Appendix A: Annual Report-Fiscal Year 2008:

Monitoring Vegetation Composition, Structure, and Function in Crater Lake National Park: Results from a Pilot Study

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Abstract

This report describes the results of a pilot vegetation study undertaken in Crater Lake in 2008 to test the Klamath Network's Vegetation Monitoring Protocol. The pilot study found that the protocol could be implemented with an average rate of one plot sampled per day over the field season. Some minor changes to the protocol have been made as a result of testing the procedures during the pilot study. Data from the 17 plots that were sampled are summarized in a format that provides a template for future annual vegetation monitoring reports.

Introduction

In 2008 the Klamath Network tested its draft vegetation monitoring protocol at Crater Lake in a pilot study. The main objectives of the pilot study were to evaluate time and feasibility of the proposed sampling. Results are described here in the format the Network 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.

Methods

Site Selection

As described in the vegetation protocol, the sampling frame that will be used in monitoring excludes areas with slopes greater than 30 degrees, and less than 100 m from a road or trail or farther than 1 km from a road or trail. There are three sampling domains: 1) Elevations above 2057 m (6750') (Alpine), 2) Areas within 20 m horizontally of a perennial stream (Riparian), 3) Remaining areas (Matrix) (Figure 1). We randomly selected 8 riparian, 15 matrix, and 12 alpine sites in a spatially balanced arrangement for sampling (Figure 1).

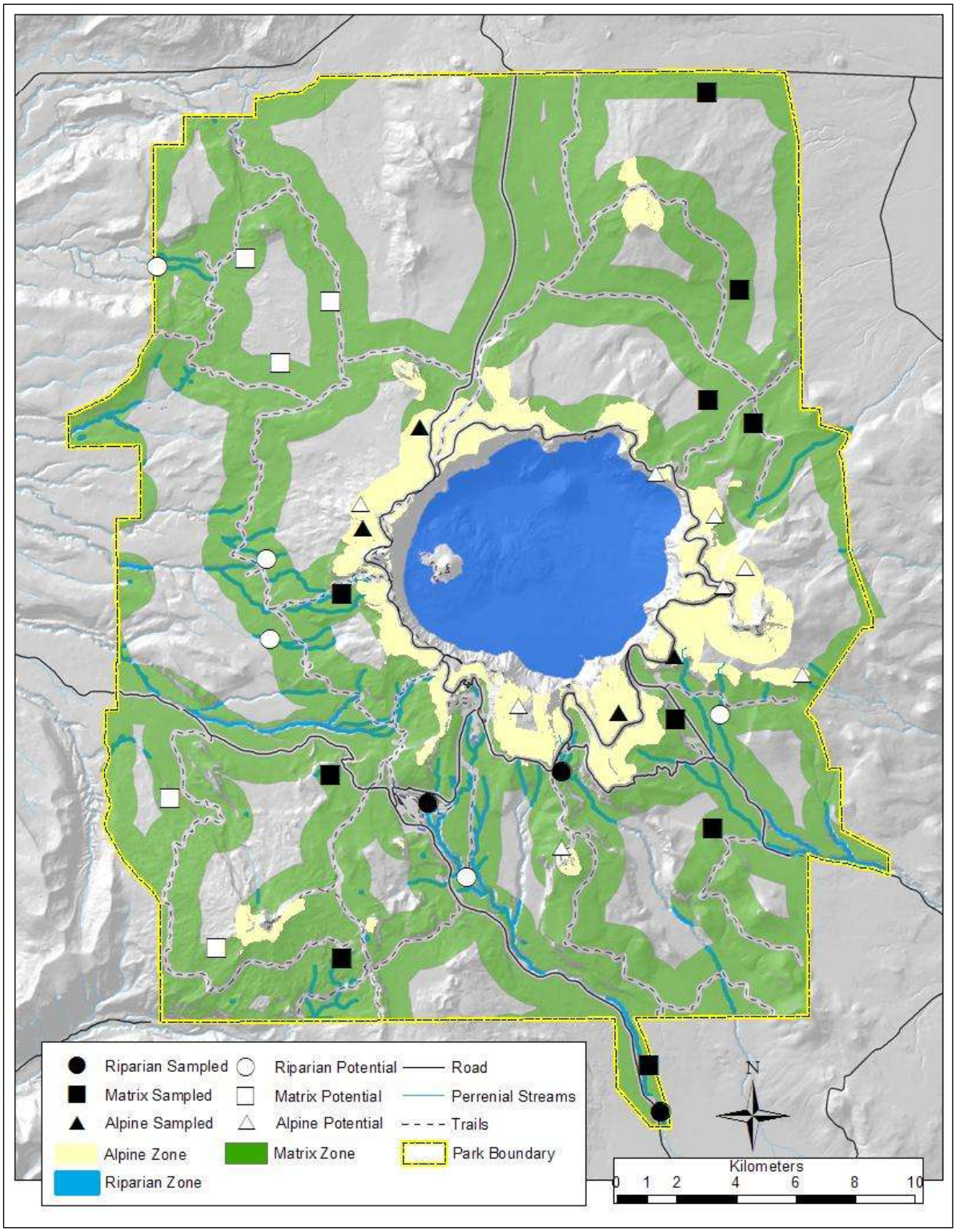

Figure 1. Sampling domains and potential sites for sampling during the vegetation Pilot Study at Crater Lake.

Field Sampling

In 2008, 17 of the 35 sites (4 alpine, 10 matrix, and 3 riparian) were sampled (Figure 1). A 20 x 50 m plot was used for matrix and alpine sites (Figure 2); a 10 x100 m plot was used for riparian sites (Figure 3). The elongated riparian plots were used to avoid going too far into the upland habitat type. Each plot consisted of ten 10 x 10 m modules, four of which were sampled intensively for cover, and seedling and sapling data.

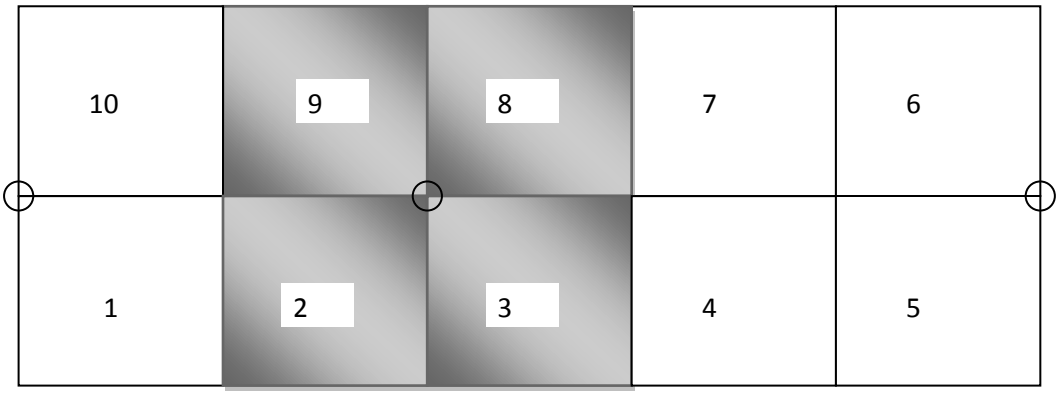

Figure 2. The 20 x 50 m matrix and alpine site layout. Each numbered square is 10 x 10 m. Shaded squares are the 4 intensive modules.

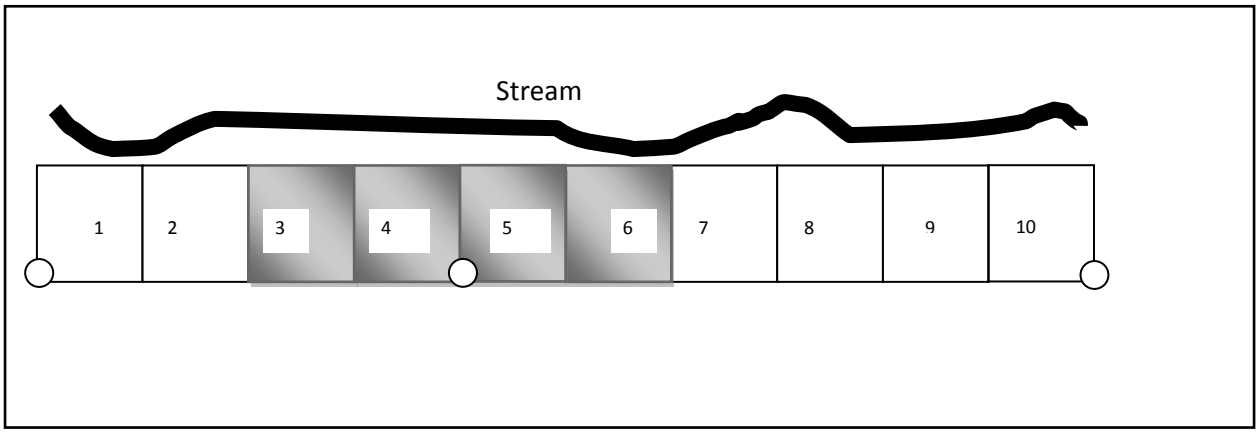

Figure 3. Ten x 100 m riparian site layout. Each numbered square is 10 x10m. Shaded squares are the 4 intensive modules.

Standard operating procedures 6-9 of the vegetation protocol (Odion et al. 2009), provide details on the collection in each plot of measurements of the following parameters:

1. Slope
2. Aspect
3. Elevation
4. Microtopography
5. Macrotopography
6. Vascular plant cover by species (three 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. General data summaries were conducted to provide measures of central tendency (mean, median) and variance (range, standard deviation) for each parameter. Select data are presented in tabular form, and where suitable, 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, annual reports may show different parameters, but will use the same type of tables and illustrations.

Results

Here we summarize selected data most relevant to our pilot study and monitoring objectives. Appendix 1 provides a more comprehensive summary of the environmental data collected at each site.

Time to Complete Sampling

Travel time to and from sites ranged from 15min to 2hrs, depending upon the distance from a suitable parking area and the terrain encountered. The time required to complete the plot measurements was also highly variable and depended on vegetation density and within-site diversity. Table 1 shows time variation for completing plot parameters, while Figure 4 summarizes the completion time data. The mean completion time was 4.6 hours (range 1.5-8.5 hours). These data indicate that, notwithstanding a few plots that took extra long to get to and sample, a rate of at least one plot per scheduled field day appears feasible in Crater Lake over the course of a field season. With good logistical planning it may be possible to complete more than one plot per day, particularly in the alpine sampling frame.

Table 1. Time to complete plot measurements and the order they were completed.

Sampling parameter	Time to complete measurements
Plot Setup, photographs, measure environmental variables	30 min- 2 hours
Subplot Sampling (cover values, small tree, saplings and seedlings)	10 min-1 hour 45 min x4 (numbers are for one of 4 intensive modules)
Overstory Sampling (tree measures)	0-2 hours 30 min
Dead and down wood and litter	0-1 hour
Canopy cover and searching for new species in the 0.1ha site	0-45 min

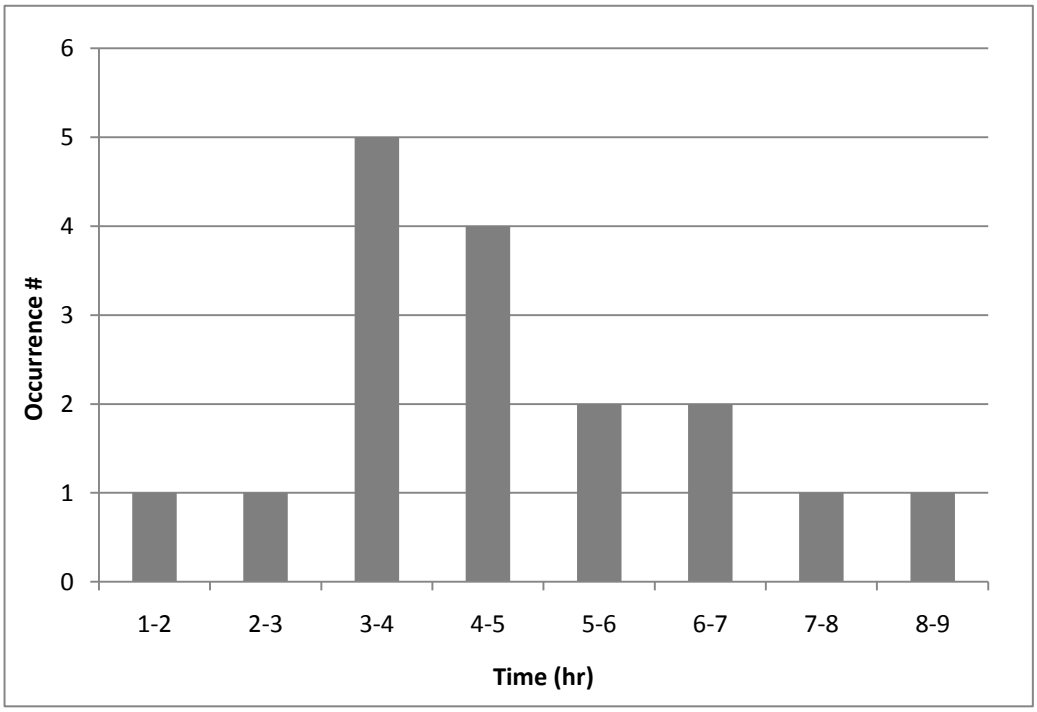

Figure 4. Histogram of the time required to complete plots during the pilot study.

Vegetation Composition

The most frequently occurring understory species by sampling frame are shown in Table 2. Four less common species were encountered that were not found in NPSpecies and were added (*Aster campestris, Ericameria greenii, Eriogonum pyrolofolium, and Salix geyeriana*). However, these were listed in Zika's 2003 Crater Lake flora. Overstory species and their relative basal areas are shown in Figure 5.

Table 2. Understory species listed which occur in at least 2 matrix, and 3 alpine and riparian sites. Actual annual reports will contain a complete list of species encountered as an appendix.

Herbs	Alpine	Matrix	Riparian	**Herbs**	Alpine	Matrix	Riparian
Aconitum columbianum			x	*Senecio triangularis*			x
Allotropa virgata		x		**Graminoides**	Alpine	Matrix	Riparian
Angelica genuflexa			x	*Achnatherum occidentale*	x	x	
Arabis platysperma	x			*Calamagrostis canadensis*			x
Arenaria pumicola	x			*Carex inops ssp. inops*		x	
Chimaphila menziesii		x		*Carex rossii*		x	
Chimaphila umbellata		x		*Elymus elymoides*	x	x	
Cistanthe umbellata	x			*Juncus parryi*		x	
Equisetum arvense			x	*Luzula hitchcockii*		x	
Eriogonum pyrolifolium	x			*Poa wheeleri*			x
Hieracium albiflorum		x		**Shrubs**	Alpine	Matrix	Riparian
Kelloggia galioides		x		*Eriogonum umbellatum*	x		
Lupinus andersonii	x	x		*Arctostaphylos nevadensis*	x		
Lupinus polyphyllus			x	*Arctostaphylos patula*		x	
Polygonum newberryi	x			*Ribes lacustre*		x	
Pyrola picta		x		*Salix scouleriana*		x	
Pyrola secunda		x	x	*Vaccinium scoparium*		x	

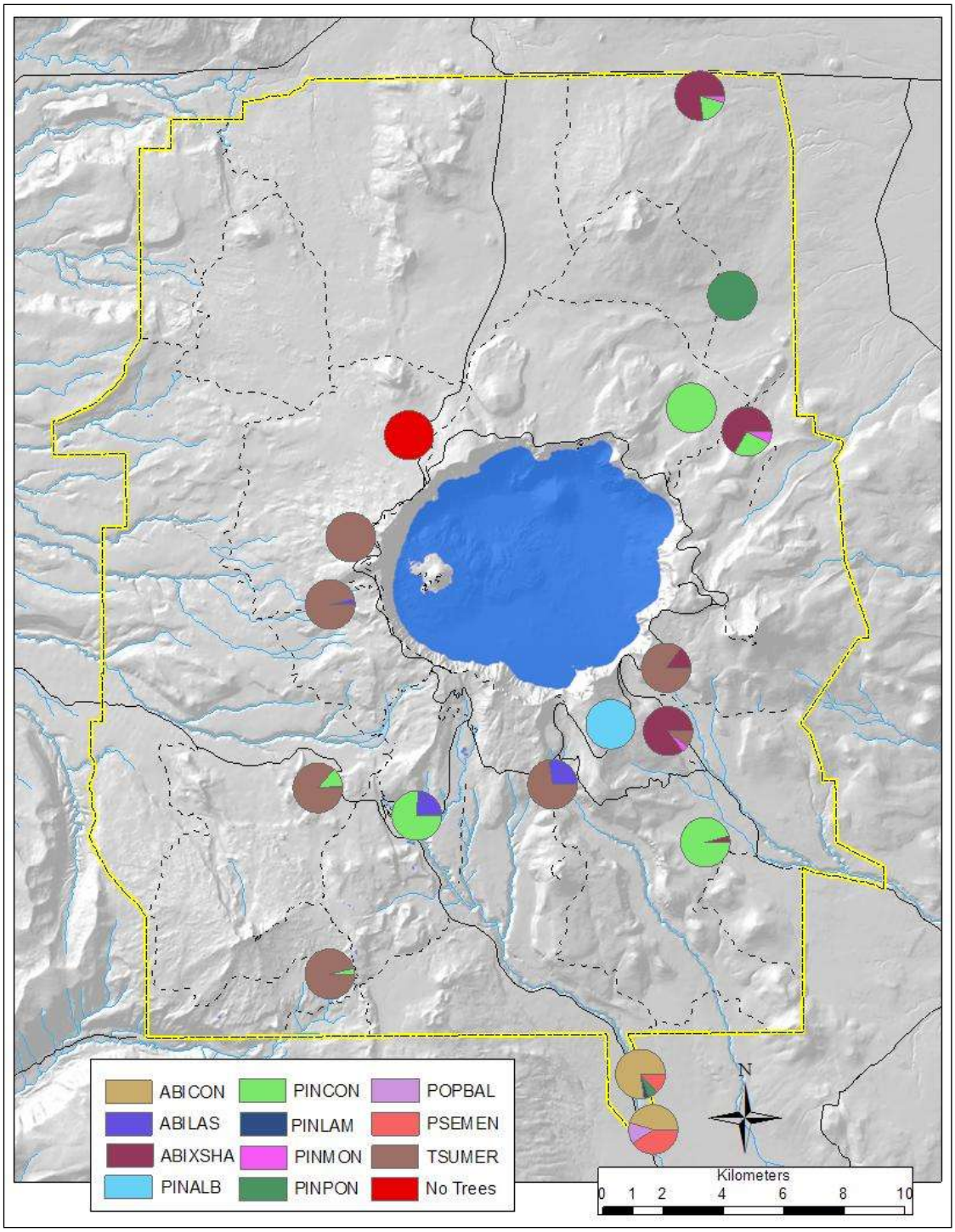

Figure 5. Individual tree species composition of the total basal area for each site. **NOTE**: the total basal area of each plot is not represented in this figure; refer to figure 8 for total basal area data. ABICON= *Abies concolor*; ABILAS= *A. lasiocarpa*; ABIXSHA= *A.* X *shastensis*; PINALB= *Pinus albicaulis*; PINCON= *P. contorta*; PINLAM= *P. lambertiana*; PINMON= *P. monticola*; PINPON= *P. ponderosa*; POPBAL= *Populus balsamifera*; PSEMEN= *Pseudotsuga menziesii*; TSUMER *Tsuga mertensiana.*

Mountain hemlock (*Tsuga mertensiana*) was the most dominant tree, followed by lodgepole pine (*Pinus contorta*). Other species were not widespread, but were locally dominant, such as white fir (*Abies concolor*) and whitebark pine (*P. albicaulis*), and Douglas-fir (*Pseudotsuga menzesii*). The riparian, alpine and matrix sampling frames had mean species richness of 62, 16 and 13 species per plot, respectively. Spatial patterns of richness are shown in Figure 6. Only one site contained a nonnative species, dandelion (*Taraxacum officinale*).

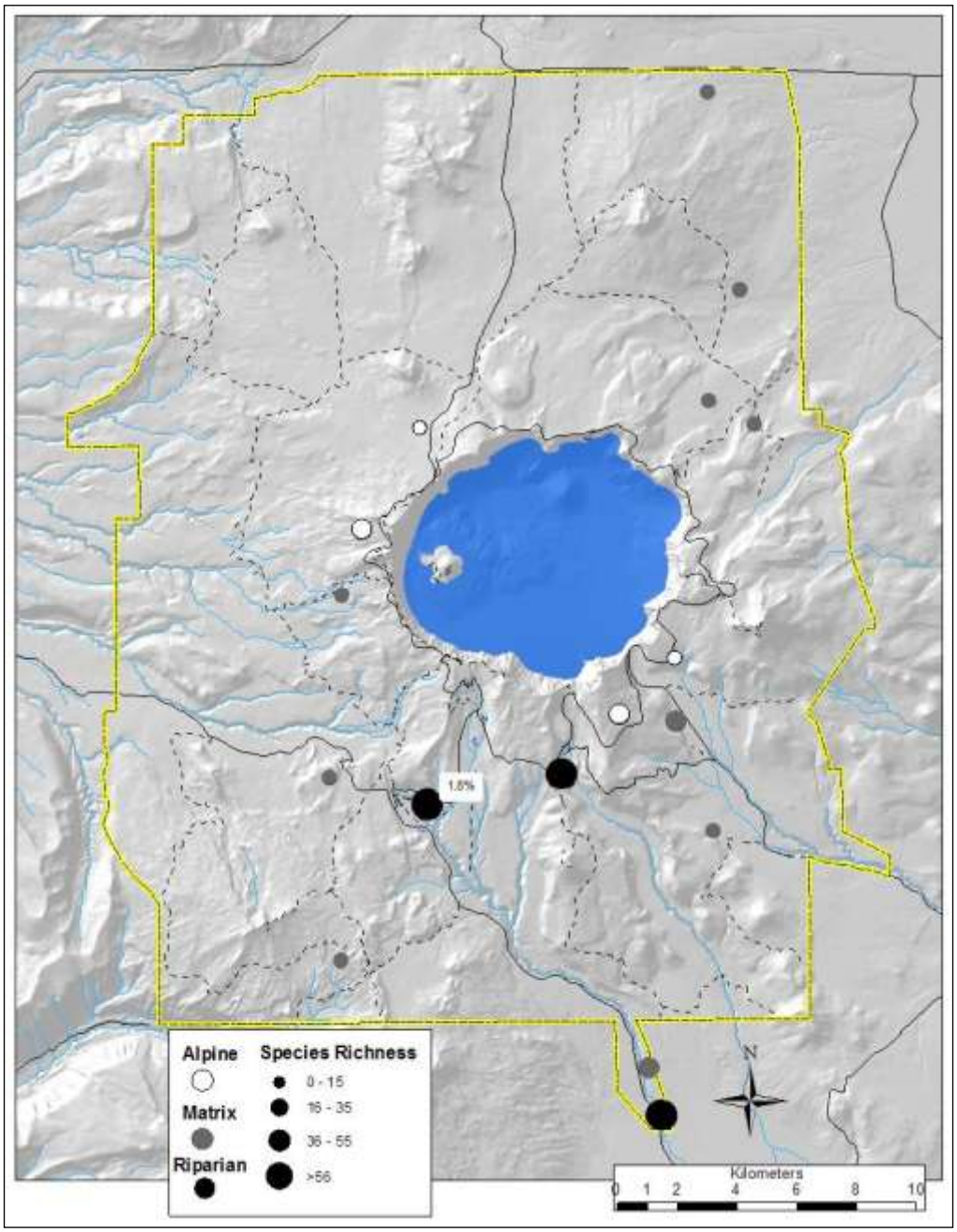

Figure 6. Site species richness from each sampling frame displayed by bubble size. Label shows percentage of species that are nonnative. Sites without a label do not have any nonnative species.

Vegetation Structure

Percent cover by stratum varied across the park (Fig. 7). Riparian sites had the highest cover for the 0-.5 m and >0.5-4.99 m strata, 56% and 47% respectively, but the lowest cover for the >5m stratum, 14%. Alpine sites had the lowest percent cover for the 0-.5 m and >0.5-4.99 m strata, 12% and 1%, respectively. Matrix sites had the highest cover for >5m stratum, 23%. Average total cover ranged from lowest in alpine (28%), to intermediate in matrix (55%), and highest in the riparian stratum (118%).

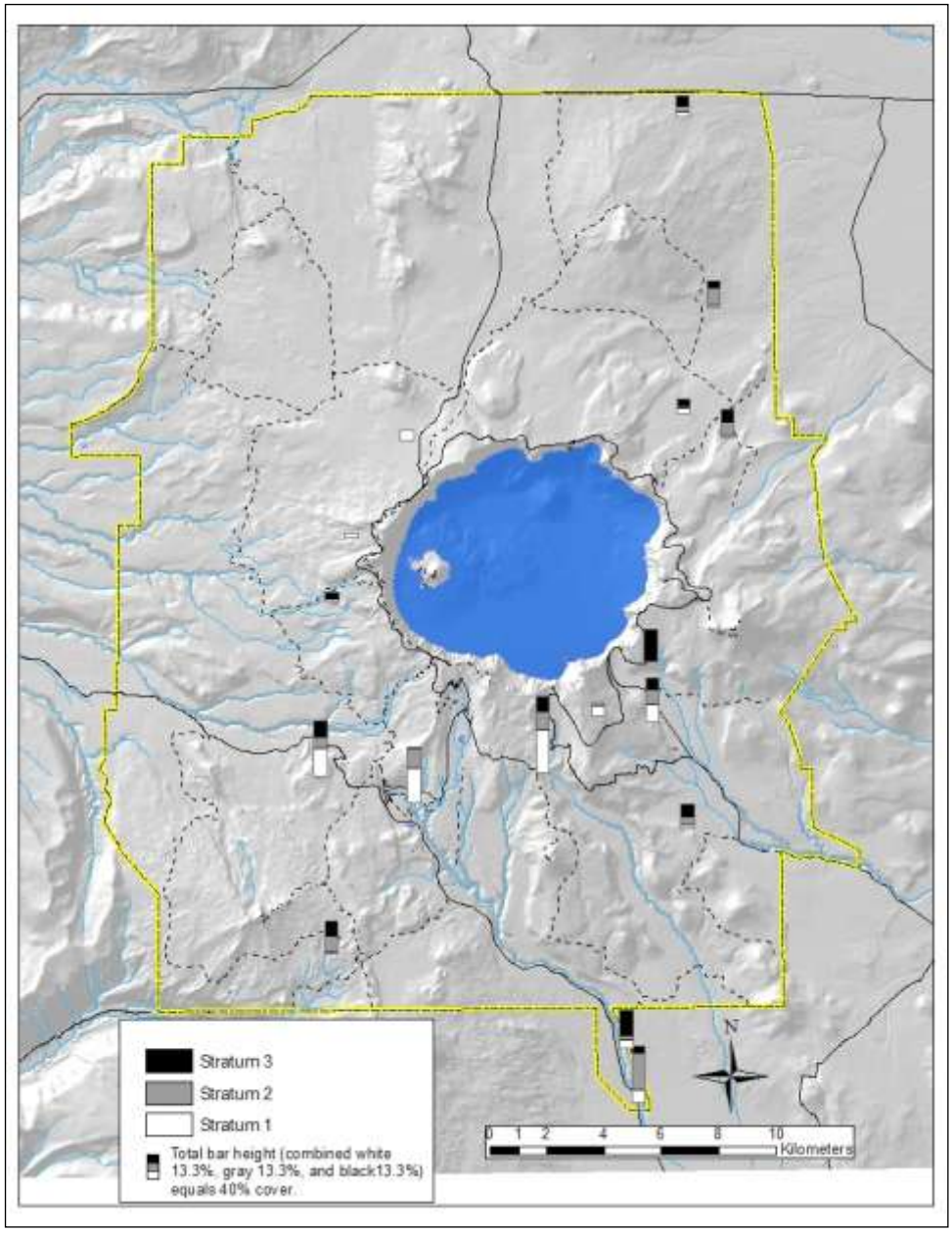

Figure 7. Vegetation cover percentages for each site by height strata Stratum 1= 0-.5m, stratum 2=>.5-4.99m, stratum 3= >5m.

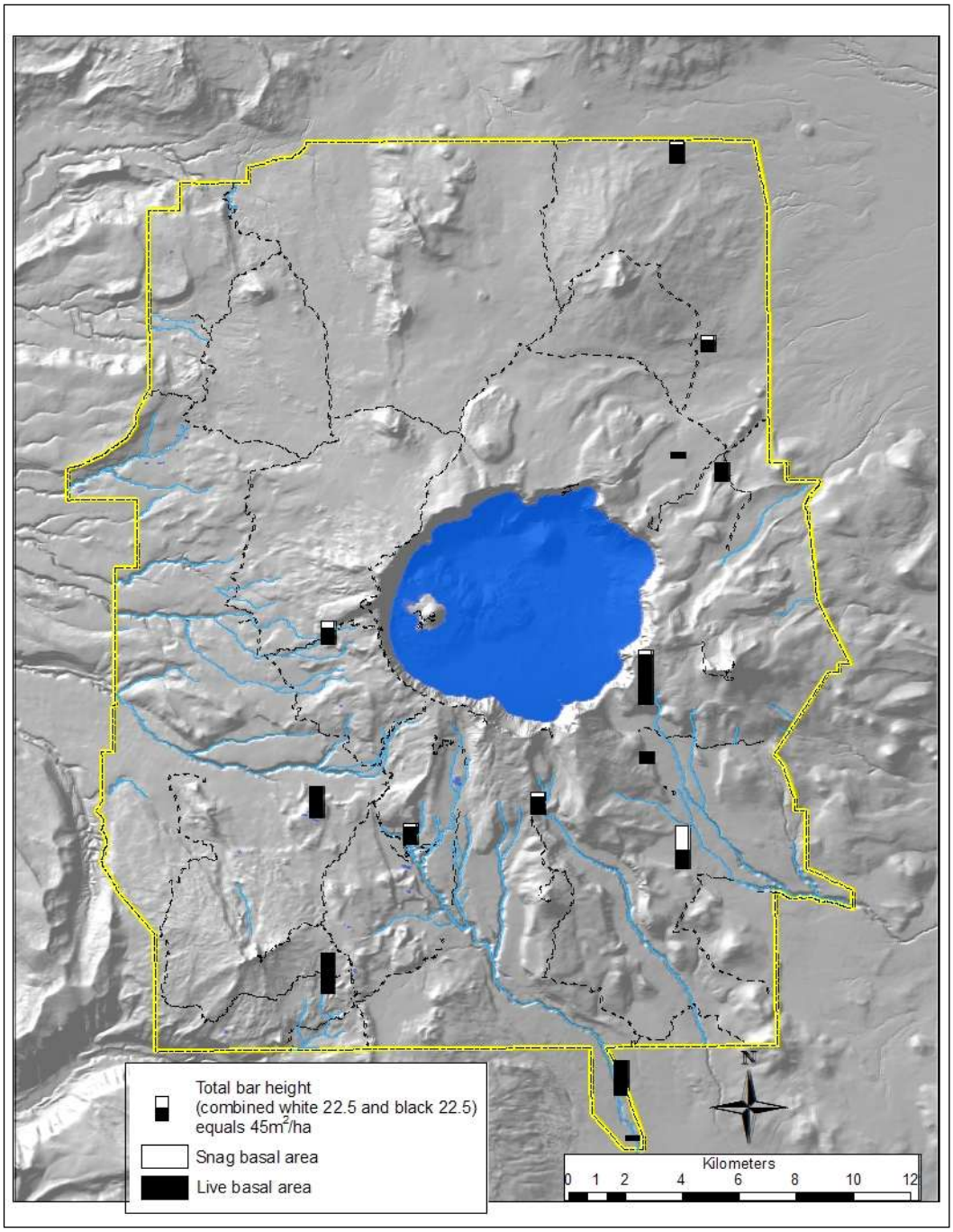

Figure 8. Live and dead tree basal area for each site. Sites with < 8m^2/ha, combined live and dead, basal area are excluded from this figure.

Live and dead tree basal area by site are illustrated in Figure 8 and summarized by sampling frame in Table 4. Basal area was highly variable and lowest in riparian areas and highest in matrix areas. Several plots lacked dead trees, while one plot dominated by mountain hemlock had mostly dead trees as a result of the Bybee Fire in 2006. Mean canopy base heights varied little between sampling frames (Table 4).

Table 4. Mean of dead and live tree parameters. Standard errors are shown in parenthesis.

	Dead		Live			
Sampling Frame	**Basal Area (m^2/ha)**	**stems/ha**	**Basal Area (m^2/ha)**	**stems/ha**	**Height to Crown (m)**	**Max.Tree Height (m)**
Alpine	2.2 (2.2)	40 (40)	24.6 (21.6)	153 (111)	8.6 (0.8)	25.1 (2.4)
Matrix	7.3 (4.2)	70 (30)	37.1 (6.2)	370 (65)	6.6 (0.3)	23.1 (0.8)
Riparian	5.6 (3.2)	20 (10)	23.5 (7.7)	137 (30)	7.7 (1.3)	27.1 (2.2)

Table 5 shows the 1, 10, 100 and 1000 hr time lag fuels. These were highest in the matrix and lowest in the alpine sampling frame, except 1000 hr rotten wood, which was highest in the alpine sampling frame. One alpine site had a total of 177 tons per acre, due to the fact that one down whitebark pine log was mismeasured. We determined this error retrospectively. The occurrence of this measurement error lead to a change in the protocol; now each data sheet will be reviewed as soon as it is completed. In the pilot study, all data sheets were reviewed at the end of sampling a site.

Table 5. Summary of woody debris time lag classes reported in tons per acre. Standard errors are shown in parentheses. S = Sound, R = Rotten.

Sampling Frame	**1 hr fuel**	**10 hr fuel**	**100 hr fuel**	**1000 hr S fuel**	**1000 hr R fuel**
Alpine	0.08 (0.07)	0.29 (0.20)	0.42 (0.36)	2.5 (2.5)	66 (41)
Matrix	0.52 (0.18)	0.89 (0.16)	1.8 (.27)	17 (4.6)	17 (6.4)
Riparian	0.04 (0.03)	0.3 (0.18)	1.8 (1.1)	11 (10)	34 (26)

Ground parameters are summarized in Table 6. The matrix sampling frame had the deepest litter and duff layers, while the alpine sampling frame had the shallowest. Mean bare soil in the alpine sampling frame was over ten times higher than the matrix or riparian frames. Mean bryophyte cover was greatest in the riparian sampling frame.

Table 6. Summary of mean and standard error of ground parameters. Standard errors are shown in parentheses.

Sampling Frame	Thickness/depth (mm)		Cover (%)			
	Litter	Duff	Fine wood /litter	Coarse Wood	Bryophyte	Bare Soil
Alpine	5.0 (2.6)	6.0 (4.8)	22.5 (20.8)	4.3 (3.0)	0.0 (0)	57.0 (19.8)
Martix	14.9 (1.6)	20.5(3.6)	68.4 (5.6)	8.4 (1.6)	0.1 (0.1)	4.2 (3.1)
Riparian	7.7 (4.1)	13.3(6.8)	11.3 (5.6)	6.0 (3.5)	6.3 (5.8)	2.7 (1.8)

Vegetation Function

The matrix sampling frame had the highest numbers of seedlings saplings and small trees (Table 7). The alpine sampling frame had the lowest densities, with zero small trees in all pole classes.

Table 7. Summary of densities/ha of seedling, saplings, and small trees. Standard errors are shown in parenthesis.

Sampling Frame	Seedlings <20cm tall	Saplings 20cm tall-1.4m tall	Small trees 1.4m tall-5cm DBH	Small trees >5 - 10cm DBH	Small trees 10 - 15cm DBH
Alpine	1750 (1668)	0 (0)	0 (0)	0 (0)	0 (0)
Matrix	4300 (1927)	2050 (595)	338 (103)	138 (43)	1085 (368)
Riparian	2250 (1181)	1750 (764)	50 (14)	8 (8)	383 (79)

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:

- **Height strata—**changed from three (<0.5 m, 0.5-4.99 m, and >5 m) to four (<0.75 m, 0.75-2.5 m, >2.5-5 m, and >5 m.
- **Shrub height—**added an average shrub height measurement for each of the 4 intensive modules. We did this to quantify potential ladder fuels in each intensive module.
- **Incidental photo metadata sheet—**added an incidental photo metadata sheet to the protocol. This will allow easier differentiation between site specific and incidental photographs.
- **Water to ground cover—**added water as a category for ground cover. This was needed especially for some riparian sites**.**
- **Double check data sheets right after sampling parameters—**In the pilot study, data sheets were double checked in the field once all field sampling was completed. One important error could have been prevented by double checking the data sheet sooner.

- **Allow plots exceeding 30 degrees slope to be sampled—** This can be at the crews discretion depending on whether the plot can be sampled safely and whether it is on a three or 30 year revisit cycle. There is greater concern for trampling damage in plots that are on a 3-year revisit cycle.

Discussion

The pilot study demonstrated the feasibility of implementing the vegetation protocol and led to a number of suggested changes. Future annual reports will discuss the status of vegetation sampled in a given year and any outstanding trends. The likely significance and cause of trends will be described based on pertinent literature. No discussion about vegetation sampled is provided here because the sample size was too limited to draw significant inferences.

Appendix 1. Site data and environmental parameters collected during the Crater Lake vegetation monitoring pilot study.

Site	Sampling Frame	Easting	Northing	Date Monumented	Macro Position	Slope Shape	Average Slope (Deg)	Average Aspect	Elevation (m)
Site-003	Alpine	568703	4759038	8/21/2008	MACPOS 2	Straight	3	180	2061
Site-004	Alpine	575389	4749419	8/5/2008	MACPOS 1	Straight/convex	16	173	2292
Site-009	Alpine	566771	4755641	8/25/2008	MACPOS 2	Straight	19	250	2184
Site-010	Alpine	577235	4751300	8/14/2008	MACPOS 2	Concave	23	45	2144
Site-013	Matrix	578390	4759947	8/19/2008	MACPOS 3	Straight	0	0	1800
Site-014	Matrix	566065	4741113	8/28/2008	MACPOS 3	Concave/straight	0	0	1890
Site-017	Matrix	579910	4759160	8/20/2008	MACPOS 3	Straight	21	100	1760
Site-018	Matrix	565679	4747304	8/6/2008	MACPOS 2	Straight	0	0	1920
Site-019	Matrix	576379	4737535	9/2/2008	MACPOS 3	Straight	0	53	1410
Site-021	Matrix	578345	4770335	8/18/2008	MACPOS 3	Straight	4	30	1699
Site-022	Matrix	566087	4753406	8/21/2008	MACPOS 3	Concave	17	347	1948
Site-023	Matrix	578529	4745493	8/26/2008	MACPOS 3	Undulating	9	87	1752
Site-025	Matrix	579425	4763682	8/19/2008	MACPOS 3	Straight	0	0	1632
Site-027	Matrix	577293	4749192	8/13/2008	MACPOS 3	Straight	45	10	1917
Site-028	Riparian	576940	4734615	8/26/2008	MACPOS 4	Straight	0	0	1340
Site-032	Riparian	573462	4747425	8/12/2008	MACPOS 4/5	Concave	30	83	1895
Site-034	Riparian	568954	4746380	8/7/2008	MACPOS 5	Straight/concave	8	60	1739

Appendix B. Univariate Power Analysis for Trend in Basal Area and Sapling Density

Kathryn M. Irvine

Abstract.

This report summarizes the preliminary univariate power analysis for the Klamath Network Vegetation protocol. The power analysis is based on the pilot study data collected at Crater Lake and US Forest Service Forest Inventory and Analysis (FIA) data from the Oregon Cascades. Pilot data are from one sample period and FIA data are from two periods that were 1 year apart. The variables analyzed were total tree basal area and saplings measured or estimated for sampling plots. Plot sizes were similar between data sources and all data were converted to per ha values for this analysis. I assume the mixed linear model for trend proposed in Urquhart et al. 1993 is appropriate for analyzing future KLMN vegetation data. I estimate the power to detect a linear trend using this model based on these limited data and the Network's temporal sampling scheme. Based on this, the sampling design seems sufficient to meet the sampling objective of detecting a 50% change over 15 years for basal area, but it may take twice that long to detect 50% change in saplings, which exhibit greater spatial and temporal variation. However, after the power analysis was conducted the Network has modified the protocol to a three year always revisit design. For estimating annual status the proposed change to the revisit design may be negatively affected. However, the switch to an always revisit design should increase the power for detecting trends as compared to the estimated power reported here. While this is encouraging, the current results are provisional; as monitoring data are gathered, power and the model used for analysis should be reassessed.

Introduction

This report summarizes the preliminary univariate power analysis for the vegetation protocol. The power analysis is based on the pilot data provided by Dennis Odion for Basal Area (meters squared/ha) and saplings (per ha) obtained and summarized from US Forest Service Forest Inventory and Analysis plots, and from the pilot study plots undertaken by the Klamath Network at Crater Lake.

Data

I used the data in *KLMNunivariateData revised DCO.xls* for the power analysis. The responses were sapling density (per ha) and plot basal area (m^2/ha). Plot sizes were similar between data sources and all data were converted to per ha values for this analysis. There was only one year of data for the sites at Crater Lake, and two observations for the FIA plots in consecutive years. Thus, it was not possible to pursue an approach that utilizes a mixed linear model for trend with temporal variance components. However, as sampling continues the Network will be able to obtain such estimates and employ the improved methods being developed for trend analysis for panel designs (Starcevich pers. comm.). Here I use the FIA dataset to provide a rough estimate of the residual variance and both the CRLA and FIA datasets to provide estimates of the site-to-site variance.

Revisit Design

The original proposed revisit design for Klamath Network vegetation monitoring is in Table 1. This is the assumed revisit design for the power analysis. Following power analyses, in response to peer-reviews of the protocol, the Network switched to a three year, always revisit design, as shown for panel 1. This change doubles the number of sites revisited at a 3 year frequency. The first year of sampling will not be 2010. The assignment of sites to panels is based on the GRTS sampling design.

	2010	2013	2016	2019	2022	2025	2028	2031	2034	2037	2040
Panel 1	X	X	X	X	X	X	X	X	X	X	X
Panel 2	X										X
Panel 3		X									
Panel 4			X								
Panel 5				X							
Panel 6					X						
Panel 7						X					
Panel 8							X				
Panel 9								X			
Panel 10									X		
Panel 11										X	

Table 1. Proposed Revisit Design for Crater Lake that was used in the power analysis.

Exploratory Data Analysis

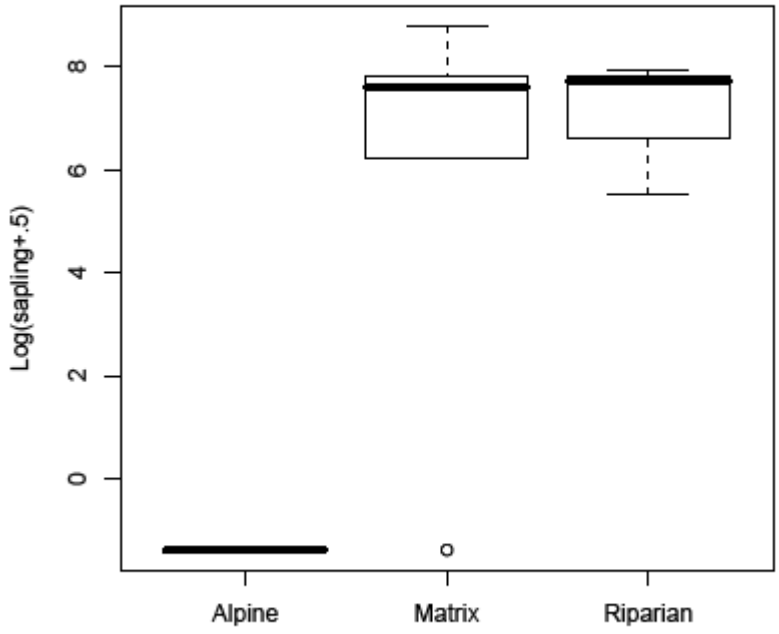

Figure 1. Boxplot of log(sapling density (ha)+.25) for three sampling frames in Crater Lake 2008

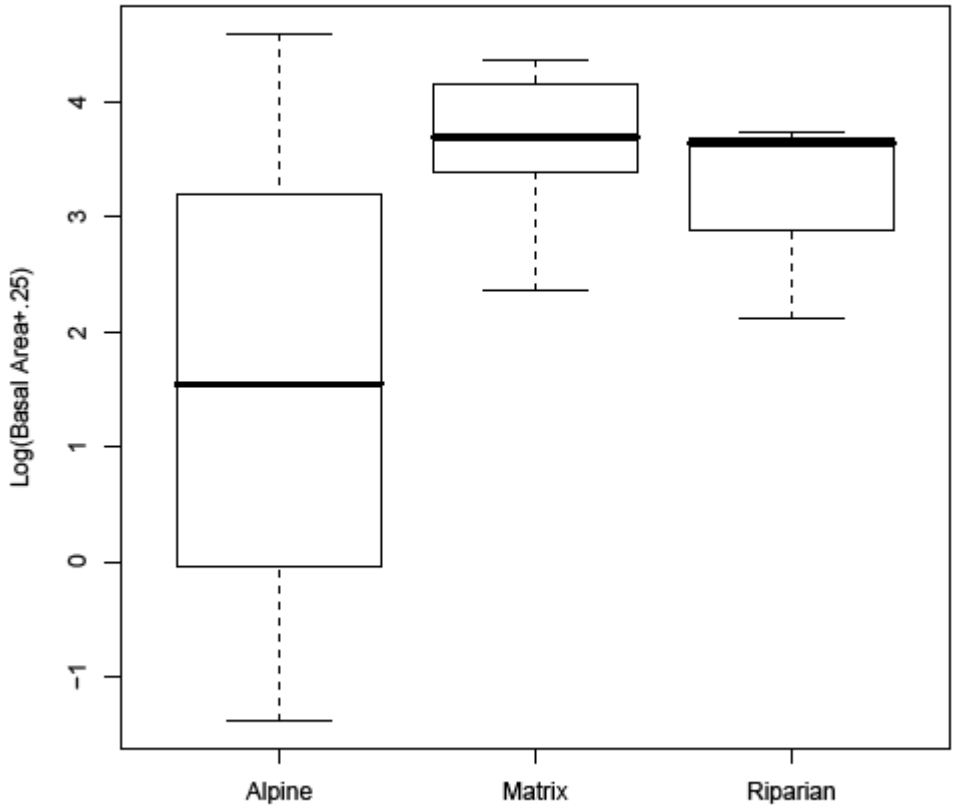

Figure 2. Boxplot of log(Basal Area+.25) for three sampling frames in Crater Lake 2008

There is evidence of one outlier for the Crater Lake matrix sites for sapling density in Figure 1, obviously with such a low sample size it is unclear if this observation is unusual or not. I include the observation

for the power analysis. There are no major outliers for Basal Area (Figure 2) in the Crater Lake sites.

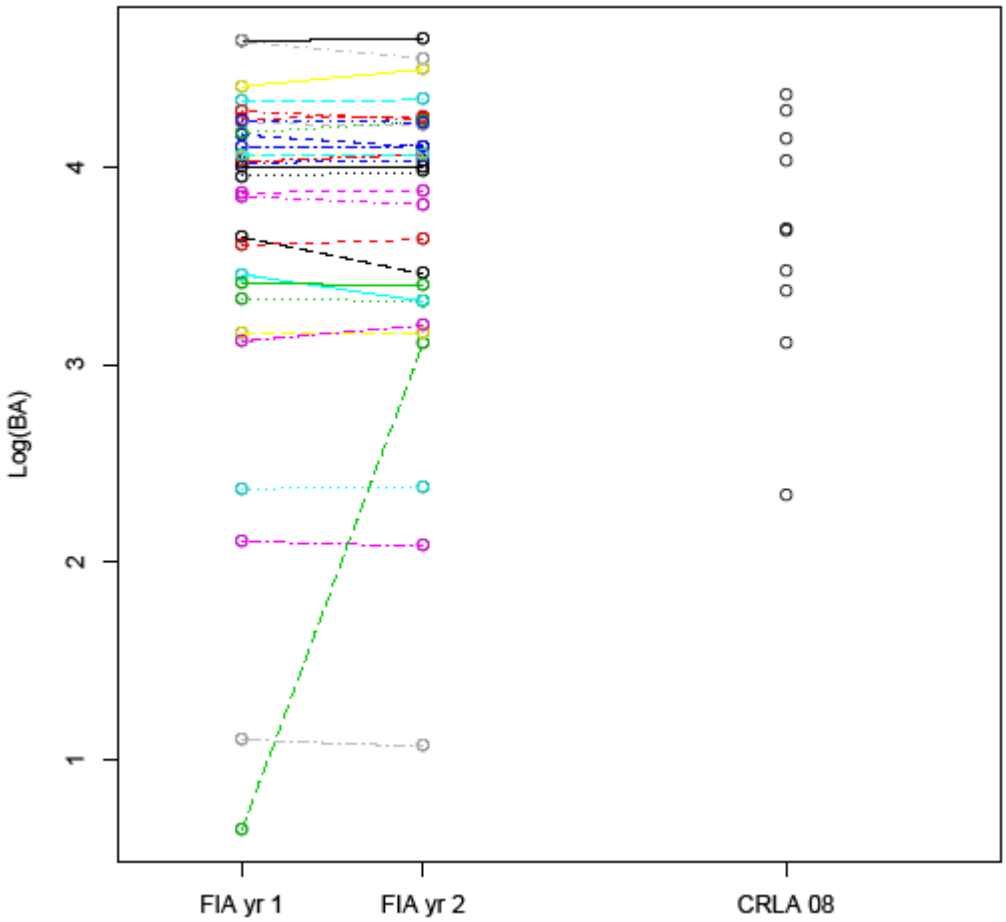

Figure 3. Basal Area for FIA plots and CRLA plots

In the FIA data, plot 5611 is the only one that showed a major increase in log(BA) from year 1 to year 2 in Figure 3. This site is driving the estimate of the residual variance component (site*year). The CRLA matrix sites have less variability among sites compared to the FIA sites.

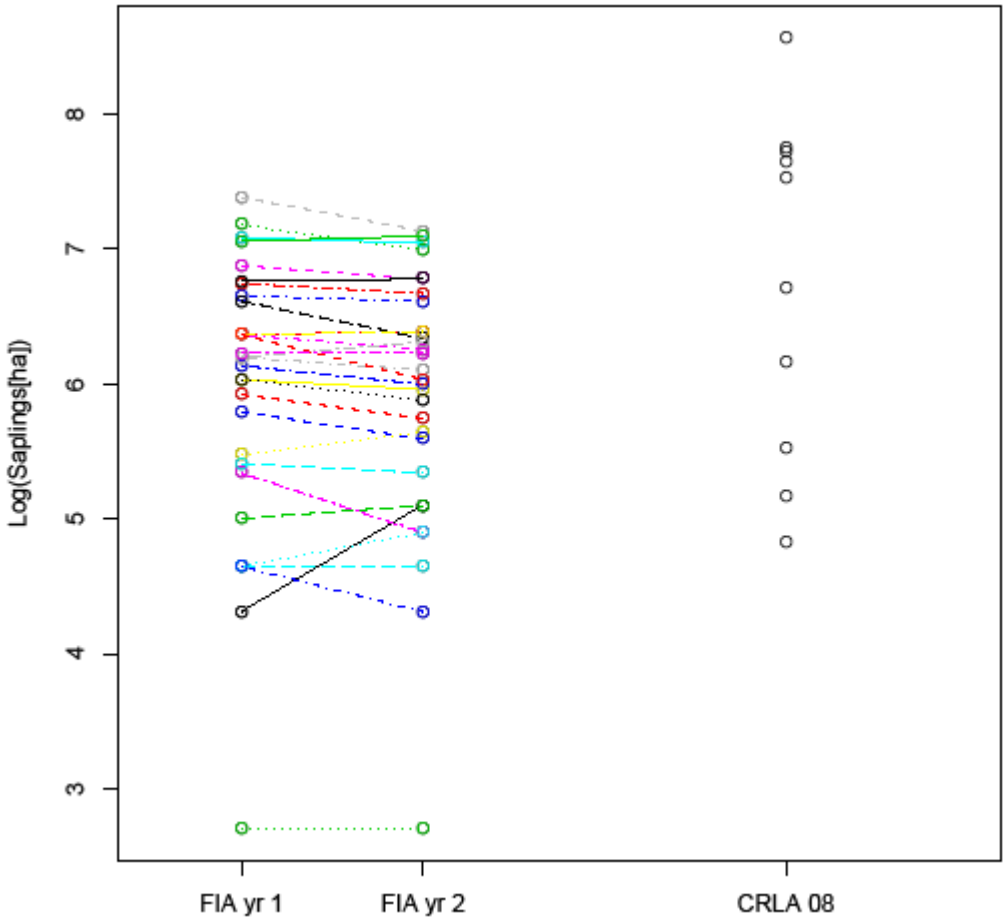

Figure 4. Sapling density for FIA and CRLA plots

Figure 4 displays Sapling density for both the FIA sites and CRLA matrix sites. There is a general pattern of a slight decline in sapling density between the two years FIA data was collected. The CRLA matrix sites appear to have similar site-to-site variability compared to the FIA plots.

Power Analysis

In order to perform a power analysis for univariate trend, a model must be assumed for the future data. I adopt the linear model presented in Urquhart and Kincaid (1999);, Larsen et. al (2001); Kincaid et. al (2004); and Urquhart et. al (1993). The model is as follows where is the observed characteristic of interest (e.g., BA) for site *i* in year *j,* , , ,and the components are assumed independent. There have been many modifications to this general model idea (Piepho and Ogutu, 2002, Van-Leeuwen et al. 1996). I used the functions written by Tom Kincaid to estimate power based on model above, for specific details refer to the paper by Urquhart et al 1993. These are *estimates* of the power because we are estimating the variance components. These estimates will be improved once more sampling is conducted. The model cannot be fully implemented using the Klamath Network's Crater Lake dataset because we do not have estimates for or . Instead we fit a simplified model assuming different values for and based on the pilot datasets from Crater Lake and FIA plots. We use a log transformation such that trend is in terms of a multiplicative change in the medians over time, this is typically appropriate for biological data that display exponential growth and increasing variability with an increase in mean.

Estimated Variance Components

I used the MIXED procedure in the SAS system which can be used to estimate the random and fixed components of mixed models. The estimated variance components using SAS are displayed in Table 2 for Basal Area and Table 3 for Sapling Density.

DATA	**Parameter**	**Estimate**
FIA and CRLA		0.547
		0
		0.093
FIA		0.636
		0
		0.094
CRLA		0.38
		0
		0

Table 2 Estimated Variance Components using REML for Basal Area.

Restricted maximum likelihood (REML) estimates are preferred for unbalanced designs (split panel designs). For the power calculations for Basal Area I assume that ,

the power is sensitive to the assumption that The estimated site-to-site variability was less for the matrix sites at Crater Lake compared to the FIA sites. To be conservative I will use the estimated variance components for FIA only for Basal Area.

DATA	Parameter	Estimate
FIA and CRLA		1.216
		0.000596
		0.024
FIA		0.964
		0.000539
		0.024
CRLA		1.63
		0
		0

Table 3. Estimated Variance Components using REML for Sapling Density

To be conservative for the power calculations for sapling density, I use the estimated variance components for all observations (FIA and CRLA) for and . Also, I investigate two different values for and assume for sapling density.

Results

For the following power analysis results I investigate four different three-year percent changes in the medians 2.5%, 3.0%, 6.0%, and 10.0%. A 2.5% and 3% per 3-year change correspond to a net change of 25 and 30 percent in the median after 10 sampling occasions (30 years); whereas a 6.0% and 10% per 3-year change corresponds to a net change of 30% and 50% in the median after 5 sampling occasions (15 years).

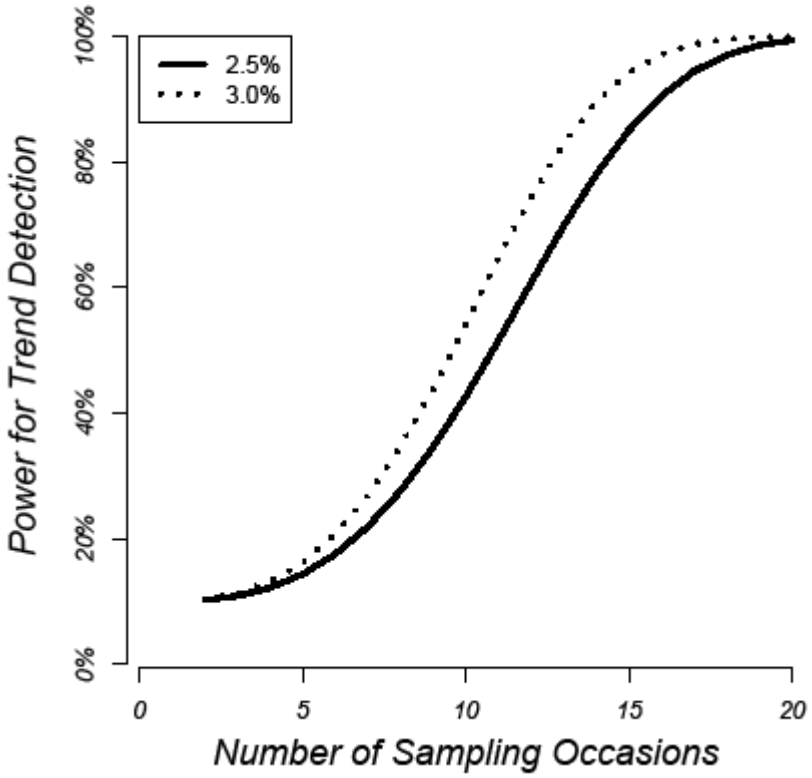

Figure 5. Power for 2.5% and 3.0% three-year trends in median Basal Area.

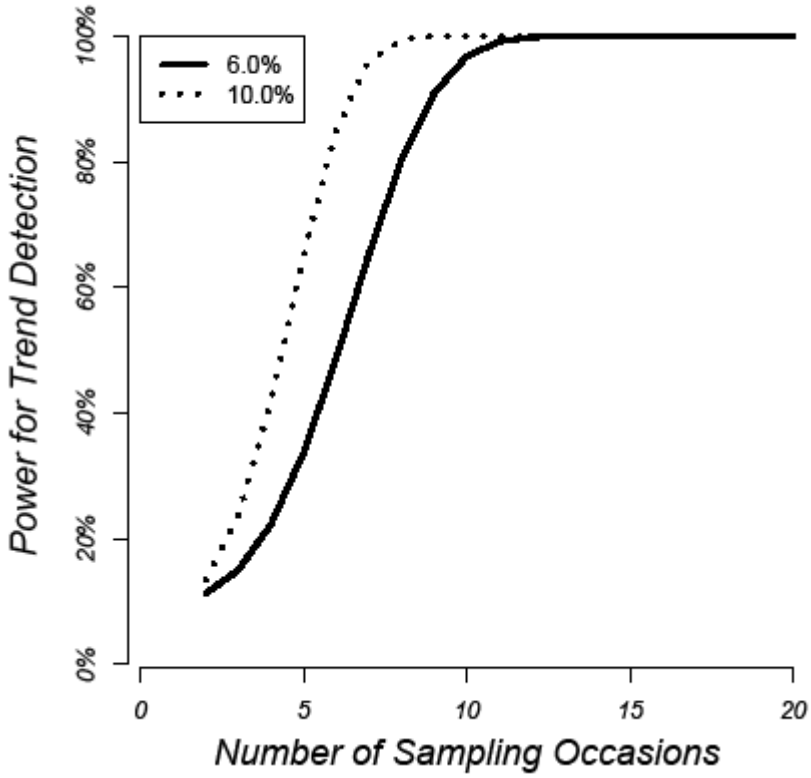

Figure 6. Power for 6% and 10% three-year trends in median Basal Area.

Figure 5 suggests for the proposed revisit design (Table 1) and the given estimated variance components (Table2), the desired 80% power to detect a 2.5% three-year change in median Basal Area will be reached after 14 sampling periods (42 years). For a greater three-year percent change (3.0%) the desired power will be reached after 11 sampling periods (33 years) of every three year sampling for Basal Area. This is an estimate of the power for the chosen sampling design to detect trend, the power will decrease if the true variance components are larger.

The stated objectives of 30% to 50% change over 15 years corresponds to a 6% and 10% three-year percent change, Figure 6 shows that for that magnitude of change it would take 8 sampling occasions or 24 years to detect a 6% three-year trend with 80% power and greater than 15 years (or greater than 5 sampling occasions)to detect a 10% three-year trend in median Basal area with 80% power. Considering that after 5 sampling occasions the total sample size is 90, 6 panels will be visited for one year and 15 sites (1 panel) will be visited every 3-years, the design seems sufficient to meet the sampling objective of detecting a 50% change over 15 years. Again this is assuming that there is no temporal variation or regional variation due to climatic factors or other regional-scale factors, if there is temporal variation the power will decline (see Figure 10). Larsen et. Al 2004 claim that the time variance component cannot be

reduced through design choices, but instead through identifying controlling factors (i.e. including regional scale covariates).

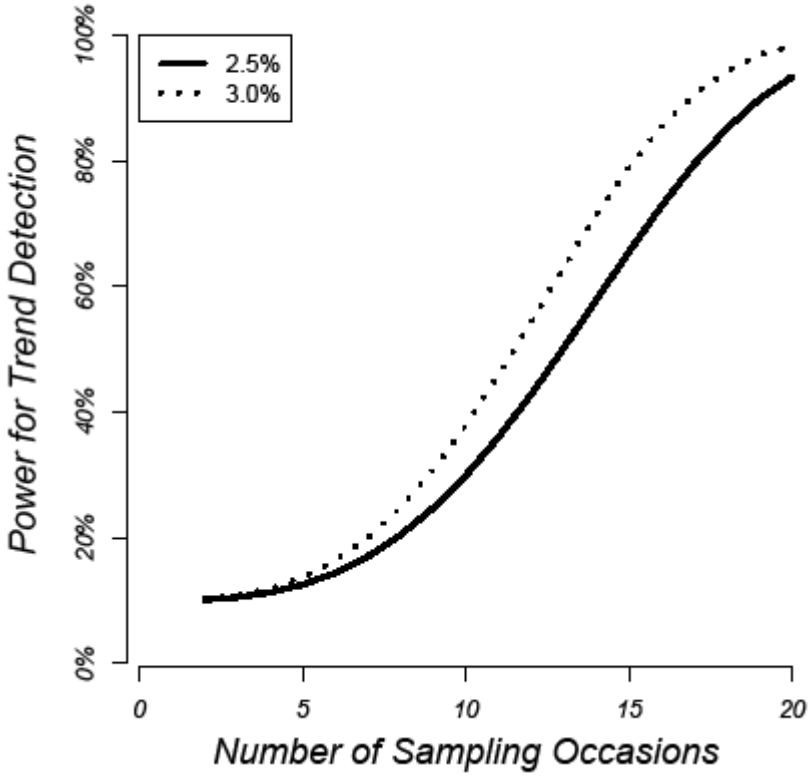

Figure 7. Power for 2.5%and 3.0% three-year trends in Sapling Density .

Figure 7 suggests for the proposed panel revisit design (Table 1) and the given estimated variance components (Table 3) the desired 80% power to detect a 2.5% three-year change in median sapling density will be reached after 17 sampling periods (51 years). For a greater % change (3.0) the desired 80% power to detect trend will be reached after 14 sampling periods (42 years).

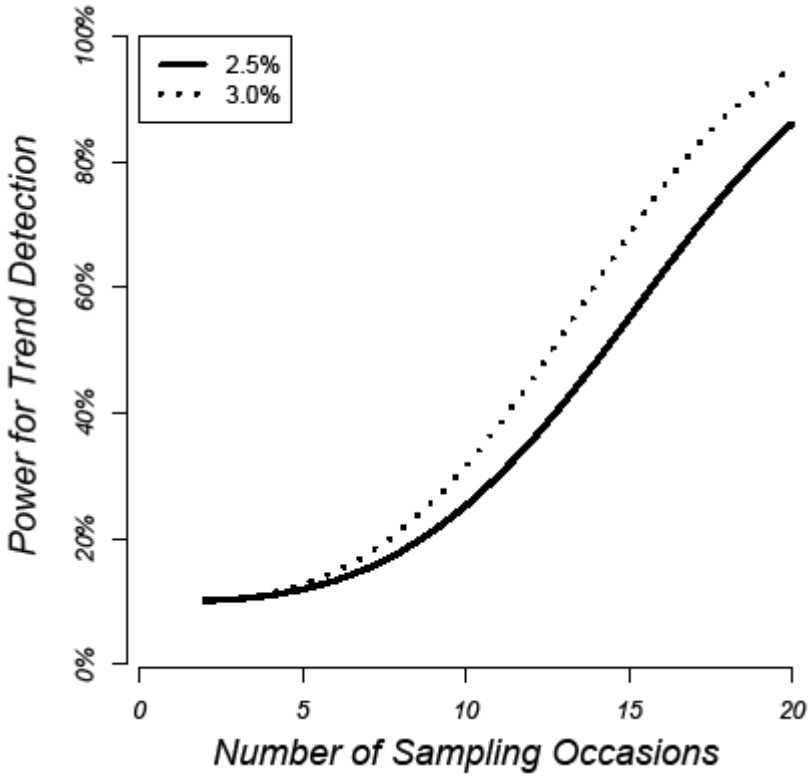

Figure 8. Power for 2.5%and 3.0% three-year trends in Sapling Density .

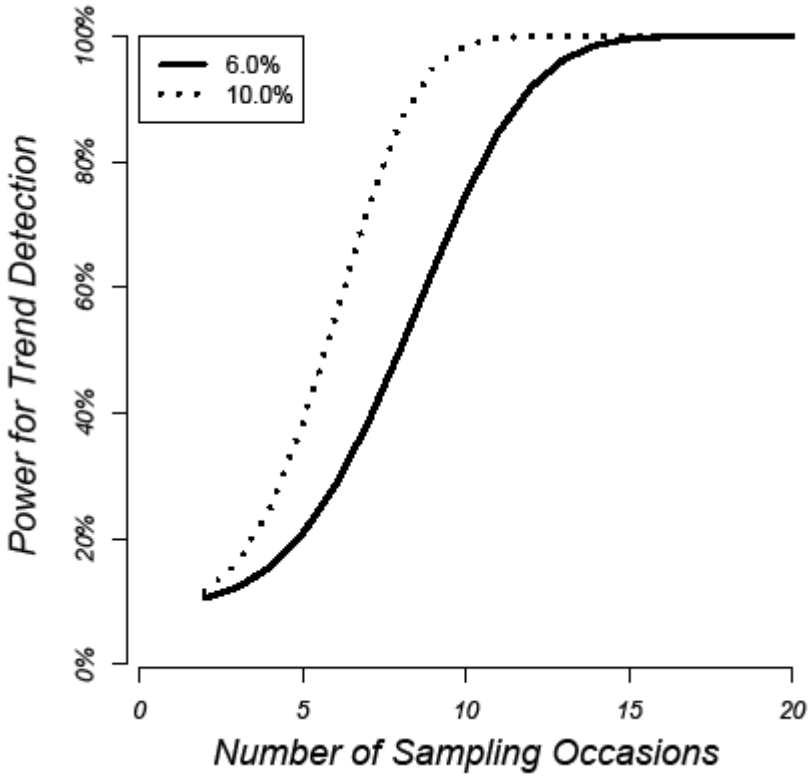

Figure 9. Power for 6.0%and 10.0% three-year trends in Sapling Density .

Figure 8 suggests that with a larger estimated variance component for site-to-site variability the power decreases, as expected. The power to detect a trend is only .70 after 17 sampling periods for a 2.5% three-year trend whereas it is only .61 after 14 sampling periods for a 3.0% three-year trend. The compiled results are presented in Table 4.

Figure 9 shows for a 6% three-year trend in median sapling density it would take more than 30 years to reach the desired power of 80%. For a 10% three-year trend it would take more than 21 years of sampling to detect that level of change in median sapling density with 80% power. It will take longer to reach the desired level of power to detect change in the median sapling density compared to median Basal area primarily because of the non-zero estimate of the variance component for year and the larger estimated variance component for site.

Sampling Occasion (every 3 yrs)	2.50%	1.216 3.00%	2.50%	3.00%
2	0.101	0.102	0.101	0.101
3	0.105	0.107	0.104	0.105
4	0.113	0.118	0.109	0.114
5	0.125	0.136	0.119	0.127
6	0.144	0.163	0.133	0.148
7	0.17	0.2	0.153	0.176
8	0.204	0.248	0.179	0.213
9	0.247	0.308	0.212	0.259
10	0.299	0.378	0.252	0.314
11	0.36	0.458	0.3	0.379
12	0.428	0.543	0.354	0.451
13	0.501	0.63	0.415	0.528
14	0.578	0.714	0.482	0.607
15	0.655	0.79	0.551	0.685
16	0.728	0.855	0.621	0.758
17	0.794	0.906	0.69	0.822
18	0.851	0.943	0.754	0.875
19	0.898	0.968	0.812	0.918
20	0.934	0.984	0.861	0.949

Table 4. Estimated Power for different three-year trends and estimates for Sapling density.

To illustrate the importance of the assumption of , I assume a minimal variance component for Basal area of .05 and the power decreases substantially (Figure 10).

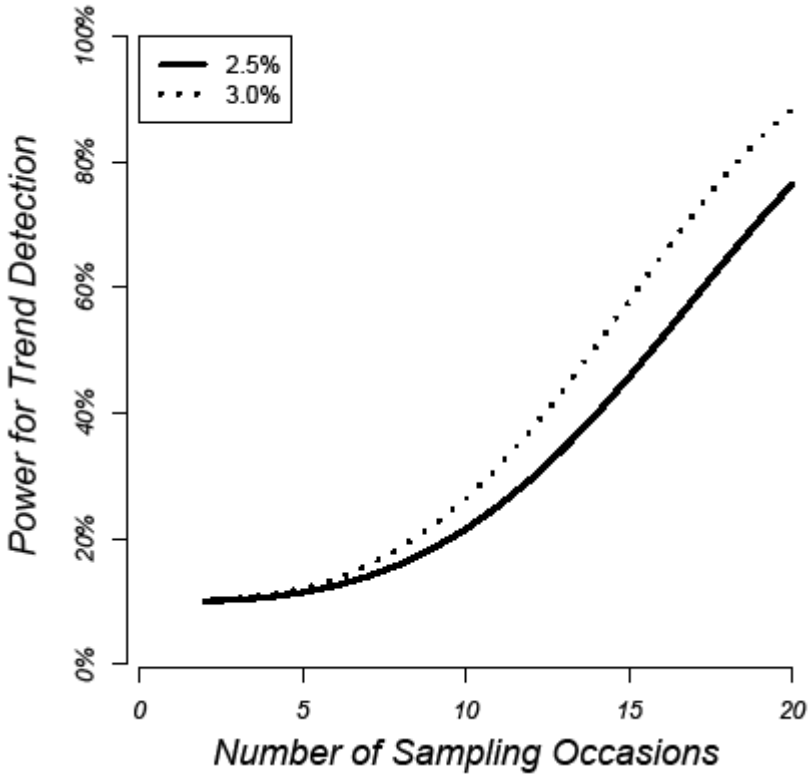

Figure 10. Power for 2.5% and 3.0%three-year trends in Basal Area with .

One point I would like to stress is that this power analysis is based on the assumed model. Starcevich (personal communication) is working on a model for improved trend detection that should be used in the future. At this point it is unknown how the estimated power based on current model versus the revised model will compare.

Appendix:

Example SAS code used to estimate random effects for site and year

```
proc mixed data=FIA method=REML;
  class Site Year;
  model lnBA = ;
  random Site Year;
  run;
```

References

Kincaid, T. K., Larsen, D. P., and Urquhart, N. S. (2004). The structure of variations and its influence on the estimation of status: indicators of condition of lakes in Northeast, U.S.A. Environmental Monitoring and Assessment, 98(12):1–21.

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Appendix C: Job Hazard Analysis for the Klamath Network Vegetation Monitoring Protocol

Version 1.00 (March 2010)

The Klamath Network will make every effort to comply with the NPSafe program and with local park safety programs. The Network takes safety seriously, and it is the number one priority when developing and implementing these protocols. Crews are expected to be trained on all safety aspects of this project prior to entering the field.

The vision of the NPSafe program is:

> *"The NPS is widely recognized for providing world-class resource stewardship and visitor experiences. Just as the NPS excels at protecting natural and cultural resources and serving park visitors, the NPS can excel in providing our employees with a safe work environment. All employees deserve the opportunity to do their jobs safely and effectively so they can go home healthy at the end of the day to fully enjoy their lives and families."*

The beliefs of the NPSafe program are:

- We believe that healthy, productive employees are our most important resource, and employee safety is our most important value.
- Injuries and occupational illnesses are unacceptable and all are preventable.
- At risk behaviors can be eliminated.
- Operating hazards and risks can be controlled.
- Safety is everyone's responsibility.
- Managing for safety excellence can enhance employee productivity, save millions of dollars in workers compensation costs, and improve overall management effectiveness.

The goals of the NPSafe program are:

1) The NPS becomes the safest place to work in DOI.
2) Safety is integrated into all NPS activities.
3) The NPS organizational culture values employee safety as much as it values protecting resources and serving visitors.
4) Employees, supervisors, and managers demonstrate unwavering commitment to continuous improvement in employee health and safety.

To meet these goals, the Klamath Network has included several Job Hazard Analyses (JHA) in this appendix that should be followed while implementing this protocol.

Appendix C. Job Hazard Analysis (continued).

JOB HAZARD ANALYSIS (JHA)		Date: 1/21/2010	
Park Unit: KLMN	Division: IMD	Branch: NRPC	Location: Ashland, Oregon
Task Title: Driving vehicles in the course of one's job		JHA Number: KLMN JHA 1	Page: 1 of 3
Job Performed By: ALL	Analysis By: Daniel Sarr	Supervisor: Daniel Sarr	Approved By: Daniel Sarr
Required Standards and General Notes:	Employees driving as part of their duties must have a valid state issued driver's license.		
Required Training:	Standard drivers training. Also need to know how to change tires and jump start vehicle.		
Required Personal Protective Equipment:	Seatbelts must be used.		
Tools and Equipment:	Vehicle		

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Starting vehicle, basic operation	• Lights not functioning, visibility impaired • Low tire pressure • Low fluid levels • Spare tire not in vehicle or deflated • Low gas	• Test headlights, turn signals, brake lights, breaks, tire pressure and all fluids • Check status of spare; insure that jack, properly sized lug wrench and all necessary tools are present in vehicle • Check gas
Using 4 wheel drive, if applicable.	• Not knowing how to engage, getting stuck in the field • Unsafe driving procedures due to perceived safety of 4 wheel drive	• Practice engaging 4 wheel drive • Engage 4 wheel drive prior to rough conditions • Use 4 wheel drive when increased traction is necessary; e.g., steep slopes, slick conditions, snow • Even in 4 wheel drive, do not assume safety is enhanced. Use cautious and defensive driving practices.
Driving in reverse	• Hitting objects, people, wildlife	• Check area behind vehicle prior to leaving site • Use a person outside the vehicle (other crew member) to direct traffic • Back into parking spots, so leaving sites after long field day is easier and less likely to result in fatigue related mishap

Appendix C. Job Hazard Analysis (continued).

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 1	Page: 2 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Transporting gear and heavy equipment	• Gear flying around, hitting driver and passenger in accident • Damage to gear during turns or stops	• Ensure that gear is adequately stowed. • If the gear comes with protective gear (e.g., electrofisher), properly stow in container. • Do not put gear on top of vehicle; stow inside.	
Passenger/driver safety	• Distracted driving	• Wear seatbelts at all times while driving. • Practice safe and defensive driving habits. • Obey traffic laws. • Do not text. Pull over and stop to use phone. • Keep windshields clean. • Drive with both hands on the wheel at 10 o'clock and 2 o'clock. • Do not pick up hitch hikers. • Use turn signals/indicators. • Plan route in advance. • Make sure seat and mirrors are properly adjusted for driver • Use headlights, even during day time driving.	
	• Driving on narrow, single lane roads with bumpy or "washboard" surfaces.	• Maintain a safe speed (this may be below the legal limit). • Stay to the right, especially on curves, and be aware for oncoming traffic. • If turning around, "face the danger," in other words, turn towards a steep slope, instead of backing into a steep slope cliff.	
	• Driving with limited visibility, as in heavy rain, fog, or dust.	• Slow down. • If possible, wait for conditions to imporve. • Drive with lights on. In some conditions, low lights may penetrate better than brights.	

Appendix C. Job Hazard Analysis (continued).

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 1	Page: 3 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Passenger/driver safety	• Fatigue driving	• Be aware of signs of fatigue. Pull over and catnap if necessary, eat a snack, or have a partner drive. If in doubt, do not drive.	
	• Storm conditions (snow, mud, wind)	• Keep informed of the weather. • If excess wind (tree top swaying, twigs falling) consider postponing trip. • Avoid wet clay roads as much as possible.	
	• Road obstacles	• Get out and move rocks in the road as necessary. If large amounts of rockfall or trees, report to the park staff. • If you hit rocks, stop and check tire conditions (wear, sidewall, and inflation) for damage. • If obstacle is an animal, slow down! Be aware of high animal traffic areas and drive appropriately. It is better to “ride out” an impact than suddenly swerve. This is true for animals of all sizes, from squirrels to cattle.	
Working/Parking on or near a roadside	•Being hit by a car	• Stay off of the road. • Use pullouts or secondary road when parking. • Be aware of the traffic. • Walk on the side of the road facing traffic. • Always set out safety triangles or flares behind the vehicle before starting any maintenance. • Never go under the vehicle while it is up on a jack.	
Working/Parking on or near a roadside	•Running into objects, parking too far off the road, getting stuck, rolling vehicle	• Park on stable surface. • Don't park on a blind corner or a solid striped road area. • Set parking break.	
Description of Task When it is Done Safely			
Crew returns safe from the field day/season, with no injuries, damages, or law suit.			

Appendix C. Job Hazard Analysis (continued).

JOB HAZARD ANALYSIS (JHA)		Date: 1/21/2010	
Park Unit: KLMN	Division: IMD	Branch: NRPC	Location: Ashland, Oregon
Task Title: Remote field site access/ trail travel/ cross-country travel		JHA Number: KLMN JHA 2	Page: 1 of 3
Job Performed By: ALL	Analysis By: Daniel Sarr	Supervisor: Daniel Sarr	Approved By: Daniel Sarr
Required Standards and General Notes:	Crew members should be physically fit		
Required Training:	None required.		
Required Personal Protective Equipment:	Footwear appropriate to terrain (probably hiking boots); pants if hiking through brush or poison oak; Tecnu poison oak pre-exposure lotion, park radio with charged batteries, GPS units, eyewear, first aid kit.		
Tools and Equipment:			

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Hiking on and off trails	• Getting lost	• Use and be trained in navigation techniques using both maps and GPS units. • Allow ample time to access site and return. • Bring safety gear (e.g., radio); extra clothes, water, food, etc. • Look at notes from crews that previously accessed this site.
	• Physical injury (e.g., twisted ankle, broken bones)	• Wear appropriate footwear, preferably boots with vibram soles and tops above the ankle, broken in prior to field season. • Walk cautiously and don't run. • Take breather breaks as necessary. • Stay physically fit. • Know basic first aid. • Be trained in radio SOP. • Avoid talus slopes. On steep slopes, avoid walking directly below others. • Take care walking on wet or slippery ground, especially bridges.
	• Getting hit with tool, implement, or vegetation branch	• Maintain 6 foot spacing • Warn people behind of "snap-back" from vegetation branches; wear safety glasses (or other glasses).

Appendix C. Job Hazard Analysis (continued).

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 2	Page: 2 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Hiking on and off trails	• Blisters	• Wear broken in and proper fitting boots. • Bring moleskin and use if blisters develop.	
	• Carrying heavy loads	• Use backpack appropriate to load; do not carry heavy items in arms or hands; make hands available to break a fall. • Properly fit backpack. • Use crew member to assist in putting pack on. • Be physically fit. • Report problems or issues to supervisor. • Stay hydrated.	
	• Loose footing; falls, broken bones, etc.	• Avoid steep slopes. • If unavoidable, walk at angle up slope; not straight up. • Wear good boots. • Do not go up hazardous slopes. • Watch for branches, wet, slick rocks, etc. Avoid as necessary. • Take your time, ascending and descending. • Plan your route so that hazardous terrain is minimized and the use of trails is maximized. • Do not travel alone (e.g., if one crew member is faster, only travel as fast as your slowest person).	
	• Branches and trees, other dangerous obstacles	• Examine for the safest way around. • Do not jump off trees. • Avoid going underneath large trees that could shift and crush a person.	

Appendix C. Job Hazard Analysis (continued).

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 2	Page: 3 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Wildfires	• Exposure to smoke and fire	• Don't panic. Be alert. Keep calm. Think clearly & act decisively. Get out of the area immediately. • Maintain communication with other crew members and with dispatch. Follow local district policies regarding reporting fire.	
Water Crossing	• Loose footing; falls, broken bones, etc.	• Choose stream crossing routes by scouting the area first • Avoid crossing when water levels are higher than knee height. Avoid crossing on logs whenever possible. • Use a stick or pole to secure footing. Place it upstream at a slight angle. Use pole to test for depth & walk to the pole. • Stay out of areas with swift current, especially after heavy snowfall, rain, or spring melt. • Use footwear with non-slip soles while walking in streams. Do not wear sandals in streams. • When possible, step on streambed proper instead of the tops of boulders that may be slippery.	
Description of Task When it is Done Safely			
Crew returns safe from the field day/season, with no injuries, damages, or law suit.			

Appendix C. Job Hazard Analysis (continued).

JOB HAZARD ANALYSIS (JHA)		Date: 1/21/2010	
Park Unit: KLMN	Division: IMD	Branch: NRPC	Location: Ashland, Oregon
Task Title: Environmental Exposure		JHA Number: KLMN JHA 3	Page: 1 of 3
Job Performed By: ALL	Analysis By: Daniel Sarr	Supervisor: Daniel Sarr	Approved By: Daniel Sarr
Required Standards and General Notes:	Field crew members in the field are expected to use common sense in dealing with exposure to elements or wildlife. Ideally, they have experience in outdoor work prior to initiating the field season.		
Required Training:	None required.		
Required Personal Protective Equipment:	Appropriate clothing for conditions.		
Tools and Equipment:			

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Being outdoors, far from facilities for long time periods	• Hypothermia	• Consult First Aid book for treatment. • Seek assistance. • Recognize the signs: Shivering; Numbness; Drowsiness; Muscle Weakness; Dizziness; Nausea; Unconsciousness; Low, weak pulse; Large pupils. • Practice prevention: stay dry; wear appropriate clothing; cotton kills; wear layers, shed layers as needed (don't overheat as sweat can cause hypothermia); watch or listen to the weather forecast, and plan accordingly; stay hydrated, cover head with warm clothing, stay active. • Be aware of the role that wind-chill can play in hypothermia; under certain conditions, hypothermia can occur without any rain or being wet.
	• heat exhaustion; heat stroke	• Consult First Aid book for treatment but generally get the victim to cooler conditions. NOTE: HEAT STROKE IS A LIFE THREATENING CONDITION. • Recognize signs: above normal body temps; headaches, nausea, cramping, fainting, increased heart rate, pale and clammy skin, heavy sweating, etc. • Practice prevention: Stay hydrated: in the midst of the summer, it may be necessary to drink 1 liter of water per hour; wear a broad brimmed hat; take rest stops in shade. • Reschedule work day to do hot, heavy work in cooler hours of the day, or during cooler weather

Appendix C. Job Hazard Analysis (continued).

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 3	Page: 2 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Being outdoors, far from facilities for long time periods	• Electrical Storms – lightning	• Watch the sky for signs of thunderstorms and seek shelter before the weather deteriorates. • Stop work in streams and lakes. • If caught in electrical storms, seek shelter inside a vehicle or building; keep away from doors and windows, plugged in appliances, and metal. Avoid contact with metal objects in vehicles.	
	• Electrical Storms – lightning	• Do not use telephones. • If outside with no shelter, do not congregate. In case of lightning strike, someone must be able to begin revival techniques (e.g., CPR). • Do not use metal objects. • Avoid standing near isolated trees. • Seek lower elevations such as valleys or canyons; avoid being on peaks and trees. • If you feel your hair standing on end and your skin tingling, this is a sign that lightning might be about to strike – crouch immediately (feet together, hands on knees).	
	• Sunburn	• The risk of sunburn is higher when working at high elevations, or when working around water (from reflection). In these conditions, you can be burned even in overcast conditions. • Wear protective clothing and use sunscreen.	
	• High wind events	• Severe wind events can create “windthrows” where strong winds can blow down trees, causing hazardous conditions to field personnel. Crews should avoid areas during high wind, exhibiting obvious previous wind damage.	

Appendix C. Job Hazard Analysis (continued).

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 3	Page: 3 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
	• Altitude sickness	• Know and recognize signs of "acute mountain sickness:" headaches; light-headedness; unable to catch your breath; nausea; vomiting. • Practice prevention: acclimate to high elevations slowly and stay hydrated. • If symptoms progress and include: difficulty breathing, chest pain, confusion, decreased consciousness or loss of balance, descend to lower elevations immediately and seek medical attention.	
	• Giardia	• Treat, filter, or boil all drinking water. Do not drink untreated water from streams, lakes, or springs.	
Description of Task When it is Done Safely			
Crew returns safe from the field day/season, with no injuries, damages, or law suit.			

Appendix C. Job Hazard Analysis (continued).

JOB HAZARD ANALYSIS (JHA)		Date: 1/21/2010	
Park Unit: KLMN	Division: IMD	Branch: NRPC	Location: Ashland, Oregon
Task Title: Wildlife and Botanical Exposure		JHA Number: KLMN JHA 4	Page: 1 of 3
Job Performed By: ALL	Analysis By: Daniel Sarr	Supervisor: Daniel Sarr	Approved By: Daniel Sarr
Required Standards and General Notes:	Field crew members in the field are expected to use common sense in dealing with exposure to elements or wildlife. Ideally, they have experience in outdoor work prior to initiating the field season.		
Required Training:	None required.		
Required Personal Protective Equipment:	Appropriate clothing for conditions.		
Tools and Equipment:			
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Driving to the site	• Animal in the road	• Slow down! Be aware of high animal traffic areas and drive appropriately. It is better to "ride out" an impact, rather than a sudden swerve. This is true for animals of all sizes, from squirrels to cattle.	
Being in the field	• Rattlesnakes	• Be alert • Do not put your feet or hands where you cannot see • Do not pick up rattlesnakes • Give a wide berth • Avoid stepping over logs, when you cannot see the other side • If bitten, seek immediate professional medical attention if possible send someone for aid. • Lower bitten extremity below your heart, cover wound with sterile bandage while en route to medical attention.	
	• Bears	• Be alert and stay calm. • If you encounter a bear, give it as much room as possible. • Try to leave the area but DO NOT RUN. Back away slowly, but if the bear follows, stop and hold your ground. • Wave your arms, make yourself look big, and talk in a normal voice • If the bear makes contact, surrender! Fall to the ground and play dead. Typically, a bear will break off its attack once it feels the threat has been eliminated. If the bear continues to bite after you assume a defensive posture, the attack is predatory and you should fight back vigorously.	

Appendix C. Job Hazard Analysis (continued).

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 4	Page: 2 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Being in the field	• Mountain Lions	• Be alert, calm, and do not panic. • If you see a mountain lion, do not run; you may stimulate its predatory nature. Shout and wave arms to let it know that you are not prey. FIGHT BACK.	
	• Ticks	• Use DEET based repellants on exposed skin. • Check for ticks during and after field work. • Remove with tweezers within 24 hours, preferably immediately. • DO NOT leave the head imbedded. • DO NOT extract with matches, petroleum jelly, or other coatings (e.g., motor oil).	
	• Roughskin newts (*Taricha granulosa*)	• Avoid handling Roughskin newts; their skin contains a potent neurotoxin. If necessary for the protocol, handle only when wearing gloves. Do not “lick” for “killer buzz.” People have died from attempting to eat roughskin newts.	
	• Insect Sting	• Do not provoke insects by swatting at them. Remain calm and move away from the area. • Be alert for buzzing insects both on the ground and in the air. Walk around any nests you encounter. Inform others of nests. • Flag if necessary. Wear long sleeved shirt and pants. Tuck in shirt. Wear bright colors. Perfumes & metal objects may attract bees. • If stung, scrape stinger off skin. Cold can bring relief. Do not use tweezers. Tweezers can squeeze venom sac and worsen injury. • If you are allergic, carry an unexpired doctor prescribed bee sting kit (EpiPen) with you at all times. • Know the allergic reactions of co-workers as well as the location of the bee sting kit. If victim develops hives, asthmatic breathing, tissue swelling, or a drop in blood pressure, seek medical help immediately. Give victim antihistamine (Benadryl or chol-amine tabs). Use EpiPen. • Prevent bug/mosquito bites by using repellent. Spray on clothing to avoid prolonged exposure to skin. Wear long sleeved shirts and pants. • Be aware of insect transmitted diseases (West Nile Virus, Lyme Disease, Plague).	

Appendix C. Job Hazard Analysis (continued).

JOB HAZARD ANALYSIS (JHA)		JHA Number: KLMN JHA 4	Page: 3 of 3
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**	
Being in the field	• Rabies	• Be aware of animals acting strangely. If bitten by a wild or domestic animal get medical attention and report to local health authorities or animal control officer. Locate animal if possible. Follow accident procedures for animal bites.	
Encountering irrigation pipes, marijuana plantation, or grow operations.	• Unfriendly encounters with criminal elements	• Do not wear uniforms. • Carry radio in backpack, not visible. • Act like tourists (i.e., act unsuspicious). • Work in pairs or larger groups. • If working in areas likely to contain operations, check in with park staff when leaving vehicle and returning to vehicle. • Do not confront strangers. • Watch for suspicious vehicles and people and report to rangers. • Watch for black piping or other signs. • If finding a definite grow operation, LEAVE IMMEDIATELY, note location, and report to park ranger.	
Travel, movement or work in area with Poison Oak	• Allergic reaction to poison oak plants	• Learn to recognize Poison Oak. • Avoid contact and wear long pants and long-sleeve shirts if travelling in dense areas. • If skin contact is made, flush with cold water as soon as possible. • DO NOT flush with warm water or use soap. This can open your pores and increase the reaction. • Use Tec-nu or similar product to wash and rinse with cold water to remove oils (follow label instructions).	
Description of Task When it is Done Safely			
Crew returns safe from the field day/season, with no injuries, damages, or law suit.			

Appendix C. Job Hazard Analysis (continued).

JOB HAZARD ANALYSIS (JHA)		Date: 1/21/2010	
Park Unit: KLMN	Division: IMD	Branch: NRPC	Location: Ashland, Oregon
Task Title: Communication		JHA Number: KLMN JHA 5	Page: 1 of 2
Job Performed By: ALL	Analysis By: Daniel Sarr	Supervisor: Daniel Sarr	Approved By: Daniel Sarr
Required Standards and General Notes:			
Required Training:	Radio / Spot use		
Required Personal Prospective Equipment:			
Tools and Equipment:	Professional Grade Radio, SPOT Monitoring System		

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Radio communication	• Communication not possible	• Make sure radio is working before you leave the office or field station. Make sure batteries are changed. Carry a second rechargeable battery as back up. • Check in mornings and evenings. If in a dead zone, try to check in from a better location throughout the day. Be prepared to relay messages in an emergency. If you are working alone, be sure to check in and out with dispatch. • Make sure that your supervisor knows your planned itinerary before you leave in case your radio fails. Follow crew-specific safety check in/checkout procedures. • Know which radio frequencies to use and which to monitor. Know who to call in case of an emergency. Know how to reach repeaters. • Carry a list of employee call numbers. Be prepared to relay messages in an emergency. • Keep messages short, less than 30 seconds per transmission. If a longer message is necessary, break every 30 seconds. • Conserve batteries. Carry a spare and don't leave scanner on. Turn radio off over night. Your life may depend on it.
Spot System	• Communication not possible	• Make sure system is working before you leave the office or field station. Make sure batteries are changed. Carry a second rechargeable battery as back up. • Make sure that your supervisor knows your planned itinerary before you leave in case your system fails. Follow crew specific safety check in/checkout procedures. • Make certain system is setup properly and includes an accurate contact list.

Description of Task When it is Done Safely
Crew returns safe from the field day/season, with no injuries, damages, or law suit.

Appendix D. Park Sampling Frame Coverages and their Location in the Klamath Network's GIS Data.

Park	Path	GIS Feature Class Name
Crater Lake	I:\Data_Management\GIS\DATABASE\KLMN\DATA\MONITORING.mdb\Vegetation	CRLA_sampling_frames_20100322
Lava Beds	I:\Data_Management\GIS\DATABASE\KLMN\DATA\MONITORING.mdb\Vegetation	LABE_sampling_frames_20100322
Lassen Volcanic	I:\Data_Management\GIS\DATABASE\KLMN\DATA\MONITORING.mdb\Vegetation	LAVO_sampling_frames_20100322
Oregon Caves	I:\Data_Management\GIS\DATABASE\KLMN\DATA\MONITORING.mdb\Vegetation	ORCA_sampling_frames_20100322
Redwood	I:\Data_Management\GIS\DATABASE\KLMN\DATA\MONITORING.mdb\Vegetation	RNSP_sampling_frames_20100322
Whiskeytown	I:\Data_Management\GIS\DATABASE\KLMN\DATA\MONITORING.mdb\Vegetation	whis_sampling_frames_20100322

Appendix E. Comparison of FIA and FMH Methods and those Presented in this Protocol.

Measureable attribute or method	FIA	FMH	Klamath
General plot layout	Main sampling units are 4 24’ radius circular subplots, each containing 1 6.8’ microplot and 3 1m^2 understory plots.	20 x50 m for forests with 50 m outer lines serving as transects for understory sampling.	20 x50 m plot with 4 10 x10 m modules each containing 1 10m^2 and 1 1m^2 nested plots.
Plots slope corrected?	Yes	No	No
Witness trees for plot relocation	Yes	No	Yes. In non-forest vegetation, features other than trees will be used.
Photographs	yes		yes
Plant cover	1 m2 plots all cover up to 6’. 24’ subplots, all cover by layer (visual estimate). Layers= 02’,2-6’, 6-16’, >16’	Point intercept, line intercept (optional)	Ocular estimate by height strata (S1 = (<0.75 m height), S2 = (0.75-2.5 m), S3 = 2.6-5 m), S4 = >5.
Tree seedlings	<2.54 cm dbh	<2.5 cm dbh, counted in plot quarters	< 2.54 cm tallied in 4 10m 2 subplots in two size classes (0-15 cm tall and 15 cm tall to 2.54 cm dbh)
Saplings and poles	1-5” (2.54- 12.7 cm) dbh	> 2.5 < 15 cm dbh tallied for whole plot or subset depending on circumstances	> 2.54 < 15 cm tallied entire plot into three size classes
Trees	Tag and measure greater than 5” (12.7 cm) dbh	Tag and measure dbh of trees > 15cm dbh.	Tag and measure dbh of trees > 15 cm dbh. Dbh can be measured to the nearest cm for 10-25 cm trees using a ruler, and for trees greater than 25 cm using a diameter tape..
Crown position	All trees > 1 in. (2.54 cm dbh, 4 categories(superstory, overstory, understory, open)	Optional. Crown position, an assessment of the canopy position of live overstory trees (Avery and Burkhart 1963), is recorded in the column marked CPC	All trees greater than 15 cm to be classified according to FMH definitions.

		(crown position code) using a numeric code (1–5). Dominant, co-dominant, intermediate, subcanopy, open.	
Overstory cover	Not measured, closely correlated with dbh.	Not measured, closely correlated with dbh.	Visual estimate and densitometer measure of canopy opening.
Crown base height	Estimated for each tree.	Not measured	Use FIA method to measure on each tree.
Snags	Greater than 5” (12.7 cm) dbh. 5 decay class categories based on Douglas-fir	Optional. > 15 cm dbh Classified into categories: Recent snag, loose bark snag, clean snag, broken above BH, broken below BH.	> 12 cm dbh tallied in whole plot. Condition classified according to FMH categories.
Down wood	Separate cwd (>3”x 3’) and fwd (< 3”). 58.9’ transects, planar intercept method. 1 transect per subplot. Diameters classes for fwd are <0.25", 0.25"-1.0", 1.0-3.0". Total length of transects sampled for whole plot is 24’, 40’, and 40’ for fwd classes and 2 x 58.9’ for cwd.	Planar intercept method. Woody fuel is tallied by size class (diameters of <0.25", 0.25"-1.0", 1.0-3.0", >3.0") and litter and duff depth is measured for different lengths of 4 50’ randomly oriented transects. Total distance is 24’ for 0-1”, 48’ for 1-3”, and 100’ for cwd.	FIA/FMH approach (planar intercept) used on center transect with slightly reduced overall distance sampled.
Downed wood decay classes	5 class system based on Douglas-fir. Decay class 5 treated differently	Sound vs. rotten distinguished.	Sound vs. rotten distinguished.
Duff/litter depth	Measured at center of 2 transects per 4 subplots.	Measure at 10 points along all 4 transects.	Measure at 10 points along one fuel transect.