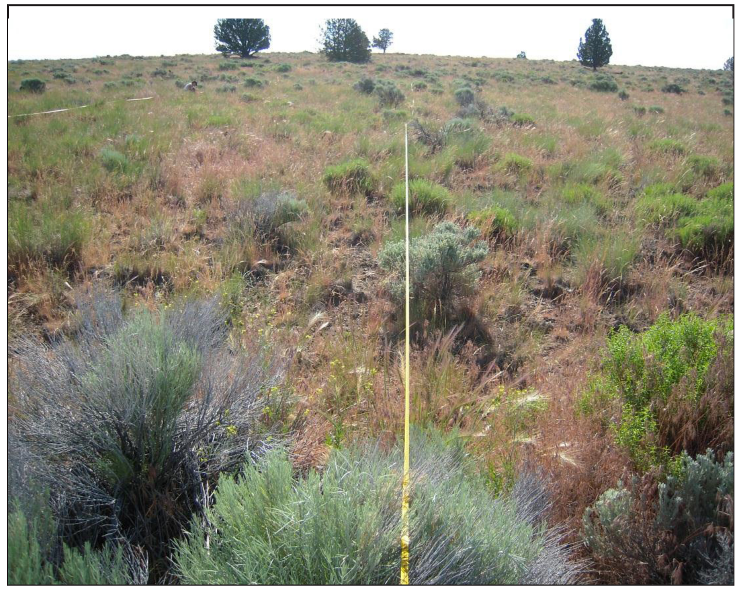
Vegetation Composition, Structure, and Function

Lava Beds National Monument, 2011

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. Monitoring began at Lava Beds National Monument (LABE) and Redwood National and State Parks (RNSP) in 2011.



An example of typical vegetation structure at a monitoring plot in Lava Beds National Monument. 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.

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 (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).

Between May 28 - July 10, 2011, the field crew established 30 matrix sites at Lava Beds, 25 of which were co-located with bird monitoring sites. A 20 x 50 m plot was used for sampling the matrix 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.

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

Vascular plant species richness at Lava Beds ranged from 14 to 51 species per 0.1 ha sampling plot (Figure 2). For all 30 plots, 131 species were recorded (141 when counting unknowns). The most frequently occurring understory species by sampling frame are reported in Smith and Sarr (2013). The invasive species cheat grass (*Bromus tectorum*) was the most commonly occurring herbaceous species, while sagebrush (*Artemisia tridentata*) was the most frequently occurring shrub at Lava Beds. Overall non-native species composition ranged from 2-29 percent of the species present at the plot level (Figure 2). A total of 12 non-native species were observed. The most frequently occurring are cheat grass, ragged chickweed (*Holosteum umbellatum*), and milk thistle (*Lactuca serriola*), occurring at 100, 63, and 57 percent of plots, respectively. Tree composition at Lava Beds consisted of only three species: juniper (*Juniperus occidentalis*) curl-leaf mountain mahogany (*Cercocarpus ledifolius*), and ponderosa pine (*Pinus ponderosa*). Figure 3 shows tree composition percentage by site.

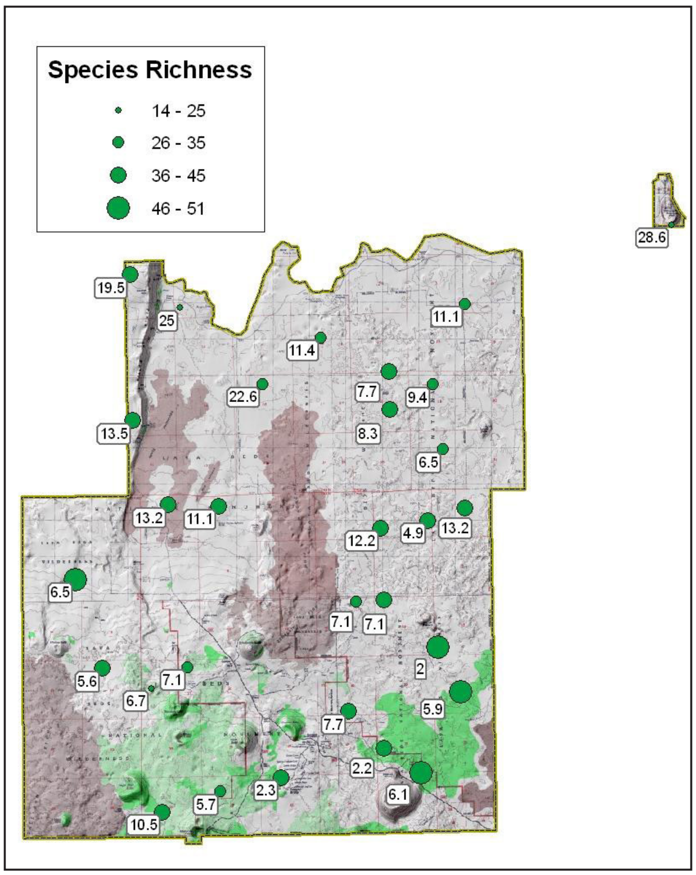


Figure 2. Site species richness from each sampling frame displayed by green bubble sizes. White labels show percentage of species that are nonnative.

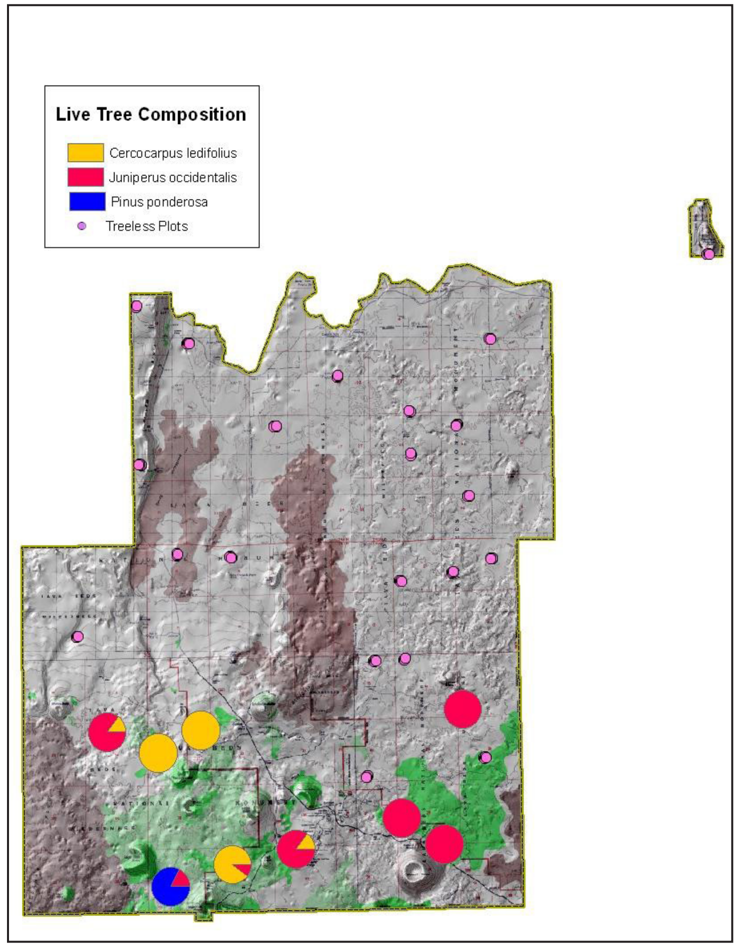


Figure 3. Tree species composition (by percentage) at each matrix site in Lava Beds.

Vegetation Function (Regeneration)

The most abundant regenerating tree species in all size classes was curl-leaf mountain mahogany. Mean regeneration counts for all tree species combined are shown in Table 1.

Curl-leaf mountain mahogany gone to seed. Photo: Z&B Johnson.

Table 1. Lava Beds regeneration by size class for all live tree species by sampling frame. Units are trees/ha, standard deviations shown in parentheses.

Frame	<15cm Tall	>15cm Tall- <2.54cm dbh	>15cm Tall >2.54 - <5cm dbh	>15cm Tall >5 - <10cm dbh	>15cm Tall >10 - <15cm dbh
Matrix	550 (1477)	833 (2842)	76 (201)	69 (168)	21 (46)

Vegetation Structure

The majority of vegetation cover at LABE occurred in the lowest two strata (Table 5). Stratum 1 (<0.75min vegetation height) had the highest cover with the trend being decreasing vegetation cover with each increasing stratum height. Overstory cover was almost nonexistent (mean = 0.8% (S.D.= 2.0%) in stratum 4 (>5m height). Figure 9 shows the typical vegetation structure at LABE.

Mean plot basal area was low for both live trees (1.09 m2/ha) and snags (0.01 m2/ha). Only 9 of 30 plots contained trees >15cm dbh. Table 6 shows basal area summary. Lava Beds tree density was low, 15 trees/ha, and snag density was 2 trees/ha.

Down woody debris was very low, ranging from an average of 0.10 tons/acre for the 1-hour lag fuel class to 0.22 tons/acre for the 1,000-hour sound fuel class.

Mean shrub height for the matrix sampling frame was 0.77 m (S.D. 0.33 m). At the plot level the minimum mean shrub height was 0.04 m and the maximum 1.42 m. All plots had shrubs.

Fine wood and litter dominated the ground cover with rock a close second. Litter and duff mean depths were very similar at 0.51 cm (S.D. 0.54 cm) for litter and 0.54 cm (S.D. 0.52 cm) for duff. Additional vegetation structural summaries are available in Smith and Sarr (2013).

Comparisons with Other KLMN Parks

As this is the first season implementing our Vegetation Monitoring Protocol (Odion et al. 2011) we can only present data on status. Data collected in 2011 were for the most part what we expected: Lava Beds and Redwoods, located at opposite ends of the coast to interior climate gradient, have very different vegetation composition. Species overlap between the two parks was limited to four species: *Achillea millefolium*, *Galium aparine*, *Sambucus mexicana*, and *Taraxacum officinale*.

Differences in structure are obvious to anyone who has driven through these parks, and are reaffirmed by our data. Overall generalities are that Lava Beds has moderate understory cover and very sparse overstory cover, low basal area and tree density, and the trees that are present aren't very tall; correspondingly, litter, duff and woody debris are also low. At Redwood, the generalities are opposite on all accounts, with RNSP even boasting some of the tallest trees in the world. Subsequent monitoring years in the other KLMN parks revealed that only one species was consistently observed among all six parks: Common yarrow (*Achillea millefolium)* (Smith and Sarr, in review).

Logistics

Sampling at Lava Beds went largely as planned. We reached our original target number of sites, as off trail travel was relatively easy. The timing of sampling at Lava Beds was about perfect, with some of the later sites having some dried, but recognizable, plants.

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.

Cheat grass (*Bromus tectorum*), the most commonly occurring understory plant and non-native species. Photo: UBC Botanical Garden and Centre for Plant Research -- Daniel Mosquin.

References Cited

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More Information

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