



Vegetation Composition, Structure, and Function *Whiskeytown National Recreation Area, 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 Whiskeytown National Recreation Area (WHIS) and Lassen Volcanic National Park (LAVO) was 2012.

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



Vegetation monitoring plot at Whiskeytown National Recreation Area. NPS photo.

(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 21 matrix sites, all co-located with Bird Community monitoring routes; 15 riparian sites, 13 co-located with Stream Monitoring sites; and 10 high elevation 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 (Smith and Sarr 2014).

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 for the 0.1 ha sampling plot at Whiskeytown ranged from 9 to 81 species for matrix, 36 to 96 species for riparian, and 10 to 48 species for high elevation sites (Figure 2). For all matrix plots, 216 species were recorded (234 when counting unknowns). For all riparian plots, 247 species were recorded (269 when counting unknowns). For all high elevation plots, 78 species were recorded (81 when counting unknowns). Non-native species composition at the plot level ranged from 0-22 % for matrix; 0-32% for riparian; and was 0 % for all high elevation sites (Figure 2). A total of 21 non-native species were observed in the matrix frame and 37 in the riparian. Tree species composition at Whiskeytown consisted of 18 species. Eleven tree species were found in the matrix, 13 in the riparian, and four in the high elevation. Only Ponderosa pine (*Pinus ponderosa*) occurred in all three sampling frames. Figure 3 shows tree basal area composition percentage by site.

We found and vouchered seven species previously absent from the Whiskeytown vascular plant species list. None of the species represent significant range extensions or are considered rare. They

are: Alaska oniongrass (*Melica subulata*), Lemmon's catchfly (*Silene lemmonii*), Black chokecherry (*Sorbus californica*), Sierra marsh fern (*Thelypteris nevadensis*), western bugbane (*Trautvetteria caroliniensis* var. *occidentalis*), red huckleberry (*Vaccinium parvifolium*) (observed on way to a site, but not collected at a site) and Rocky Mountain cliff fern (*Woodsia scopulina*). Six species currently on the Whiskeytown vascular plant list but lacking vouchers were observed and collected.

We collected two specimens which must be reviewed by taxa experts for identification confirmation.

Vegetation Function (Regeneration)

The most abundant regenerating tree species in the matrix sampling frame >15cm tall height class was black oak (*Quercus kelloggii*). Canyon live oak (*Quercus chrysolepis*) was the most abundant species in all other size classes. The two smallest size classes in the riparian sampling frame were also dominated by *Quercus chrysolepis*. In the third size class, canyon live oak *Quercus chrysolepis* and white alder (*Alnus rhombifolia*) were tied, and *Alnus rhombifolia* was the dominant species in the largest two size classes. The most abundant regenerating tree species in the high elevation sampling frame was red fir *Abies magnifica* in all classes except in the >15cm tall and <2.54 cm dbh class, where white fir (*Abies concolor*) was the most abundant.

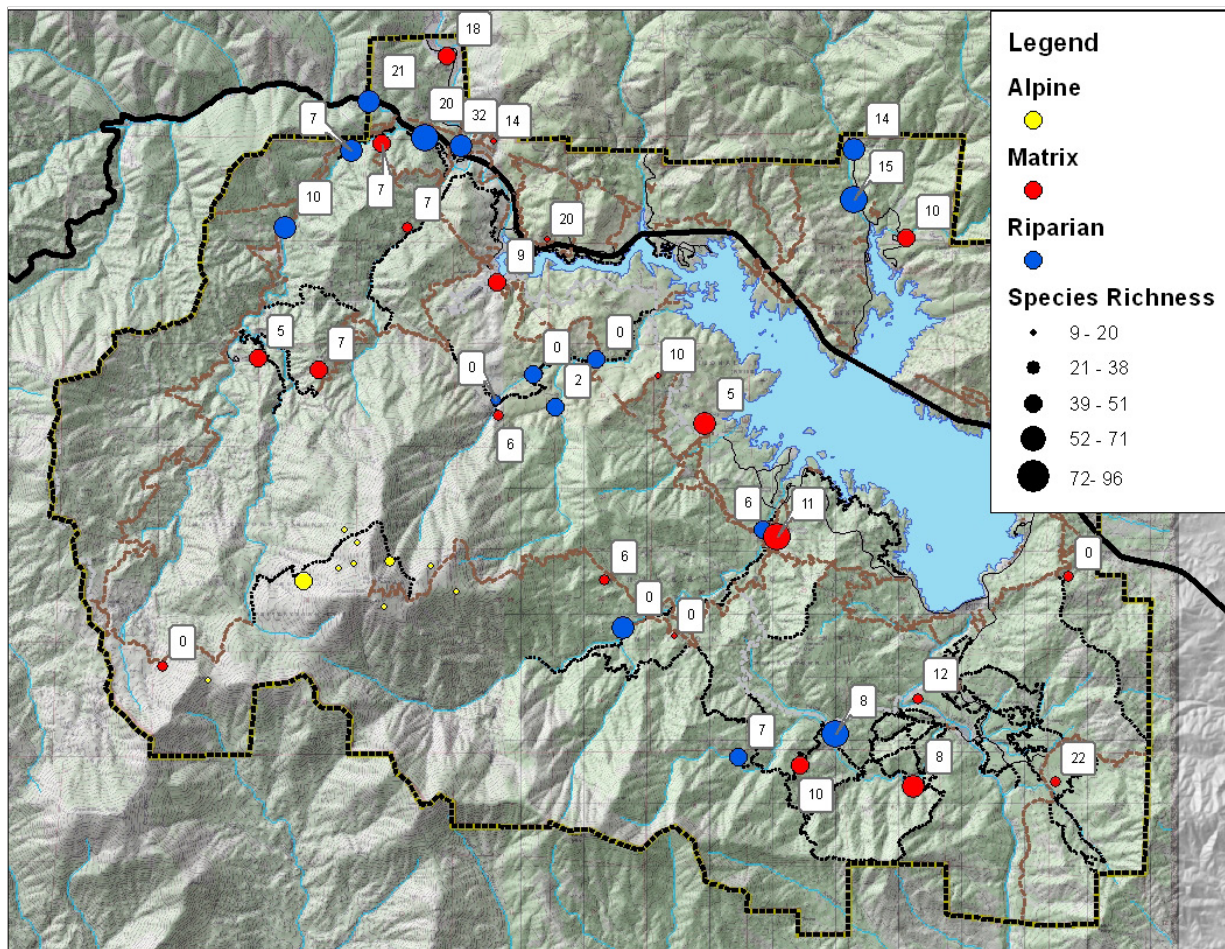


Figure 2. Whiskeytown site species richness from each sampling frame. White labels show percentage of species that are non-native. Sites with no non-native species are not labeled.

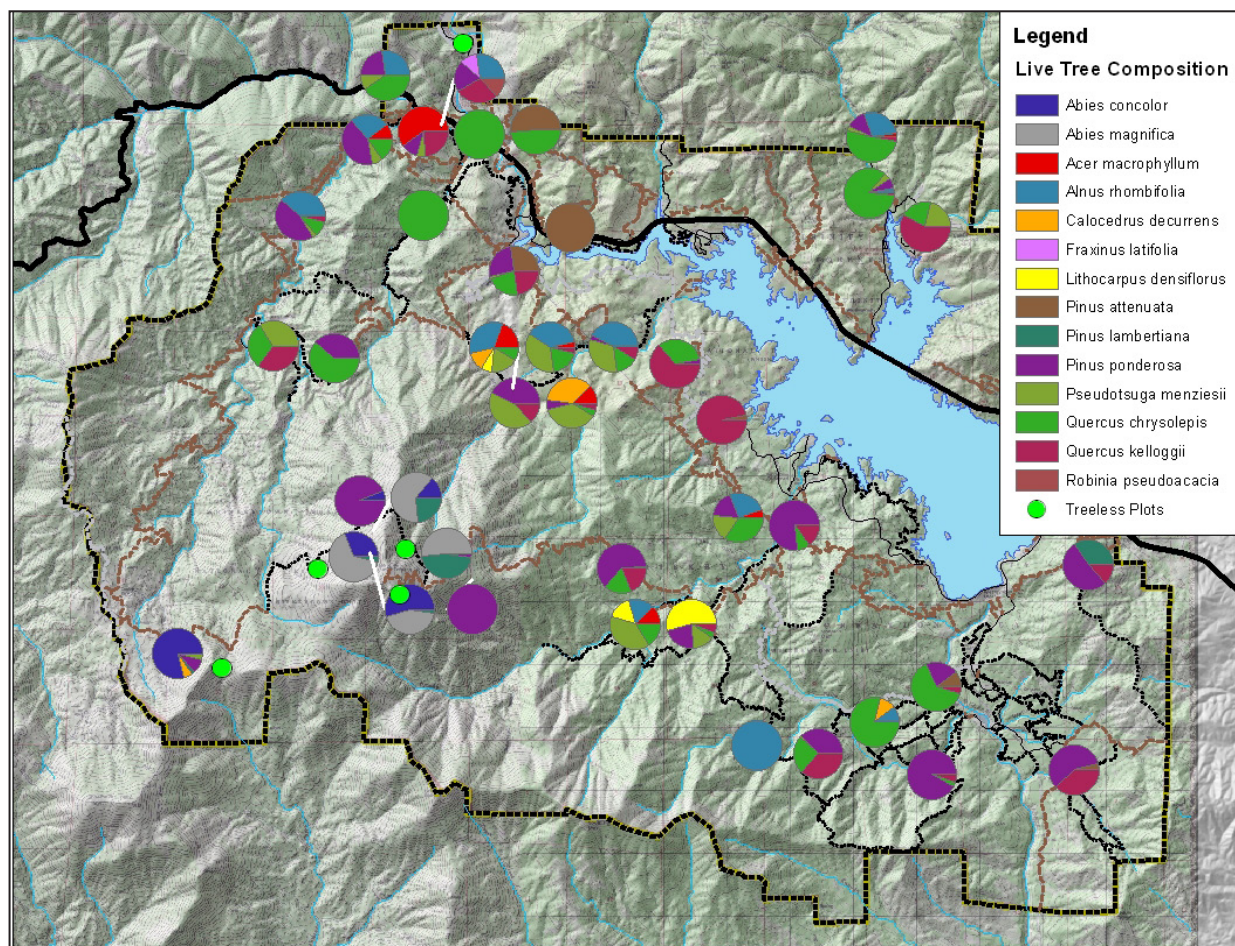


Figure 3. Individual tree (>15cm dbh) species basal area composition of Whiskeytown sites.

Vegetation Structure

Both the matrix and riparian sampling frames had the same pattern of vegetation cover, with the stratum 3 (2.6-5m) having the lowest percent cover followed by, in increasing order, strata 1 (<0.75m), 2 (0.75 - 2.5m), and 4 (>5m). Relative mean cover in each riparian frame stratum was higher than the corresponding matrix stratum. The majority of the vegetation cover in the high-elevation sampling frame occurred in strata 1 and 2.

Mean plot basal area for the matrix sampling frame was 23.4 m²/ha for live trees and 0.3m²/ha for snags. Only one of 21 matrix plots lacked trees >15cm dbh. Mean plot basal area for the riparian sampling frame was 36.7 m²/ha for live trees and 0.2 m²/ha for snags. All riparian plots had trees >15cm dbh. Of all three sampling frames, the high elevation

sites had the lowest basal area for live trees (18.7 m²/ha) and snags (0.18 m²/ha). Table 1 shows tree basal area summary for all sampling frames. Tree density followed the same pattern as basal area with riparian sites being the most dense (325 trees/ha), followed by matrix sites (293 trees/ha), and, lastly, high elevation sites (165 trees/ha). Mean snag density was highest in the matrix sampling frame (34 trees/ha)

Mean shrub heights were approximately 1m for all sampling frames, with high elevation at 0.8 m, matrix at 1.0 m, and riparian at 1.3 m.

Fine wood/litter dominated the ground cover for all three sampling frames. See Smith and Sarr (2104) for more information about vegetation structure.

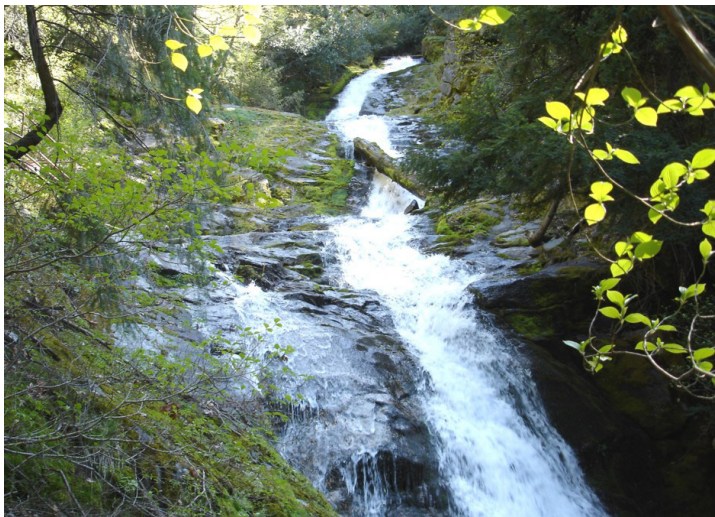
Table 1. Basal Area (BA) minimum, maximum, average, and standard deviation for sampling frames. Units are m²/ha.

Sampling Frame	Minimum Basal Area	Maximum Basal Area	Mean Basal Area	Standard Deviation
High Elevation- Live Trees	0.00	67.54	18.70	22.64
Matrix - Live Trees	0.00	71.70	23.37	17.55
Riparian - Live Trees	3.68	87.19	36.66	22.48
High Elevation - Snags	0.00	0.95	0.18	0.31
Matrix - Snags	0.00	1.35	0.33	0.42
Riparian - Snags	0.02	0.70	0.21	0.25

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 Whiskeytown and Lassen 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 one species was consistently observed among all six parks: Common yarrow (*Achillea millefolium*) (Smith and Sarr, in review).

Our addition of seven new species to the park list and seven new specimens of species previously on the list but not yet vouchered greatly exceed the results from Lassen, and from Redwoods and Lavabeds during the 2011 field season. The other parks have had much more botanical work done at them. In addition, the diverse topography at Whiskeytown discourages cross-country travel. Whiskeytown Falls, a 400-foot waterfall, was rumored to exist in the park but was not formally documented until 2003. Given the relative recentness of such a large discovery, it is entirely plausible further intensive botanical exploration of Whiskeytown would produce more new species.



A portion of Whiskeytown Falls. AP photo.

Logistics

During this first year of vegetation monitoring in Whiskeytown, we surveyed 100% of matrix, 75% of riparian, and 100% of high elevation target sites. We encountered only minor logistical challenges while sampling at Whiskeytown. Off trail travel was more straightforward than expected because sites were all <150 m from a road or trail. Very few sites were rejected due to accessibility or safety issues. We attribute the failure to reach all the target sites to an injury sustained by our most botanically experienced seasonal crew member during time off. This injury resulted in us only having one crew for one sampling trip because only the crew lead was experienced enough to identify all species at the plot with confidence. We feel confident that, barring the injury, we would have reached our revised goals. We realize the need to have more built in resiliency among crew members, in particular, having members with strong botanical skills with the ability to identify most vascular plants we encounter to species-level, and at minimum, genus-level.

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

- Odion, D. C., D. A. Sarr, S. R. Mohren, and S. B. Smith. 2011. [Monitoring vegetation composition, structure and function in the parks of the Klamath Network Parks](#). Natural Resource Report NPS/KLMN/NRR—2011/401. National Park Service, Fort Collins, Colorado.
- Smith, S.B., and D. Sarr. 2013. [Monitoring vegetation composition, structure, and function in Lava Beds National Monument and Redwood National and State Parks: Fiscal year 2011 annual report](#). Natural Resource Data Series NPS/KLMN/NRDS—2013/447. National Park Service, Fort Collins, Colorado.
- Smith, S. B., and D. Sarr. 2014. [Monitoring vegetation composition, structure, and function in Whiskeytown National Recreation Area and Lassen Volcanic National Park: Fiscal year 2012 annual report](#). Natural Resource Data Series NPS/KLMN/NRDS—2014/628. National Park Service, Fort Collins, Colorado.
- Smith, S. B. and D. Sarr. In review. Monitoring vegetation composition, structure, and function in Oregon Caves National Monument and Crater Lake National Park: Fiscal year 2013 annual report. Natural Resource Data Series NPS/KLMN/NRDS—2017/XXX. National Park Service, Fort Collins, Colorado.

More Information

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