

Zion National Park Protocols for Establishing and Monitoring Modified Ecodata Long Term Vegetation Plots

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Introduction

The Ecodata plot monitoring program in Zion National Park was initiated by Laurie Kurth in 1996. In 1996, plots were setup mainly by Laura Welp and a few assistants. A modified Ecodata protocol was developed for the establishment of these type of plots, however, the protocols were not consistently applied. Seventeen plots were permanently established in Zion National Park. One ZION other plot was partially completed, and one plot was established in Cedar Breaks National Monument. Data were collected at most plots only once. Since the Wildcat Canyon Fire burned portions of Horse Pasture Plateau where four plots were located, these plots were surveyed twice, pre-burn and post-burn. All but two plots were established in *Pinus ponderosa* woodland communities.

In 1997, I was hired to re-survey the 1996 plots and setup new plots in other plant community types ZION. Due to the inconsistent way plots were setup in 1996, I found it difficult to survey the plots from 1996. Many errors were found and corrected when the 1996 plots were resurveyed. However, many problems still existed because time was a limiting factor. All except for two of the 1996 plots were resurveyed in 1997. The plot in Cedar Breaks and a plot along the Chinle Trail were not resurveyed. Along with the plot that was partially completed in 1996, sixteen new plots were established: four in pinyon-juniper communities, one in a *Pinus ponderosa* community, and 11 in riparian communities. Two of these plots, one in the pinyon-juniper and one in a riparian zone of Taylor Creek, were established in the Kolob Canyons sector of Zion National Park.

There are 33 Ecodata long-term monitoring plots established in Zion National Park and one in Cedar Breaks. Since none of these plots have been resurveyed in the past four years, some have fallen into disrepair. Recognizing that these plots are a valuable tool for monitoring the vegetation of the park, Resources Management would like to continue this monitoring program at 5 year, staggered intervals. I was hired to review the 1996 and 1997 plots and rewrite and add to the protocols established in 1996 and 1997 in an attempt to eliminate the inconsistencies of the original plot designs. The following instructions are based on the original Ecodata protocols found in the 1996 binder, on changes made during the 1997 season, and on my recommendations for making plot setup and survey more efficient and replicable.

Instructions for the Setup and Surveying of Modified Ecodata Monitoring Plots

Baseline Location

Plots were selected to be located within a specific community type as identified by the primary overstory species. Currently plots are located in *Pinus longaeva* communities, *Pinus ponderosa* communities, pinyon-juniper communities (both *Pinus monophylla* and *Pinus edulis*), and in *Populus fremontii* and *Salix* dominated riparian communities. Vegetation communities selected for sampling were obtained from copies of Kimball Harper's Zion National Park vegetation community map.

After the community was selected and an identifiable access point along a trail or road was found, a random azimuth and a random number of paces (limited to the boundary of the plant community; a pace here is defined as every other step i.e. every step of the right foot) were determined using a random number generator on a calculator or in some cases by using the dial of a compass. The 20m endpoint of the plot was located at the last pace.

The baselines were run at 90°, from the 0m rebar to the 20m rebar. If the plot is located on a steep slope, greater than 30°, the baseline should be placed perpendicular to the slope. The determination whether to run baselines perpendicular or due east has purely been subjective and not consistently applied.

The plots are 20m by 20m. The tape should be stretched at ground level, through shrubs as necessary, as tight as possible so that the 0m and 20m rebar are placed correctly. Once the baseline rebars have been installed, each rebar should be labeled with a brass tag. The tag should have the plot name and rebar location (0m or 20m) stamped on it.

Photopoints

A series of photopoints should be established at each rebar. The camera should be mounted on a 1.2 meter monopod or tripod. This standard was established because the monopod used in 2001 was 1.2 meters tall. A log should be kept for each plot recording the photos taken, the azimuth the camera was pointing and the type of camera and lens used.

Two photos should be taken at the 0m rebar: one at a 45° angle from the baseline, and one along the baseline azimuth toward the 20m rebar.

Two photos should be taken at the 20m rebar: one at a 45° angle from the baseline and one along the baseline toward the 0 m rebar.

The photopoints taken along the baseline are for placing the baseline tape in the same location each year. These do not need to be retaken each time a plot is resurveyed. The photopoints taken at an angle from the baseline are for long term monitoring and should be taken each time the plots are surveyed.

In addition, photos should be taken from the baseline facing the 20m end of each transect.

Transect Location

There are 5 transects per plot. The transects are established due north for plots with baselines running due east, or are to be established upslope perpendicular to the baseline azimuth. 0m and 20m transect locations along the baseline should be rejected for all plots established after 2001 so that all microplots are located within the plot boundaries. Plots established in 1996 and 1997 did not follow this procedure. Five random numbers from 1 to 19 should be selected from a random number chart or random number generator. The sampling scheme on Tables 1 and 2 of the Ecodata protocols is an example of possible transect and microplot locations. In 1996, all transects and microplots were selected from these six sets of numbers only. In 1997, random numbers were selected by using the compass dial in the field or using a random number generator on a calculator. All new plots should be established using randomly generated numbers. These 5 numbers will be the permanent transect locations for the plot.

Each transect is 20m long. The transect tape should be stretched as tight and as low to the ground as possible, going through shrub if necessary. In 1996, this procedure was not followed, so many of the microplots do not match from 1996 to 1997, especially in oak or manzanita shrublands.

Microplot Location

There are 5 microplots per transect, for a total of 25 per plot. Microplots locations should be selected by generating random numbers from 0 to 19m. A few of the transects from 1996 have microplots at 20m, which is no longer within the plot boundaries.

Microplots are 0.5 by 0.5 meters. A square quadrat frame should be used for delineating the microplot boundary. The microplot frame is placed on the left side of the transect tape (toward the 0m rebar) with the lower left corner at the point along the transect tape. The lower edge of the plot frame is placed directly under the transect tape.

The protocols in 1996 state that microplots are placed on the right side of the transect tape. In 1997, I found that microplots were not consistently placed on the right or left side, since some plots were setup incorrectly. I was often confused when trying to determine how each plot was measured. I cannot say for certain that I read all microplots on either the right or left side. Data collected in 2001, suggest that the left side was the microplot location for at least plots PPRCSSW and PPGFLIZ. All microplots in all plots surveyed in the future should be placed on the left side of the transect tape.

Five new random numbers should be selected for the remaining four transects.

Photographs of each transect from the baseline facing toward the 20m end of the transect should be taken once, so that transect tapes can be placed accurately in the future.

Recording Microplot Data

Percent cover of the ground layer (bare ground, gravel, rock, cryptobiotic soil, moss, wood, litter/duff) should total close to 100 percent. In 1996 and 1997, estimates were recorded in whole numbers. In 2001, a cover scale was created base on Daubenmeyer (1959). It should be used for all percent cover estimates in both the ground layer and species cover section of the data sheet.

Percent Cover Scale modified from Daubenmeyer (1959)

Value	Range	Median %
+	<1%	0.5
1	1-4.9%	3.0
2	5-24.9%	15.0
3	25-49.9%	37.5
4	50-74.9%	62.5
5	75-94.9%	85.0
6	95-100%	97.5

In 1996 and 1997, the species cover for each microplot was sampled in the same way as the ground level cover. All future surveys will use the cover scale above.

The species level stratum does not total to 100 percent usually. The percent cover of all species rooted within the quadrat frame is recorded in the species cover section of the data sheet. The cover of all annuals, perennials, shrubs and trees are estimated. Shrubs and tree cover are only captured when the basal trunk or stem is at least partially within the quadrat frame. The total percentage of ground level cover is usually reduced by the percentage of tree trunk in the plot.

Line Intercept

Subshrubs, shrubs, cacti, and trees are measured along the transect tape. The distance of canopy intersection, rounded to the nearest 0.05 meters, is obtained for each species that intersects the transect tape. A gap in the canopy less than 0.1 meters is interpreted as continuous canopy cover. These values are later converted to percent cover by the following equation:

$$100 \times \text{total live canopy cover intercepted for 1 species} / 20 \text{ meters}$$

Fuel Transect

Fuels are measured along each transect. From 0m to 3m, small and medium sized fuels are tallied. Small category fuels are detached wood from 0 to ¼" in diameter. Medium category fuels are detached wood from ¼" to 1" in diameter. From 0m to 6m, large category fuels are tallied. Large fuels are detached wood from 1" to 3" in diameter. Extra large fuels, either rotten or solid, are measured along the entire transect. Extra large fuels are detached, downed logs or branches greater than 3" in diameter. The diameter, not the distance intersecting the transect tape, of each extra large category piece of wood is recorded for each transect.

In 1996, this protocol was not correctly followed. Small fuels were defined as being only ¼" in diameter. All smaller fuels were lumped with litter. In 1997, the standard fuel protocols above were followed.

In addition to the tallying the fuels along the transect, the depth of the litter and the depth of the duff should be recorded at two places along the transect. These measurements should be taken at 6 meters and 12 meters.

In 1996, the depth of the duff and litter were lumped into one measurement and measured at the 0m and 20m end of each transect. Since these measurements are at the edge of the plot, they are disturbed by the time the plot is setup. This protocol was changed to reduce the effect of trampling on the litter and duff measurements. The Ecodata protocols do not specify where the depth measurements should be made.

In 1997, the depth was not measured.

Trees

All trees with a DBH (a main trunk at least 4.5 meters high) should be tagged. The tags should be placed so they are visible only at the center of the plot. A transect tape can be lain at the 10m point along the baseline so that the investigator can stand at the center of the plot and be able to place the tree tags in the correct spot. On large trees, nails should be used to affix brass tags on the trunks of the trees. Do not hammer nails all of the way into the trunk. Leave 1" to 2" sticking

out so that the tree has room to grow. For smaller trees, hang tags by looping & twisting wire so that the diameter of the wire is at least 2X the diameter of the branch. Affix these tags as close to the trunk as possible.

In 1996, all trees with a DBH <7.5 cm were not tagged. Trees smaller than 4.5 meters, but with a trunk or basal diameter of greater than 7.5 cm were tagged. In 1997, these protocols were scrapped and trees were either added or deleted from the 1996 plots based on the protocol above.

In general trees split below DBH into 2 main trunks were tagged & measured as separate trees. A protocol needs to be developed for trees, especially juniper in the southern half of the park, that have three or more (sometimes up to five) main, upright trunks split below DBH. In 1997, they were tagged separately, which was a very time consuming process and probably not worth the time spent.

Plot Problems (not addressed above or needing resolution)

1. Except where noted in the 2001 report, all azimuths in 1996 and 1997 should not be assumed to include declination. The 1997 data should mostly include 13-14° of declination. Baseline and transect azimuths should be verified for all plots not remeasured in 2001. Changes should be noted when errors are found.

2. All azimuths for 1996 and 1997 plot location directions should not be assumed to include declination. The 1997 data should mostly be with 13-14° of declination. Plot directions should be modified and updated when errors are found. In 1997, some errors were fixed and are represented in the updated list of plot directions.

3. All tree and baseline tags need to be replaced with brass tree tags and labeled accordingly.

4. Except for PPGFLIZ, all plots need to have photopoints taken, including baseline and transect photos. PPRCSSW needs to have the 20m photopoint, 0m baseline, and transect photos taken.

5. All 1996 plots should have instructions for finding plots rewritten and fixed. Laura did not use her compass correctly or accurately. Her paces were not recorded correctly. Some plots have paces counted as every step.

6. Do not trust the maps included in the 1996 plot data report. At least PPOSE, PPE1, PPRCSSW and possible PPS1 are incorrectly placed on the maps.

7. If either BPCB01 or PJCT01 have been setup incorrectly according to the 2001 protocols, changes should be made and recorded.

8. A protocol for how deep to hammer rebar and where to place ID tags needs to be written

9. A protocol for permanently establishing plot corners on sandstone slickrock needs to be written.

Short Instructions for Establishing and Surveying a Plot

1. Use random numbers obtained for paces and azimuth to locate the 20m rebar location.
2. Stretch the tape for 20 meters at 180° to locate the 0m rebar (for level or low sloping sites)
OR
Stretch the tape for 20 meters perpendicular to the slope to locate the 0m rebar location. Take an azimuth facing the 20m rebar to determine the baseline azimuth (for steeply sloping sites).
3. Label the rebar with the plot ID and location (0m or 20m)
4. Take photopoints at the 0m rebar at a 45° angle and along the baseline.
5. Take photopoints at the 20m rebar at a 45° angle and along the baseline.
6. Use a set of 5 random numbers from 1 to 19 to determine the points for setting up transects.
7. At each random transect point on baseline, stretch the transect tape for 20 meters perpendicular to the baseline.
8. Photograph the transect standing at the baseline facing the 20m end.
9. Record the S, M, L, and XL fuels along the transect and record the depth of the litter and duff at 6 and 12 meters.
10. Use a set of 5 random numbers to place microplots along the transect.
11. Read microplots at the random points along the transect, placing the plot frame on the left side of the tape.
12. Record line intercept data for canopy cover of all subshrubs, shrubs, cacti, and trees.
13. Repeat steps 7-12 for the other 4 transects along the baseline.
14. Tag and record height and DBH for all trees on the plot if they have a main trunk at DBH (4.5 feet).

