



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



ON THE COVER

Vegetation Biotechs Dorothy Wallace-Senft and Violet Holley size up a Redwood tree.
Photograph by: Katy Craley

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The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Abstract

This report describes the results of the first year of implementing the Klamath Network's Vegetation Monitoring Protocol. At Lava Beds NM we accomplished our goal of monumenting and reading 30 matrix plots. At Redwood NSP, we monumented and read 26 matrix and 21 riparian sites, falling short of our 40 matrix and 30 riparian site goal. Data from these plots are summarized below in a format that provides a template for future annual vegetation monitoring reports. Some minor changes to the protocol have been made at the request of park staff and due to some unexpected situations that occurred, not specifically addressed in the original SOPs.

Introduction

In 2011, the Klamath Network Inventory and Monitoring Program (KLMN) implemented the first season of its vegetation monitoring protocol (Odion et al. 2011) at Lava Beds NM and Redwood NSP. The protocol measures vegetation composition, structure, and function across on selected sampling frames in each of six parks of the network every three years. The data will be summarized in annual reports for each year of sampling in a given set of parks, with more complex analysis and synthesis reports at less frequent intervals.

The main objectives for the FY 2011 field season were to monument and read 30 matrix sites at Lava Beds and 40 matrix and 26 riparian sites at Redwood. At LABE, 25 matrix sites were to be co-located with Bird Community monitoring (Stephens et al. 2010) routes at Lava Beds, and to monument and sample 5 additional matrix sites, not collocated. At Redwood, we planned to monument 30 matrix sites co-located with Bird Community monitoring, and to monument and read 30 riparian sites to be collocated with Stream Monitoring sites (Dinger et al. 2012). Results are described here in the format the KLMN proposes to use in the future for annual reporting of the vegetation monitoring. Annual reports are intended for park staff and partners and will summarize the work completed in a given field season and the status of vegetation composition, structure and function based on the data collected. The analyses and data summaries are selected to convey basic descriptive information in an easily interpreted format. More complex analyses and syntheses will be conducted every third year as outlined in the vegetation monitoring protocol (Odion et al. 2011).

Methods

Complete methods for site selection, data collection, data management and analysis are described in Odion et al. (2011), which provide detailed guidance for sampling in each park. This methodological summary is an abbreviated overview to provide context for this report.

Site Selection

The monitoring sampling frame used for was constrained for safety and logistical reasons to exclude areas with slopes greater than 30 degrees, and locations less than 100 m or more than 1 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). In 2011, we sampled only matrix sites at Lava Beds (the park has no riparian areas or high elevations) and matrix and riparian sites at Redwood (it has no high elevation areas).

Field Sampling

A 20 x 50 m plot was used for sampling matrix sites (Figure 1); a 10 x100 m or two 10x50 m plots was used for riparian sites, plot shape depended on the sinuosity of the stream channel (Figure 2a and b). The 10 m wide riparian plots were used to avoid going too far into the upland habitat type, and the varying angles (plot were not strictly linear) allowed us to capture more of the streamside vegetation. Site diagrams were drawn in the field for all riparian sites. Each plot, regardless of sampling frame) consisted of ten 10 x 10 m modules, four of which were sampled intensively for species and ground cover, and seedling and sapling data. At the request of Redwood staff, we implemented an extended plot in old growth forests. We defined an old growth forest as having at

least 4 trees >75 cm dbh. Extended plots were double our regular plot size (40 x 50 m) and we measured all our standard overstory parameters only on trees > 75cm dbh in the extended area.

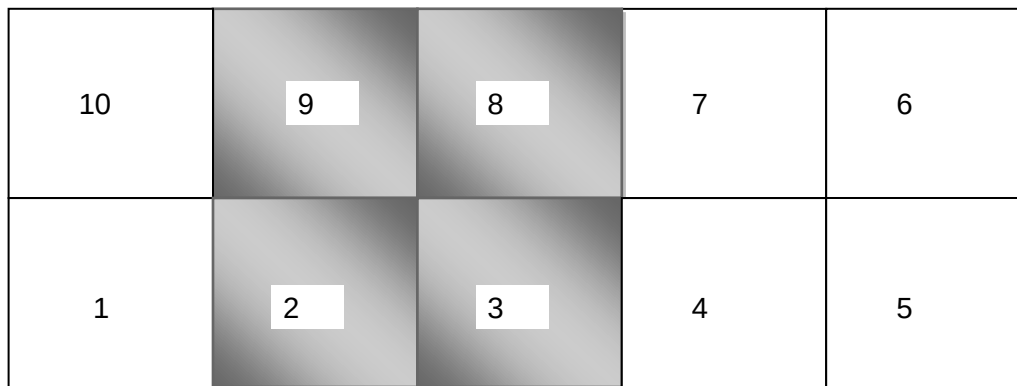


Figure 1. The 20 x 50 m matrix and alpine site layout. Each numbered square is 10 x 10 m. Shaded squares are the 4 intensive modules.

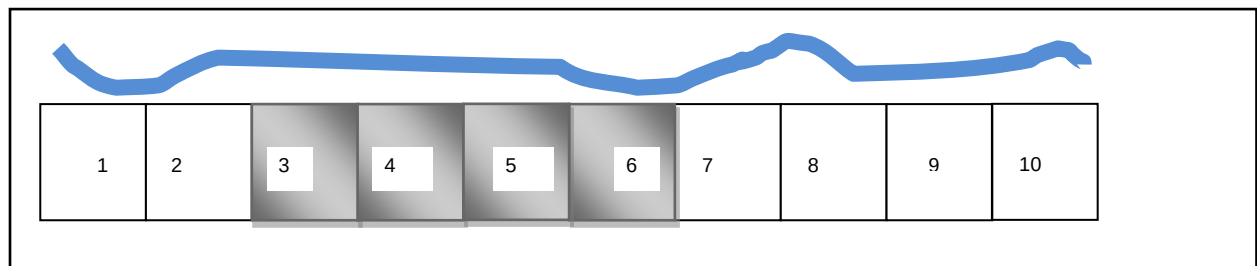


Figure 2a. Ten x 100 m riparian plot layout. Each numbered square is a 10 x10m module. Shaded squares are the 4 intensive modules.

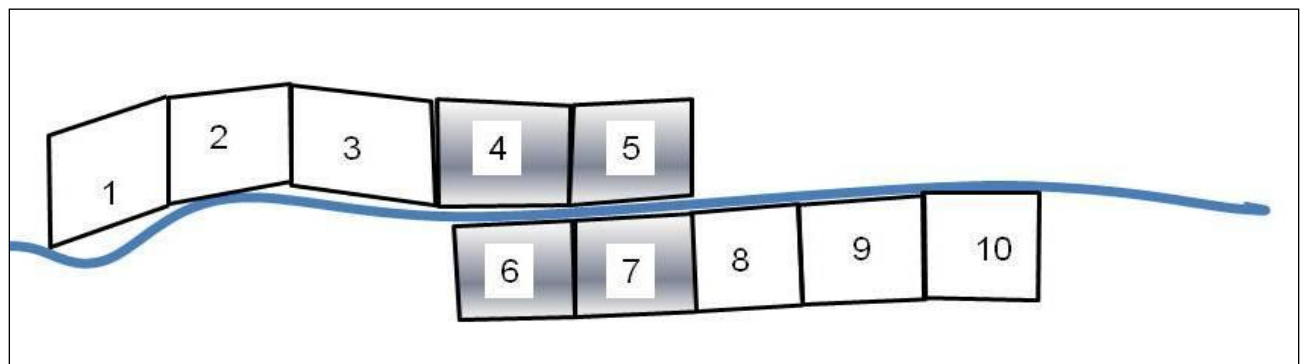


Figure 2b. Ten x 50 m riparian site layout. Each numbered square is 10 x10m. Shaded squares are the 4 intensive modules.

Standard Operating Procedures 6-9 of the vegetation protocol (Odion et al. 2011), provide details on the collection in each plot of measurements of the following parameters, which are sampled in the field:

1. Slope
2. Aspect
3. Elevation
4. Microtopography
5. Macrotopography
6. Vascular plant cover by species (four height strata)
7. Ground cover
8. Tree seedlings
9. Tree saplings by size class
10. Small trees by size class
11. Live trees (dbh, canopy position and condition)
12. Dead trees (dbh, decay class)
13. Fine wood (< 7.6 cm diameter)
14. Coarse wood (> 7.6 cm in diameter, size and decay class)
15. Litter and Duff: (depth/thickness)

Data Management, Analysis and Presentation

All data management followed the procedures outlined in Standard Operating Procedure 12 of the Vegetation Monitoring Protocol. Field data were collected on tablet computers in the field, with nightly or weekly downloads to a secure computer. Verification of specimens and validation of data occurred throughout the field season, and was finalized at the end of the field season, led by the field crew leader (Smith).

General data summaries were conducted to provide descriptive statistics of the park vegetation. These included measures of central tendency (mean, median) and variance (range, standard deviation) for each parameter. Data are presented in tabular form, and where suitable, in a user-friendly graphical format to aid in the visualization of data distribution or geographic variation across the sampling frame. A procedure for producing bubble maps was created for use in the future. Depending on data collected in future monitoring of the parks, annual reports may show different statistics, but will use the same general families of analysis and similar tables and illustrations.

Due to database constraints, the vascular plant taxonomy used in the study is a combination of The Jepson Manual 1st edition (Hickman et al. 1993) and USDA Plants Database (USDA, NRCS. 2012).

Woody debris tons/acre was calculated using FFI (FEAT/FIREMON Integration Database; Lutes et al. 2009) fuel constants. We did not calculate weighted averages.

Results

Here we summarize selected data most relevant to our monitoring objectives. Appendixes 1, 2, and 3 provide a more comprehensive summary of the environmental data collected at each site.

Sampling dates, completed sites, and logistics

Three crew members began work on May 23rd to assist the Crew leader with site sampling. Training occurred during the first work 'hitch' (the name for the 8 day work period of the crew's 8 days on 6 days off work schedule). The training consisted of protocol and SOP review, safety and JHA discussions in the office, as well as site visits to both parks for species familiarization and hands on instruction of protocol procedures. After training as a group, we split into two groups and sampling was conducted by two person crews. Near the end of the season (August 21st) an injury occurred that prevented one crew member from continuing field work. At this point two new crew members were hired and sampling continued with one two person crew and one three person crew.

Survey dates at Lava Beds were from May 28th to July 10th, during which time 30 matrix sites were sampled (Figure 3). Very few logistical challenges occurred while sampling at Lava Beds, off trail travel was relatively easy and overstory cover very sparse. The two person crew completed 29 sites in 22 work days (one site was completed with a 4 person crew during training). The crew stayed at the Lava Beds Research center while working. Although the research center is in the southern half of the monument, vehicle travel time was very feasible for completing a plot, and, to occasionally, start another plot, in a ten hour work day.

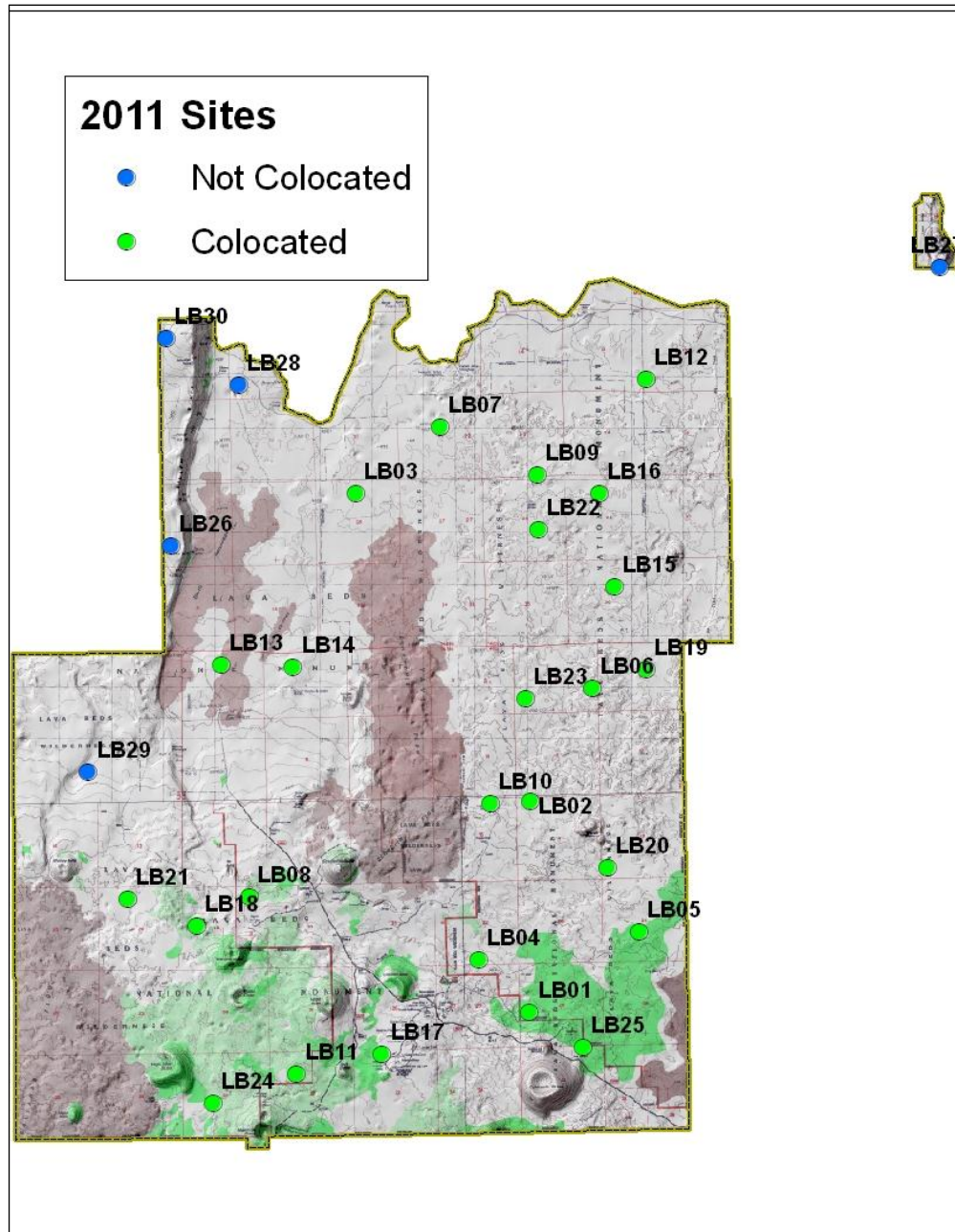


Figure 3. Location of Vegetation Monitoring plots at Lava Beds NM. Green circles are co-located with Bird Community monitoring.

Survey dates at Redwood were from June 6th to Sept 27th, during which time 26 matrix and 21 riparian sites were completed (Figure 4). Numerous logistical or unforeseen challenges occurred while sampling at Redwood (see Discussion). Off trail travel was much more difficult than anticipated due to steep terrain and frequently encountered dense and tall shrub cover. Crews stayed at Mill Creek campground while working in the northern portion of the park and Prairie Creek campground while working in the southern portion of the park. Vehicle travel time to plots was often longer than originally accounted for.

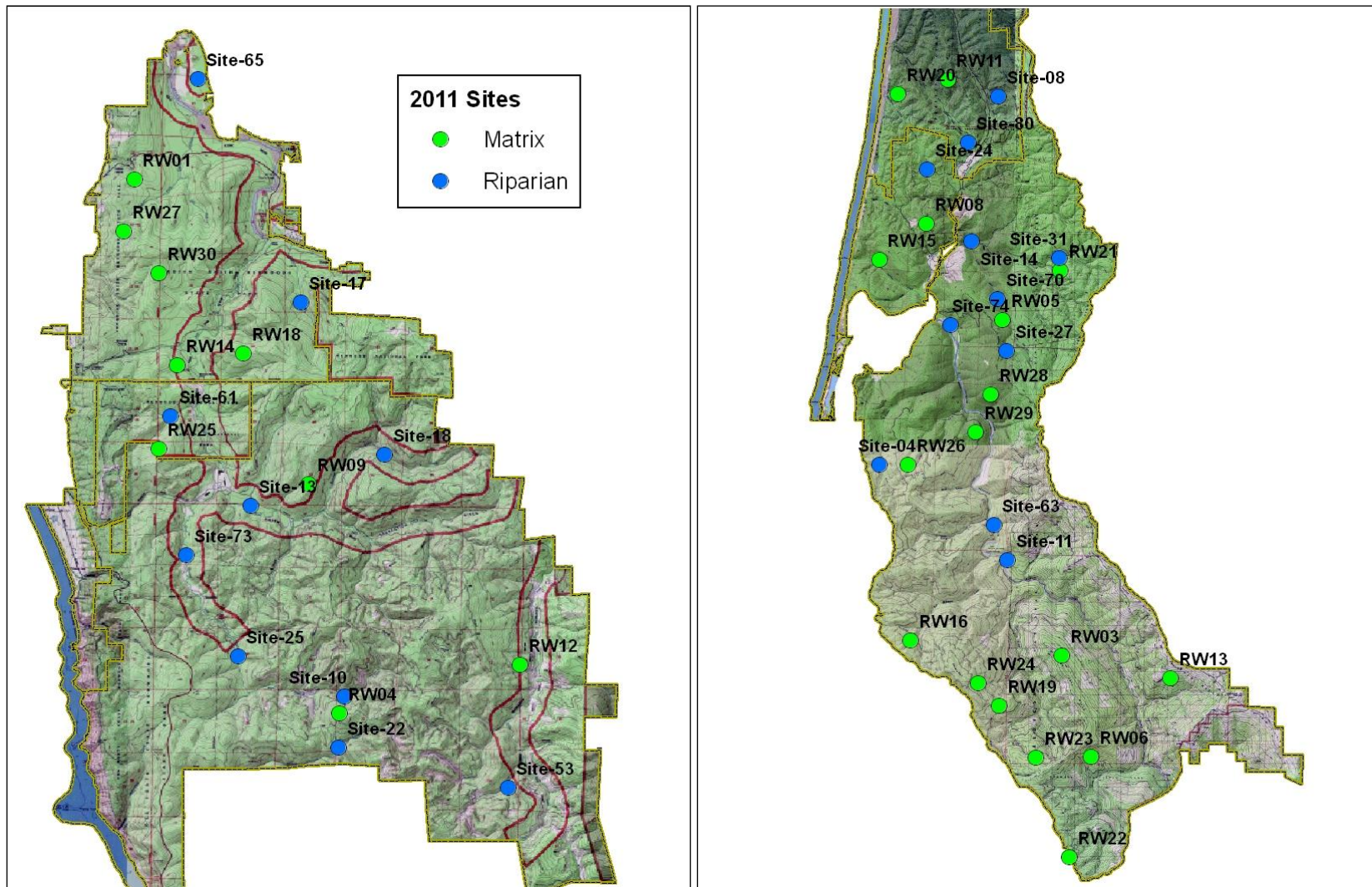


Figure 4. Location of Vegetation Monitoring sites at Redwood NSP. North half of the park is on the left, the southern half is on the right (The central portion of the park has been excluded from this map, as we did not have any plots there). All matrix sites are co-located with bird community monitoring sites. Riparian sites (some or all) will be co-located with stream monitoring sites.

Vegetation Composition

Lava Beds

Vascular plant species richness at Lava Beds ranged from 14 to 51 species per 0.1 ha sampling plot. (Figure 5, Table1). For all 30 plots, 131 species were recorded (141 when counting unknowns). The most frequently occurring understory species by sampling frame are shown in Table 2. 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 5). A total of 12 non-native species were observed, the most frequently occurring are noted in Table 2. Tree composition at Lava Beds consisted of only three trees: juniper (*Juniperus occidentalis*) curl-leaf mountain mahogany (*Cercocarpus ledifolius*), and ponderosa pine (*Pinus ponderosa*). Figure 6 shows tree composition percentage by site.

Redwoods

Species richness at Redwood for the matrix sampling frame ranged from 13-58 species per 0.1 ha sampling plot (Figure 7, Table 1). Across all matrix plots sampled, 148 (169 when counting unknowns) species were observed. The riparian sampling frame proved to be very diverse, species richness at the plot level ranged from 23-84 species, with 182 species observed (212 when counting unknowns). Overall 264 species were observed (275 when counting unknowns). The most frequently occurring understory species for each sampling frame are shown in Tables 3 and 4. The most frequent understory species in both sampling frames was sword fern (*Polystichum munitum*). The most frequently occurring shrub in the matrix and riparian sampling frames were salal (*Gaultheria shallon*) and salmon berry (*Rubus spectabilis*), respectively. Non-native species composition ranged from 0-70 percent in matrix sites, and 0-59 percent in riparian sites. We observed 38 non-native species in the matrix sampling frame, and 45 in the riparian. None of these species occurred with notable frequency (Tables 3, 4). Fourteen tree species were observed; 11 occurred in the matrix sampling frame and all 14 in the riparian frame. Tree composition by site is shown in Figure 8.

Three forbs were observed that, if confirmed, would be new additions to the RNSP flora: 1) *Agrostis oregonensis*—was observed at one plot. Material collected was insufficient for a positive identification; 2) *Lotus crassifolius*—was observed at one plot. Material collected was insufficient for a positive identification; 3) *Rosa eglanteria*—was observed at one plot. This non-native species was not collected, but is distinctive and was identified with confidence at the site.

Table 1. Species richness minimum, maximum, mean, and sample frame total from the 2011 Vegetation Monitoring plots.

Park	Sample Frame	SR min	SR max	SR mean	Sample Frame total
LABE	Matrix	14	51	37	141
RNSP	Matrix	13	58	25	169
RNSP	Riparian	23	84	49	212

Table 2. Most frequently occurring understory species at Lava Beds matrix sites, number indicates constancy (% of plots species occurred in) (* indicates non-native species).

Herbs		Herbs	
<i>Bromus tectorum</i> *	100	<i>Chaenactis douglasii</i>	47
<i>Gayophytum</i> spp.	97	<i>Lithophragma tenellum</i>	47
<i>Elymus elymoides</i>	93	<i>Claytonia rubra</i>	43
<i>Poa secunda</i>	93	<i>Lomatium nevadense</i>	43
<i>Pseudoroegneria spicata</i> ssp. <i>spicata</i>	90	<i>Phlox gracilis</i>	43
<i>Achnatherum thurberianum</i>	87	<i>Agoseris heterophylla</i>	40
<i>Draba verna</i>	80	<i>Galium aparine</i>	40
<i>Arabis sparsiflora</i>	77	<i>Phlox diffusa</i>	40
<i>Mentzelia albicaulis</i>	73	<i>Stephanomeria virgata</i>	40
<i>Phacelia linearis</i>	73	<i>Zigadenus paniculatus</i>	40
<i>Crepis acuminata</i>	70	Shrubs	
<i>Collinsia parviflora</i>	67	<i>Artemisia tridentata</i>	93
<i>Holosteum umbellatum</i> *	63	<i>Chrysothamnus nauseosus</i> ssp. <i>consimilis</i>	90
<i>Cryptantha ambigua</i>	57	<i>Purshia tridentata</i>	73
<i>Descurainia pinnata</i> ssp. <i>halictorum</i>	57	<i>Ribes velutinum</i>	63
<i>Lactuca serriola</i> *	57	<i>Chrysothamnus viscidiflorus</i>	57
<i>Penstemon deustus</i>	57	<i>Leptodactylon pungens</i>	57
<i>Plectritis macrocera</i>	57	<i>Ribes cereum</i>	57
<i>Phacelia heterophylla</i>	53	<i>Cercocarpus ledifolius</i>	37

Table 3. Most frequently occurring understory species at Redwood matrix sites, number indicates constancy (% of plots species occurred in) (* indicates non-native species)

Herbs		Herbs	
<i>Polystichum munitum</i>	88	<i>Luzula parviflora</i>	23
<i>Viola sempervirens</i>	81	<i>Pleuricospora fimbriolata</i>	23
<i>Trillium ovatum</i>	73	Shrubs	
<i>Blechnum spicant</i>	62	<i>Gaultheria shallon</i>	92
<i>Galium triflorum</i>	62	<i>Vaccinium ovatum</i>	92
<i>Trientalis borealis</i> ssp. <i>latifolia</i>	58	<i>Vaccinium parvifolium</i>	77
<i>Goodyera oblongifolia</i>	46	<i>Rhododendron macrophyllum</i>	65
<i>Oxalis oregana</i>	46	<i>Rubus spectabilis</i>	42
<i>Pteridium aquilinum</i> var. <i>pubescens</i>	46	<i>Mahonia nervosa</i>	31
<i>Prosartes hookeri</i>	42	<i>Rubus ursinus</i>	27
<i>Athyrium filix-femina</i>	27	<i>Whipplea modesta</i>	27
<i>Corallorrhiza maculata</i>	27	<i>Rubus parviflorus</i>	23
<i>Iris douglasiana</i>	23		

Table 4. Most frequently occurring understory species at Redwood riparian sites, number indicates constancy (% of plots species occurred in) (* indicates non-native species)

Herbs		Herbs	
<i>Polystichum munitum</i>	95	<i>Prosartes hookeri</i>	57
<i>Athyrium filix-femina</i>	90	<i>Trillium ovatum</i>	57
<i>Oxalis oregana</i>	90	<i>Equisetum arvense</i>	52
<i>Tolmiea menziesii</i>	90	<i>Vancouveria hexandra</i>	52
<i>Stachys rigida</i> var. <i>rigida</i>	86	<i>Claytonia sibirica</i>	48
<i>Carex leptopoda</i>	81	<i>Glyceria striata</i>	48
<i>Blechnum spicant</i>	76	<i>Petasites frigidus</i> var. <i>palmatus</i>	48
<i>Bromus vulgaris</i>	76	Shrubs	
<i>Galium triflorum</i>	76	<i>Rubus spectabilis</i>	95
<i>Mimulus dentatus</i>	71	<i>Ribes bracteosum</i>	86
<i>Luzula parviflora</i>	67	<i>Vaccinium parvifolium</i>	86
<i>Adiantum aleuticum</i>	62	<i>Vaccinium ovatum</i>	71
<i>Dryopteris expansa</i>	62	<i>Gaultheria shallon</i>	62
<i>Festuca subulata</i>	62	<i>Rubus ursinus</i>	57
<i>Asarum caudatum</i>	57	<i>Rubus parviflorus</i>	48
<i>Boykinia occidentalis</i>	57		

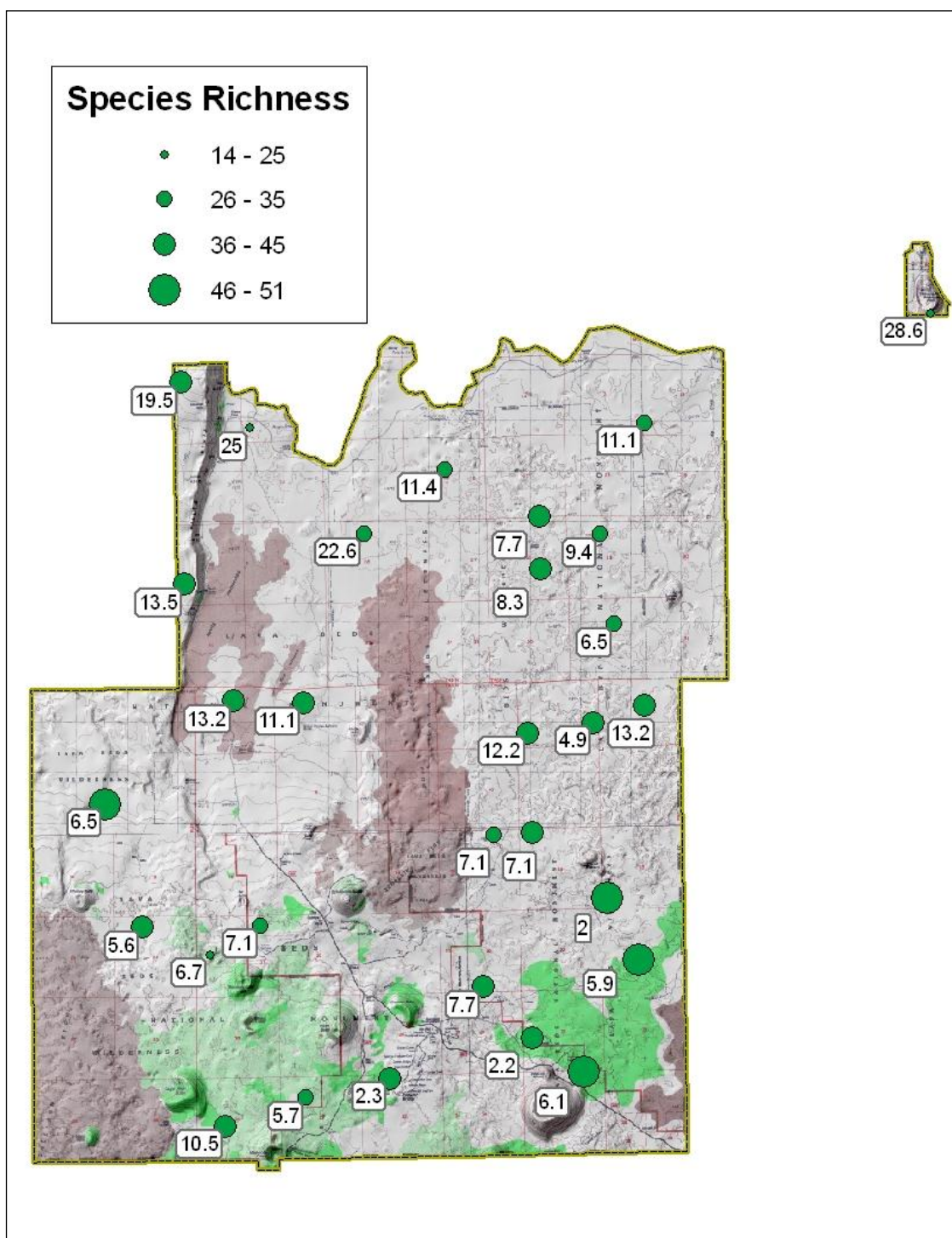


Figure 5. Site species richness from each sampling frame displayed by green bubble sizes. White labels show percentage of species that are nonnative. Sites without a label do not have any nonnative species.

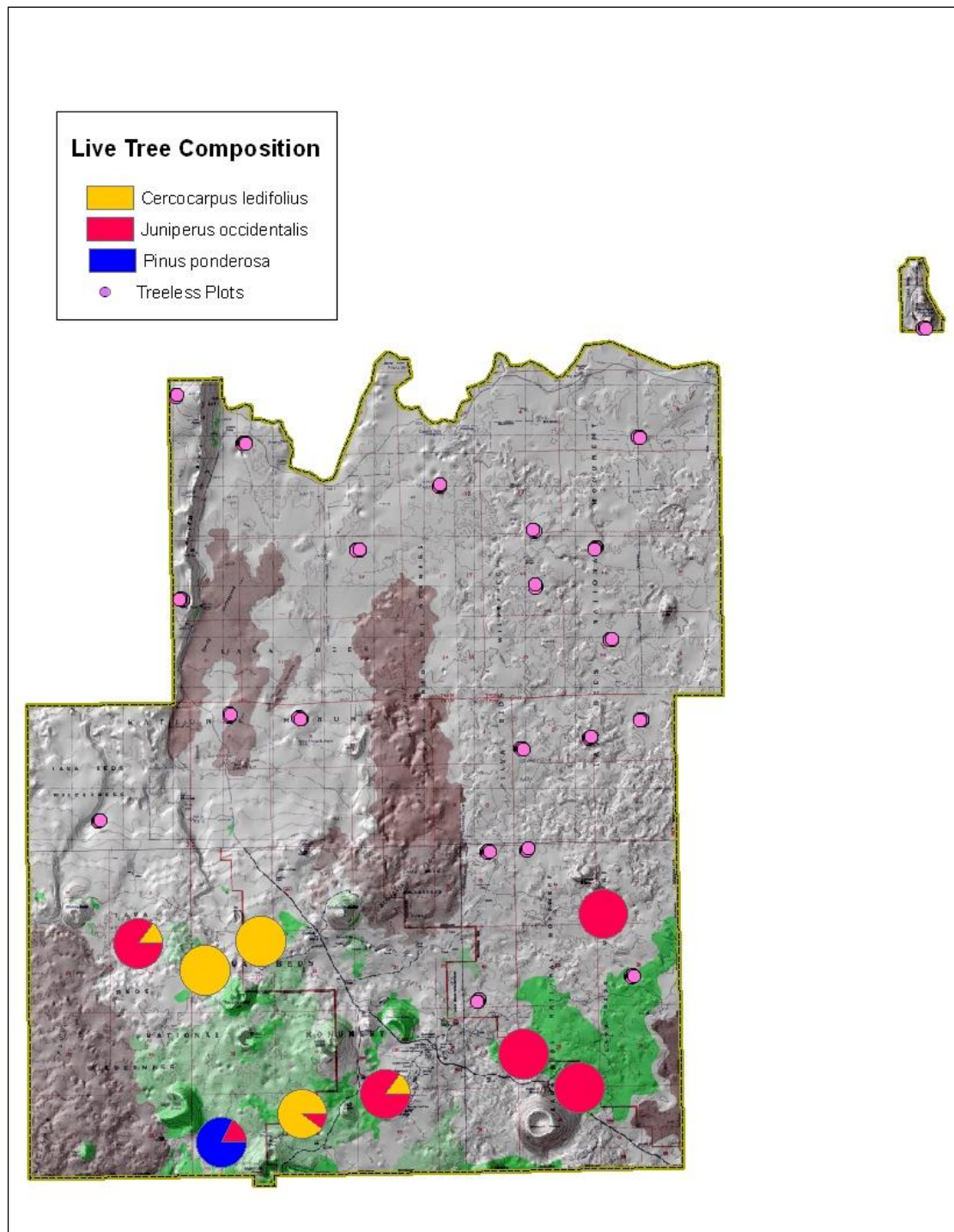


Figure 6. Individual tree species composition of LBE matrix site.

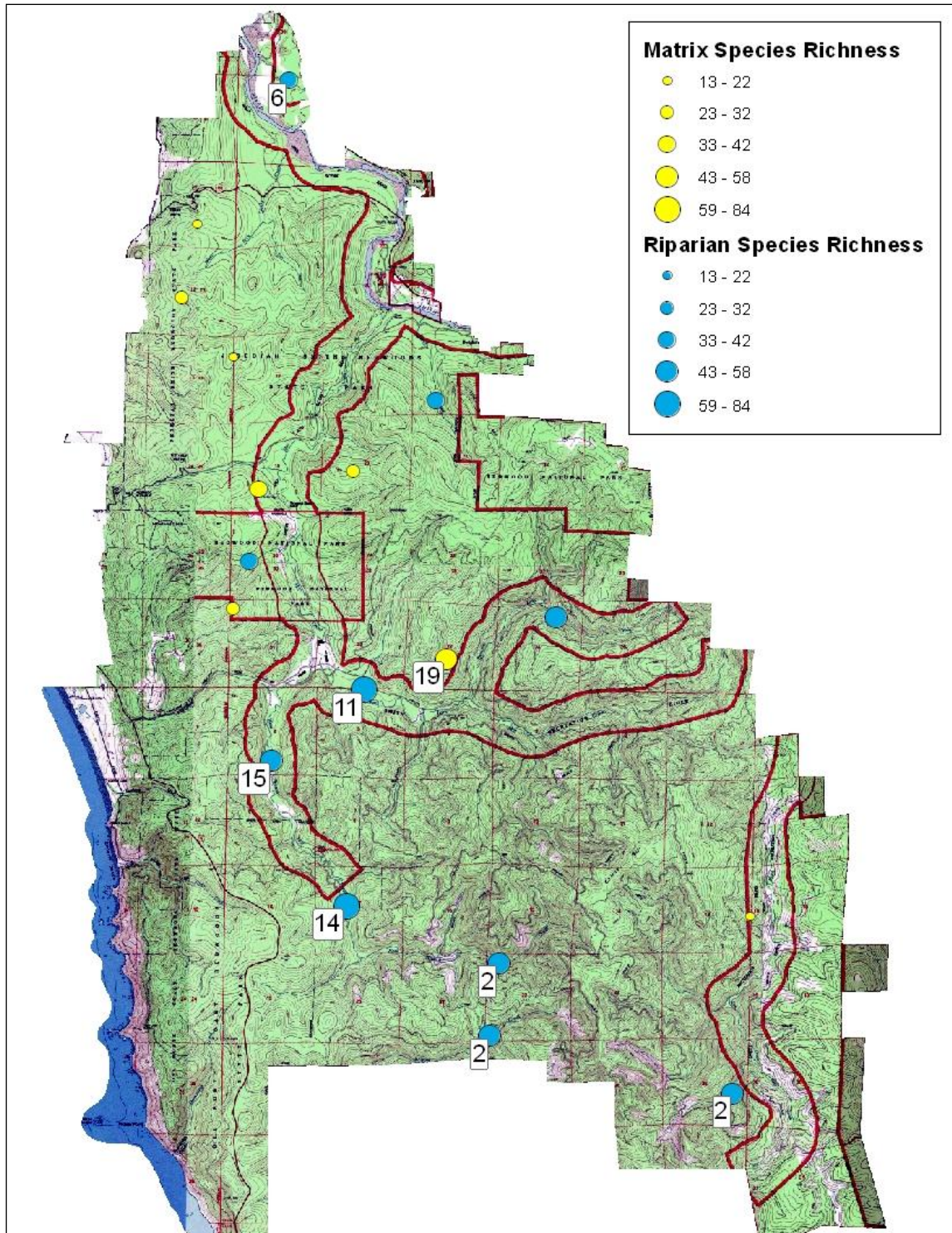


Figure 7a. Site species richness from each sampling frame displayed by green or blue bubble sizes. White labels show percentage of species that are nonnative at a site. Sites without a label do not have any nonnative species. North half of the park is shown here. The southern half is in figure 7b.(The central portion of the park has been excluded, as we did not have any plots there). Red lines delineate Smith River tributaries.

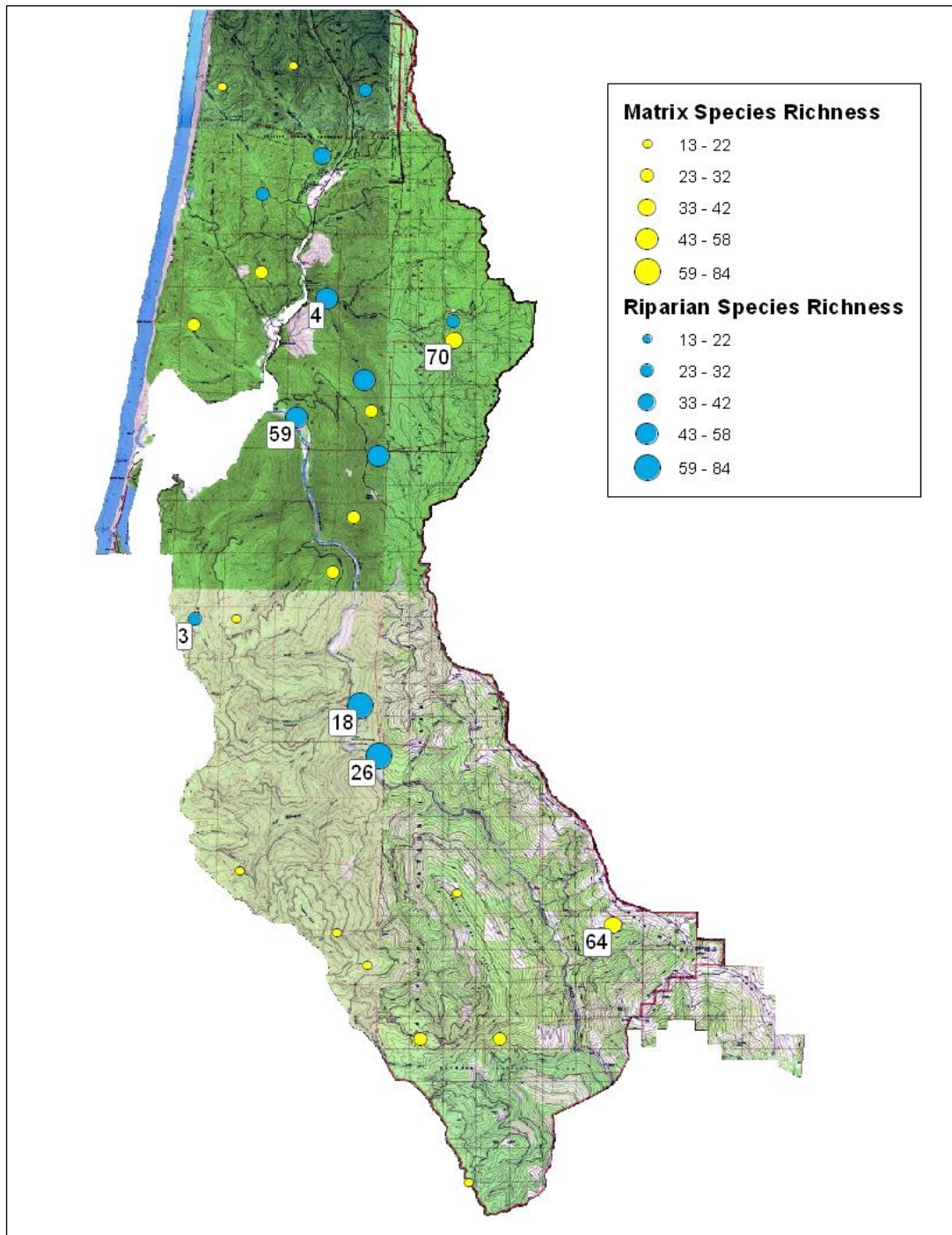


Figure 7b. Site species richness from each sampling frame displayed by green or blue bubble sizes. White labels show percentage of species that are nonnative at a site. Sites without a label do not have any nonnative species. Southern half of the park is shown here. The northern half is in figure 7a. (The central portion of the park has been excluded, as we did not have any plots there).

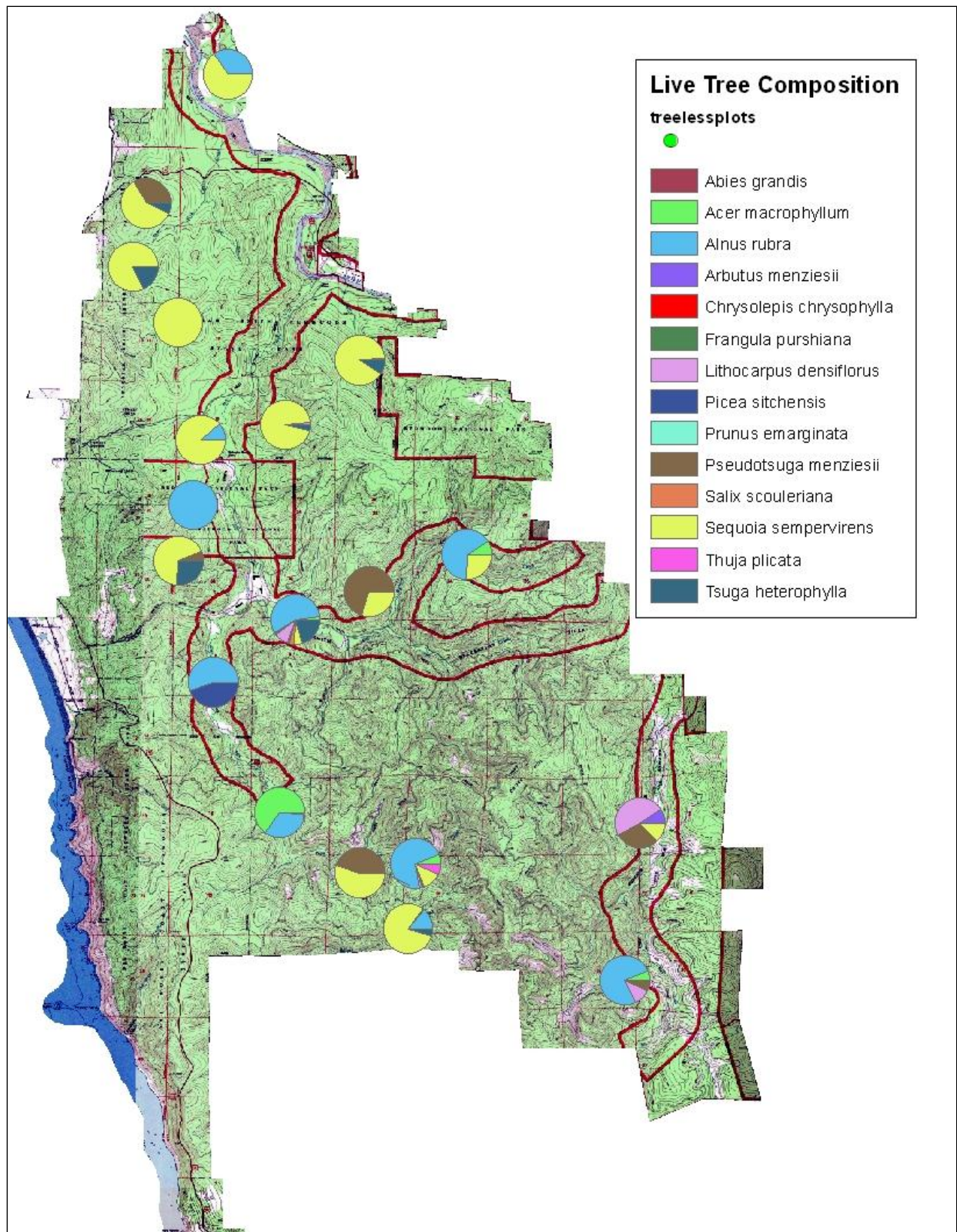


Figure 8a. Individual tree species composition of RNSP sites. North half of the park is shown here, the southern half is in figure 8b.

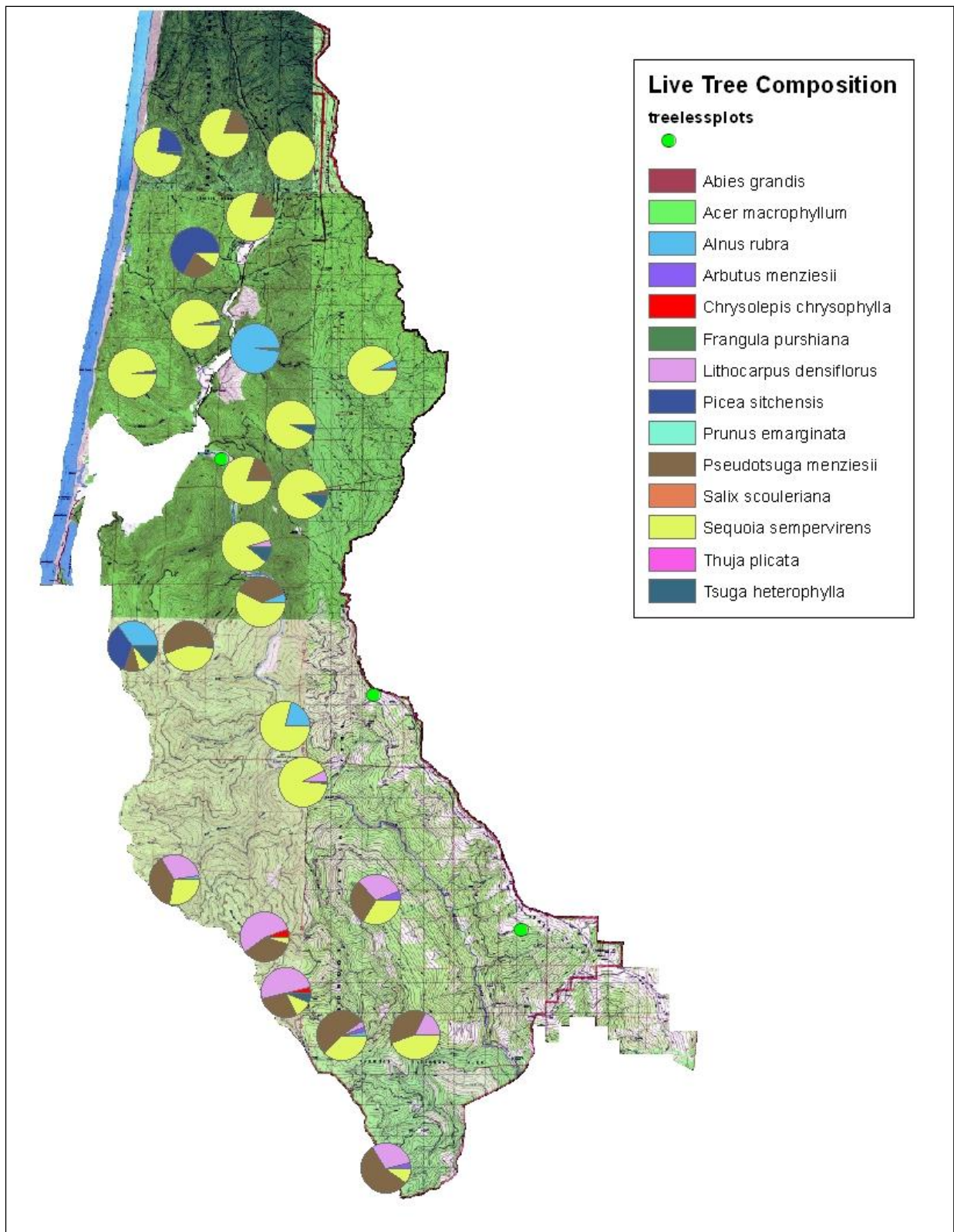


Figure 8a. Individual tree species composition of RNSP sites. South half of the park is shown here, the northern half is in figure 8a.

Vegetation Structure

Lava Beds NM

The majority of vegetation cover at LABE occurred in the lowest two strata (Table 5). Stratum 1 had the highest cover with the trend being decreasing vegetation cover with each increasing stratum height, and with overstory cover (measured with a densitometer) 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 (Table 7), and snag density was 2 trees/ha (Table 8.) Tree height and height to crown are shown in table 7, snag heights are in Table 8.

Down woody debris was very low at LABE (Table 9.)

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; ground cover summary is shown in Table 10.

Litter and duff mean depths were very similar 0.51 cm (S.D. 0.54 cm) for litter and 0.54 cm (S.D. 0.52 cm) for duff. Table 11 shows the litter and duff depth summary.



Figure 9. An example of vegetation structure at LABE.

Redwood NSP

At RNSP average vegetation cover percent was highest in stratum 4, with an average of 80.1 (S.D. 29.5) and 74.9 (S.D. 27), for the matrix and riparian, respectively; both sampling frames had a maximum of 131.5% cover. Figure 10 shows an example of vegetation structure at RNSP.

Mean live tree basal area at RNSP was high, with the matrix (301 m²/ha) and riparian (250.9 m²/ha) being comparable. Snag basal area was much lower than live tree basal area. Two matrix and one riparian plot lacked trees. Table 6 shows a basal area summary. Matrix site tree density mean (458 trees/ha) was higher than the riparian (325 trees/ha), snags followed a similar pattern, but with the totals being a whole order of magnitude less (Table 7 and 8). Tree height and height to crown are also shown in table 7, snag heights are in table 8.

Dead and down woody debris is shown in Table 9. In the RNSP riparian sampling frame the three sites with the most rotten woody debris were riparian sites #27, #8, and #24, with 303, 203, and 163 tons/acre, respectively. The mean of the riparian rotten log 1000 hr fuel was twice as large as the matrix. In contrast the RNSP matrix sound log 1000 hr fuel was almost 5 times higher than the riparian.



Figure 10. An example of vegetation structure at RNSP.

Mean shrub heights were comparable between the matrix 1.97 m (S.D. 1.01 m) and riparian 1.83 (S.D. 0.89 m). The matrix minimum was 0.0 m and the maximum 3.84 m, two plots lacked shrubs. The riparian minimum was 0.56 m and the maximum 4.47 m, all plots contained shrubs.

Fine wood and litter was the dominant ground cover in both the matrix and riparian sampling frame. Coarse wood was the second most prevalent ground cover in the matrix, while bryophytes had second highest cover for the riparian. The ground cover summary is in Table 10.

Mean litter and duff depths were greater for the matrix sampling frame. Table 11 shows litter and duff depth summary.

Table 5. Vegetation cover (%) by stratum for each park and sample frame.

Park	Frame	Stratum 1 (<.75m)				Stratum 2 (.75-2.5m)			
		Min	Max	Mean	S.D.	Min	Max	Mean	S.D.
LABE	Matrix	7.6	98.2	36.0	23.8	0.0	32.8	12.3	9.5
RNSP	Matrix	2.2	94.2	16.8	22.4	0.0	81.8	40.4	25.1
RNSP	Riparian	10.8	69.9	31.6	14.4	4.1	85.6	48.0	21.5
Park	Frame	Stratum 3 (<2.5-5m)				Stratum 4 (>5m)			
		Min	Max	Mean	S.D.	Min	Max	Mean	S.D.
LABE	Matrix	0.0	15.8	2.3	4.2	0.0	7.5	0.8	2.0
RNSP	Matrix	0.0	65.5	18.0	14.7	0.0	131.5	80.1	29.5
RNSP	Riparian	0.0	69.8	17.5	18.3	0.0	131.5	74.9	27.0

Table 6. Basal Area (BA) minimum, maximum, average, and standard deviation for sampling frames. Units are m²/ha.

Park	Sampling Frame	Min BA	Max BA	Mean BA	S.D.
LABE	Matrix	0.00	10.10	1.09	2.65
REDW	Matrix	0.00	301.02	113.74	90.89
REDW	Riparian	0.00	250.94	81.31	71.74
Park	Sampling Frame	Min Snag BA	Max Snag BA	Mean	S.D.
LABE	Matrix	0.00	0.09	0.01	0.02
REDW	Matrix	0.00	26.46	2.81	6.65
REDW	Riparian	0.00	7.26	0.91	1.77

Table 7. Mean live tree density (Stems/ha), height (m), height to crown (m), and maximum tree height (m). Standard deviations shown in parentheses.

Park	Frame	Mean Tree Density	Mean Tree Height	Mean Height to Crown	Max Height
LABE	Matrix	15 (29)	6 (2)	1 (1)	12
RNSP	Matrix	458 (293)	23 (13)	13 (7)	83
RNSP	Riparian	325 (212)	25 (11)	12 (7)	92

Table 8. Mean density (Stems/ha) and height snags. Standard deviations shown in parentheses.

Park	Frame	Mean Snag Density	Mean Snag Height
LABE	Matrix	2(6)	1(2)
RNSP	Matrix	42 (42)	10(9)
RNSP	Riparian	27 (37)	9(8)

Table 9. Summary of woody debris time lag classes reported in tons per acre. Standard deviations shown in parentheses.

Park	Frame	1hr	10hr	100hr	1000hr Rotten	1000hr Sound	Total of Frame Means
LABE	Matrix	0.10 (0.09)	0.37 (0.36)	0.31 (0.44)	0.07 (0.39)	0.22 (0.80)	1.08
RNSP	Matrix	0.83 (0.60)	1.83 (1.47)	2.41 (2.26)	34.39 (36.36)	54.79 (86.34)	94.25
RNSP	Riparian	0.31 (0.20)	1.42 (0.68)	1.47 (1.29)	63.44 (82.78)	11.43 (18.63)	78.07

Table 10. Ground cover/substrate mean cover percentages. Standard deviations shown in parentheses.

Park	Frame	Bare Soil	Bryophytes	Coarse Wood	Fine Wood / Litter	Rock	Water
LABE	Matrix	17 (15)	4 (4)	1 (2)	46 (20)	33 (23)	0
RNSP	Matrix	1 (1)	5 (6)	10 (7)	85 (9)	1 (1)	0
RNSP	Riparian	5 (12)	12 (11)	9 (6)	73 (13)	6 (7)	2 (3)

Table 11. Litter and duff minimum, maximum, mean. Units are in centimeters. Standard deviations shown in parentheses.

Park	Frame	Min Litter Depth	Max Litter Depth	Litter Mean	Min Duff Depth	Max Duff Depth	Duff Mean
LABE	Matrix	0.05	2.75	0.51 (0.54)	0	1.9	0.54 (0.52)
RNSP	Matrix	1.22	8.33	3.87 (1.71)	0	11.25	4.01 (2.72)
RNSP	Riparian	0	7.13	2.81 (2.12)	0	5.02	2.26 (1.85)

Vegetation Function (Regeneration)

Lava Beds

The most abundant regenerating tree species in all size classes was *Cercocarpus ledifolius*. Mean regeneration counts for all tree species combined are shown in Table 12.

Redwood

In the matrix sampling frame *Lithocarpus densiflorus* was the most abundant regenerating tree in all size classes except >2.54 - <5 cm DBH, where *Sequoia sempervirens* was the most abundant. In the riparian sampling frame *Frangula purshiana* was the most abundant regenerating tree in the smallest two classes; *Alnus rubra* was the most abundant regenerating tree in the largest three size classes. Mean regeneration counts for all tree species combined are shown in Table 12.

Table 12. Regeneration by size class for all live tree species by sampling frame. Units are trees/ha, standard deviations shown in parentheses.

Park	Frame	<15cm Tall	>15cm Tall- <2.54cm dbh	>2.54-<5cm dbh	>5-<10cm dbh	>10- <15cm dbh
LABE	Matrix	550 (1477)	833 (2842)	76 (201)	69 (168)	21 (46)
RNSP	Matrix	913 (1321)	1298 (1987)	186 (280)	216 (257)	113 (145)
RNSP	Riparian	575 (778)	1088 (1673)	138 (185)	158 (160)	80 (85)

Discussion

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 LABE was about perfect, with some of the later sites having some dried, but recognizable, plants. Conditions that tend to slow sampling, i.e. high tree density, high species diversity, high cover percentages, tall understory vegetation (shrubs mostly), difficult off trail hiking (bush whacking), long drive time to plots, and large and dense down woody debris do not really occur at LABE. Conversely, these conditions occur much more often at RNSP, making sampling very challenging, and as a result we were not able to meet our original target number of sites. Our 2012 effort at RNSP resulted in meeting 65% (26/40) of our sample size goal for the matrix sites and 80% (21/26) for riparian sites. Sampling at RNSP could have been made more efficient if we had camped closer to some of the sites requiring more drive time. In particular, the sites south of the A-9 deck on the Westside Access Rd., and especially the sites on Bridge Creek ridge or near, and in the Mill Creek acquisition. Leonel Arguello, Redwood NP vegetation ecologist, said the NPS would likely approve camping on park service land, if we agree to follow some special regulations. Camping in the Mill Creek acquisition area would require permissions from the California State Parks. Reducing drive time would likely liberate 3-5 person days for additional sampling. At RNSP, sites #11 and #74 along Redwood Creek had very dry vegetation when we sampled them in mid September; these sites should be sampled in mid August at the latest. Sampling of all other plots seemed to capture most species before they senesced. The two person crew was entirely adequate for work at Lava Beds. A three person crew would have been preferable for RNSP.

As this is the first season implementing our Vegetation Monitoring Protocol (Odion et al. 2011) we can only present data on status, found in the results section. Data collected in 2012 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 4 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 Redwoods the generalities are opposite on all accounts; with Redwoods even boasting some of the tallest trees in the world.

Changes to protocol

As a result of the pilot study a number of possible improvements to the protocol were revealed. These were evaluated with Klamath Network staff, and the following changes were made:

- **Allow plots exceeding 30 degrees slope to be sampled**— At Redwood some riparian plots with sections over 30 deg were sampled. If the entire slope of a plot was >30 deg the plot

was rejected, however if a site had one or two sections with a slope over 30 deg it was sampled. If any portion of the site slope exceed 40 deg the site was rejected except when small cliffs occurred in the plot but did not compromise crew safety (the crew could easily navigate around them).

- **Riparian plot design was modified to allow for one 10x100m plot or two 10x50m plots**—It was problematic at Redwood to place a 100m long linear riparian plot along some stream reaches. Often sinuosity of the stream caused the long linear plot design to diverge either into the stream or out of the immediate riparian corridor. We also allowed for a non-linear plot boundary parallel to the stream. Crews recorded azimuths of each plot boundary and drew a site diagram.

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Appendix 1. Site data and environmental parameters collected during 2011 from LBE matrix sites.

Park	Frame	Site	Monument Date	Easting	Northing	Macro Position	Slope Shape	Elevation	Avg Slope	Avg Aspect
LABE	Matrix	LB01	5/28/11	625949	4618970	MACPOS 3	Undulating	1370	0	N/A
LABE	Matrix	LB02	6/24/11	625959	4623001	MACPOS 5	Concave	1300	0	N/A
LABE	Matrix	LB03	6/12/11	622598	4628941	MACPOS 5	Concave	1255	0	N/A
LABE	Matrix	LB04	6/26/11	624981	4619990	MACPOS 5	Straight	1348	0	N/A
LABE	Matrix	LB05	6/26/11	628045	4620492	MACPOS 3	Convex	1300	4	N/A
LABE	Matrix	LB06	6/23/11	627196	4625210	MACPOS 5	Concave	1269	0	N/A
LABE	Matrix	LB07	6/6/11	624209	4630222	MACPOS 3	Concave	1239	7	252
LABE	Matrix	LB08	7/5/11	620598	4621181	MACPOS 5	Undulating	1456	0	N/A
LABE	Matrix	LB09	6/12/11	626072	4629327	MACPOS 4	Convex	1246	0	N/A
LABE	Matrix	LB10	6/25/11	625179	4622952	MACPOS 4	Concave	1314	0	N/A
LABE	Matrix	LB11	7/9/11	621470	4617742	MACPOS 4	Undulating	1572	0	N/A
LABE	Matrix	LB12	6/8/11	628158	4631178	MACPOS 5	Concave	1226	0	N/A
LABE	Matrix	LB13	6/22/11	620052	4625660	MACPOS 5	Concave	1290	0	N/A
LABE	Matrix	LB14	6/22/11	621433	4625595	MACPOS 4	Undulating	1288	0	N/A
LABE	Matrix	LB15	6/10/11	627619	4627155	MACPOS 4	Undulating	1244	0	N/A
LABE	Matrix	LB16	6/10/11	627296	4628969	MACPOS 4	Undulating	1242	0	N/A
LABE	Matrix	LB17	7/5/11	623116	4618169	MACPOS 3	Undulating	1485	0	N/A
LABE	Matrix	LB18	7/9/11	619547	4620585	MACPOS 2	Undulating	1495	1	267
LABE	Matrix	LB19	6/9/11	628220	4625564	MACPOS 4	Undulating	1246	0	N/A
LABE	Matrix	LB20	6/25/11	627431	4621712	MACPOS 4	Undulating	1300	0	N/A
LABE	Matrix	LB21	7/8/11	618243	4621149	MACPOS 4	Concave	1450	12	274
LABE	Matrix	LB22	6/11/11	626115	4628227	MACPOS 4	Undulating	1245	0	N/A
LABE	Matrix	LB23	6/24/11	625851	4624990	MACPOS 4	Undulating	1276	3	175
LABE	Matrix	LB24	7/10/11	619869	4617224	MACPOS 3	Concave	1556	0	N/A
LABE	Matrix	LB25	7/6/11	626965	4618253	MACPOS 5	Undulating	1358	5	15
LABE	Matrix	LB26	7/7/11	619082	4627960	MACPOS 2	Concave	1349	4	226

Park	Frame	Site	Monument Date	Easting	Northing	Macro Position	Slope Shape	Elevation	Avg Slope	Avg Aspect
LABE	Matrix	LB27	6/20/11	633818	4633332	MACPOS 2	Convex	1235	10	N/A
LABE	Matrix	LB28	6/20/11	620341	4631066	MACPOS 4	Convex	1221	0	N/A
LABE	Matrix	LB29	7/7/11	617461	4623571	MACPOS 3	Convex	1364	5	324
LABE	Matrix	LB30	6/21/11	618981	4631979	MACPOS 2	Convex	1390	7	268

Appendix 2. Site data and environmental parameters collected during 2011 from RNSP matrix sites.

Park	Frame	Site	Monument Date	Easting	Northing	Macro Position	Slope Shape	Elevation	Avg Slope	Avg Aspect
REDW	Matrix	RW01	6/26/11	406440	4628802	MACPOS 2	Concave	160	11	113
REDW	Matrix	RW03	7/9/11	418316	4557900	MACPOS 2	Concave	602	8	67
REDW	Matrix	RW04	8/19/11	411771	4614922	MACPOS 2	Concave	437	13	3
REDW	Matrix	RW05	6/8/11	415775	4572449	MACPOS 3	Convex	356	11	98
REDW	Matrix	RW06	7/23/11	419649	4553524	MACPOS 3	Straight	515	26	164
REDW	Matrix	RW08	7/19/11	412490	4576607	MACPOS 1	Undulating	229	5	50
REDW	Matrix	RW09	8/6/11	410953	4620856	MACPOS 2	Straight	301	25	286
REDW	Matrix	RW11	7/10/11	413425	4582838	MACPOS 1	Convex	209	23	166
REDW	Matrix	RW12	8/21/11	416481	4616175	MACPOS 1	Concave	402	28	355
REDW	Matrix	RW13	6/6/11	423082	4556936	MACPOS 2	Undulating	507	16	251
REDW	Matrix	RW14	6/22/11	407520	4623980	MACPOS 3	Straight	121	19	77
REDW	Matrix	RW15	7/21/11	410453	4575034	MACPOS 3	Straight	135	22	204
REDW	Matrix	RW16	6/24/11	411796	4558588	MACPOS 2	Straight	509	16	44
REDW	Matrix	RW18	8/4/11	409240	4624258	MACPOS 2	Concave	230	22	343
REDW	Matrix	RW19	8/6/11	415646	4555760	MACPOS 2	Convex	631	3	260
REDW	Matrix	RW20	8/17/11	411230	4582212	MACPOS 2	Straight	99	26	326
REDW	Matrix	RW21	7/7/11	418235	4564562	MACPOS 2	Undulating	611	9	135
REDW	Matrix	RW22	6/25/11	418685	4549207	MACPOS 1	Undulating	680	11	98
REDW	Matrix	RW23	8/3/11	417251	4553494	MACPOS 2	Straight	663	9	20
REDW	Matrix	RW24	7/20/11	414722	4556681	MACPOS 3	Straight	694	17	112
REDW	Matrix	RW25	8/5/11	407063	4621797	MACPOS 3	Concave	228	7	292
REDW	Matrix	RW26	7/25/11	411712	4566167	MACPOS 2	Straight	381	8	182
REDW	Matrix	RW27	8/3/11	406170	4627441	MACPOS 2	Convex	199	8	165
REDW	Matrix	RW28	7/23/11	415260	4569244	MACPOS 3	Straight	366	10	121
REDW	Matrix	RW29	8/5/11	414597	4567552	MACPOS 3	Undulating	244	12	99
REDW	Matrix	RW30	8/1/11	407063	4626364	MACPOS 2	Straight	206	24	75

Appendix 3. Site data and environmental parameters collected during from RNSP riparian sites.

Park	Frame	Site	Monument Date	Easting	Northing	Macro Position	Slope Shape	Elevation	Avg Slope	Avg Aspect
REDW	Riparian	Site-04	9/18/11	410474	4566191	MACPOS 5	Straight	225	0	N/A
REDW	Riparian	Site-08	9/16/11	415620	4582102	MACPOS 5	Concave	141	23	318
REDW	Riparian	Site-10	8/21/11	411894	4615337	MACPOS 5	Concave	232	35	260
REDW	Riparian	Site-11	9/18/11	416017	4562096	MACPOS 5	Concave	39	16	122
REDW	Riparian	Site-13	9/4/11	409472	4620310	MACPOS 5	Convex	81	12	84
REDW	Riparian	Site-14	8/31/11	414467	4575805	MACPOS 5	Concave	40	3	25
REDW	Riparian	Site-17	8/30/11	410752	4625543	MACPOS 5	Concave	128	22	190
REDW	Riparian	Site-18	9/14/11	412899	4621651	MACPOS 5	Concave	240	19	315
REDW	Riparian	Site-22	9/1/11	411765	4613994	MACPOS 5	Concave	286	30	164
REDW	Riparian	Site-24	9/13/11	412511	4578932	MACPOS 5	Straight	74	0	N/A
REDW	Riparian	Site-25	8/17/11	409125	4616381	MACPOS 5	Straight	111	0	N/A
REDW	Riparian	Site-27	9/13/11	415936	4571138	MACPOS 5	Concave	441	32	15
REDW	Riparian	Site-31	9/19/11	418206	4575097	MACPOS 5	Concave	242	24	339
REDW	Riparian	Site-53	9/2/11	416106	4612960	MACPOS 5	Concave	380	26	245
REDW	Riparian	Site-61	9/15/11	407368	4622628	MACPOS 5	Straight	103	2	94
REDW	Riparian	Site-63	9/27/11	415352	4563568	MACPOS 5	Concave	54	9	26
REDW	Riparian	Site-65	9/15/11	408034	4631426	MACPOS 5	Undulating	49	0	N/A
REDW	Riparian	Site-70	9/16/11	415571	4573336	MACPOS 5	Concave	234	16	15
REDW	Riparian	Site-73	9/3/11	407796	4619061	MACPOS 5	Straight	100	2	297
REDW	Riparian	Site-74	9/17/11	413308	4572219	MACPOS 5	Straight	4	0	N/A
REDW	Riparian	Site-80	9/27/11	414293	4580139	MACPOS 5	Straight	79	14	242