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Revised Sampling Locations and Schedule

Dear Gordon:

Attached is a brief, revised study plan and schedule for the summer for my portion of the LTEM vegetation work. This focuses more precisely on the actual field work this summer compared to the earlier, more general document. We are primarily evaluating more efficient techniques of sampling cover and of determining species richness compared with the present techniques. I'm also trying some exploratory work investigating less expensive (hopefully) methods of evaluating berry production.

This is my best guess at a schedule at the moment. With the drastic change in helicopter schedule that occurred earlier this week plus some additional schedule changes, I had to substantially change my schedule from what I sent you earlier. I have not had a chance yet to confirm space in Gallup cabin or in C camp with these revisions, and that may cause further revisions.

Since we are primarily evaluating techniques this summer, in most cases we do not need to be in specific areas. However, since I would like to become more familiar with some of the vegetation and changes over the years for the modeling, I am trying to locate some of this year's trials on sites that were sampled in the early 1980s or that appear to be successional, thus accomplishing two tasks with the same level of work.

Sincerely,

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Introduction

The focus of the 1999 field season for the vegetation component of Long-Term Ecological Monitoring Program (LTEM) will be on evaluating sampling techniques for vegetation cover and secondarily for berries. Although many aspects of the vegetation design are on hold until the Park LTEM coordinator is on board, it is hard to imagine any vegetation sampling scenario without cover, and many questions have been raised concerning the existing protocols in Rock Creek (Helm and Roland 1999; Roland 1999). One paragraph quoted from Stohlgren et al. (1995a) seems particularly relevant to this part of the program:

> For our landscape-scale vegetation studies, for example, decisions must be made about plot shape and size, the parameters elected to study, and the frequency and precision and accuracy of measurements, which all affect the value of the long-term data set. We might have to test various techniques to quantify specific resources before we know the merits of each. In many cases, it may be worthwhile to consider other options before following blindly existing field methods.

At the beginning of that same paper, they refer to the difficulties of answering landscape-scale questions from several small plots (similar to Rock Creek plots) or of trying to obtain appropriate information for individual landscapes or parks from large national programs, such as EMAP (Environmental Monitoring and Assessment Program) which evolved into the FHM (Forest Health Monitoring Program).

Objectives

With these thoughts in mind, we have chosen the following specific objectives for the 1999 field season.

1.Compare three methods of evaluating cover and species richness based on numbers of species recorded, standard error within a site, time to sample a sampling unit, time to sample an “adequate” number of sampling units, reproducibility by same observer and by other observers of varying skill levels. The methods to be tested include modified Whittaker plots, point intercept (systematic points along a line), and Forest Health Monitoring techniques. These will be tested across several scales of vegetation pattern.

2.Determine how long it takes to do the forest mensuration methods on a Forest Health Monitoring plot in several forested types and raise any questions about the techniques.

3.Explore the possibility of using digital imagery to evaluate berry production for bear food.

Background

Cover and Species Richness

Concerns exist about reproducibility among observers for ocular estimates for vegetation cover as currently used in the Rock Creek LTEM plots and are in the present pilot protocols for the Forest Health Monitoring program (FHM). Also, the small square plots used by FHM for cover are believed to be too small and too few for cover estimates in forested communities. The round subplots are believed to be inefficient for cover and species richness since rectangular plots are usually more efficient than circles. Systematic points are believed to be relatively repeatable but miss most minor species. The modified Whittaker plots are believed to be too large to estimate cover reliably in but will pick up many of the minor species. Hence, we are trying to (1) validate our assumptions about repeatability and efficiency and (2) demonstrate that a combination of the systematic points for cover estimates and the Whittaker plots for species richness may be better techniques for the objectives of the Denali LTEM than the pilot FHM methods would be. (Our hope is that if these techniques are superior to the FHM methods, then perhaps the Alaskan FHM program would adopt those techniques, but there is no guarantee. Then Denali's data could be compared to the FHM network throughout Alaska.)

Nearby studies have shown that 20-m transects with points spaced 50 cm apart work well in open white spruce forest and low shrub vegetation types (Helm 1985). Helm (1980) found that an optimum combination of transect length and point spacing existed for various vegetation types in Colorado ranging from fine-scaled subalpine meadows through cold desert communities to forests in the mountains. Points that were too close together were highly autocorrelated and much time was wasted recording little new information. If points were spaced too far apart, then much time was wasted walking between points.

Forest Mensuration

The forest mensuration techniques consist of mapping individual stems within a circular plot based on distance and azimuth from the center. Heights and dbh are determined for each stem. By monitoring these stems over time, one can track their growth (height and diameter), death, fall, and decomposition. Density and basal area can be calculated from these data also. Although rectangular plots are usually more statistically efficient for these measurements, the mapping of stems using polar coordinates (distance, azimuth) is believed to be faster and more reliable than rectangular coordinates where two distances and azimuths are needed from two baselines (one each). However, we need to determine how long it takes to do these measurements and whether they are adequate for our vegetation (or whether we get too many 0s in forested plots). The fact that the USFS has been using this size plot for several years in southeastern Alaska suggests that the plot size may be appropriate, so it is primarily an issue of time that we are trying to determine.

In addition to the mensuration techniques, the other FHM components that we are considering include the damage indicators and lichens for air quality indicators. The national indicator lead for lichens (Peter Neitlich) is now employed by NPS in Nome, Alaska, so we feel this technique will be adaptable and is needed. A committee is already working on damage indicators for Alaska (spruce bark beetle, etc). These techniques will not be part of this summer's tests.

Berry Production

Berry production and its spatial and temporal pattern appears to be a critical issue with bear investigators. However, berry production tends to be quite variable and quite expensive to measure directly - except perhaps on research-level plots. Given the fact that the bear investigators may not need detailed berry production, but rather need to know about “good” vs “poor” sites, we should try to find a feasible method of providing this information. Collecting or counting berries is probably not economically feasible on the proposed scale of extensive or intermediate plots on LTEM. An index may be adequate, but some method of standardizing it among users and across years is needed.

I propose to explore the feasibility of using digital imagery from a handheld camera to create an index of berry availability. The key is how much can be seen with a low-end digital camera at what distance. We would be looking at dark blue berries against partially senesced blueberry leaves (small, broad) (blueberry, *Vaccinium uliginosum*), almost black berries against leaves that are more awl- or needle-shaped (plus whatever other leaves are around) (crowberries, *Empetrum nigrum*), and red berries against green leaves and possibly gravel bar in background (buffaloberry, *Shepherdia canadensis*). The buffaloberry may be the easiest of the three because of the contrast in color.

Methods

Cover and species richness techniques will be evaluated in vegetation with several scales of pattern. We will do at least two, possibly three, sites in each of the following vegetation types: large white spruce, small or dwarf black spruce, broadleaf (or mixed broadleaf and needleleaf), low shrub, and herbaceous. These types are believed to cover the range of scales of pattern found in Denali - ranging from small scale herbaceous communities with many small plants of different species to large trees with accompanying understory patterns (these may actually have multiple scales within a site). As we progress, we may find that our time is better spent addressing the multiple scales in the forested

communities, that is more stands taken in needleleaf communities with a variety of crown closures, rather than sampling an equal number of stands in herbaceous or low shrub communities.

Although if we use a systematic grid, multiple vegetation types may occur at one grid point, we are doing the initial sampling testing on relatively pure stands so we do not confound scales of pattern. Some sites sampled later in the summer may be located on arbitrary GPS points just to see how the techniques may work on a real site. The ability to do this depends on how many "pure" sites we are able to sample earlier in the season.

If time permits, we would like to resample the Rock Creek LTEM plots with a proposed alternative method to compare old and new protocols, which is essential to long-term monitoring. However, this would more likely occur next year after we have had time to more thoroughly evaluate this summer's results.

In addition to testing the techniques in multiple scales of vegetation, user reproducibility will be tested by having at least two observers read each plot. Some observers will be experienced (Carl Roland, Dot Helm, and perhaps Mike Duffy) and some will be inexperienced, but hopefully know the major plant species.

In addition to the normal measurements, time to setup a sampling unit and time to read a sampling will be tracked to be able to evaluate time efficiency.

Cover and Species Richness

Both the systematic points and modified Whittaker plots can be adapted in size to fit various scales of pattern. However, the systematic points are usually used with 20-m transects and 50-cm point spacings. The modified Whittaker plots are usually used with 20 m x 50 m boundaries. To test multiple scales of both of these as well as reproducibility among observers on all the various stands would require more time than what is present in the summer. Hence, the testing will be divided into two components: reproducibility and sampling unit size. On the first example of each vegetation type, trials testing the different transect lengths and point spacings will be run with only one observer to determine the optimum length/spacing. The other observer will then read at least one transect (or Modified Whittaker plot) to test for reproducibility. More will be read if time permits or they can be read on a different day. Some sites evaluated early in the sampling testing will be re-read near the end of the testing, if time permits. This will test reproducibility across days although there may be some seasonal variation.

Systematic Points. The systematic point technique is implemented by recording all plant species "hit" by a pin. Overstory cover is recorded using a rifle sighting scope on a pole and recording the species at the cross-hair intersection. A height category is also recorded. In areas where the leaves or aggregation of leaves are relatively broad, it may be possible to "eyeball" the hits without actually using a pin, which may speed things up. This will be tested on some plots to determine if there is a significant loss of reproducibility.

If multiple vegetation types occur along the transect, the distance at which the breaks occur will be recorded, recognizing that the actual boundary may be fuzzy. For simplicity in this discussion, the statistics will be analyzed as if the entire transect is in one vegetation type. The number of hits for each species in each height category are divided by the number of points and multiplied by 100% to calculate the cover.

A limited species list can be compiled from the hits, but a species list is usually made from a belt transect alongside, frequently 5-m wide (thus a 5 m x 20 m plot), which is comparable to the 100 m^2 subplot of the Modified Whittaker plots described below.

Modified Whittaker Plots. Modified Whittaker plots consist of a series of subplots all in a 2x5 width to length ratio nested in a 1000 m^2 (20 m x 50 m) plot. There are ten 1-m^2 (0.5 m x 2 m) subplots,

two 10 m^2 (2 m x 5 m), and one 100 m^2 (5 m x 20 m) plots (Stohlgren et al. 1995b). The number of species encountered in the plots is counted, and species area curves derived. The cumulative number of species in the three smaller plots can be used in a semilog linear regression to estimate the number of species in the 20x50 m plot. The spacing of these subplots within the main plot reduces the autocorrelation present with Whittaker's original design (Stohlgren et al. 1995b). As with the point intercept method described above, the design can be shrunk for small areas, such as riparian zones, or expanded for areas with scattered trees (Stohlgren et al. 1995b). However, they point out that better field surveying techniques might be needed for larger plots.

Forest Health Monitoring Cover and Mensuration Methods. The FHM plots consist of four circular subplots of 7.33-m radius. Three down woody debris transects (~ 18 m) radiate from the center of each of those subplots, and the 1-m^2 quadrats for cover are located along those transects. That results in four 1-m^2 quadrats for each subplot and 12 quadrats for each plot. Cover is estimated in each of these quadrats by species and life form. A species list is achieved by listing all species found in the 7.33-m radius subplots.

Within each subplot, all trees are mapped using a distance and direction from the center, and height and dbh are also measured.

Berry Production

I am anticipating that about 5 (3 to 10) photos may be taken in an area the size of an FHM subplot (7.33-m radius) from within a few feet of the plants. Whether the photos are taken directly above or obliquely or horizontally remains to be determined - how are the berries displayed relative to the leaves and how far away can a person get and still have reasonable resolution. I am proposing that some software can be used to evaluate the histogram (what percentage of the photo has wavelengths like that of the berries) or something like image processing software (such as MultiSpec) where the berries form a signature and that area of the photo is 'mapped' as berries (percentage of photo in that type class). There are a lot a feasibility issues to be resolved and explored before a real sampling design can be realistically proposed, but some preliminary evaluation is needed.

It may be that a higher end camera with better resolution and a wider angle lens would be needed compared to the camera I am presently using (Konica Q-mini, 640x480 pixels, lens equivalent to 35 mm I think). Another alternative is using regular film and scanning images, but that requires delays in processing and more time and expense..

Worst case scenario is that we would end up with photos documenting what the various categories of berry production per unit area (or perhaps bush) and hence might be able to standardize ocular estimates across years.

Study Sites

White spruce - Front country area, including Rock Creek
Black spruce - Rock Creek, west end
Deciduous trees - Front country; and near Muldrow Glacier or other floodplains
Low shrub - Front country, Rock Creek, west end
Herbaceous, including mat and cushion tundra - Eielson, Rock Creek, possibly Kantishna
(See schedule for locations. If I can catch up with Mark Clark to access their data for parts of the Park they have already mapped, I will be more specific.)

Analyses

Data will be analyzed for cover percent by species and number of species. Shannon's and Simpson's reciprocal diversity indexes and their evenness components will also be calculated. Parameters evaluated will include the mean cover percent, standard error, variation among users, time to sample sampling unit, number of sampling units needed for “adequate” sampling within a homogeneous

vegetation type, and time to “adequately” sample such a vegetation type. Adequacy of sampling for these purposes will be based on being able to detect a change of 20% cover of the dominant species. This is being selected somewhat arbitrarily at this point as a goal to see if it is realistic. (An alternative is to determine the power of a technique based on the number of sampling units that can be set up and collected in a fixed period of time, such as 4 hrs.) Actual adequacy or power criteria will be developed later in the vegetation protocol development.

Mean densities, heights, and dbhs as well as their standard error will be calculated for the forest mensuration plots.

Products

A report summarizing the above analyses will be produced, including recommendations for various objectives.

References

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Stohlgren, T.J., D. Binkley, T.T. Veblen, and W.L. Baker. 1995a. Attributes of reliable long-term landscape-scale studies: malpractice insurance for landscape ecologists. Environmental Monitoring and Assessment 36:1-25.

Stohlgren, T.J., M.B. Falkner, and L.D. Schell. 1995b. A modified-Whittaker nested vegetation sampling method. Vegetatio 117:113-121.

Proposed Schedule

July 6-9 Front country - east of Sanctuary River and possibly east of Savage River - white spruce, low shrub communities

July 10-11 Rock Creek - sample near some of existing plots to test new techniques, but not on top of them so as to avoid trampling (actual resampling is proposed for later when a new protocol has been developed)

July 12-14 can continue working in Front country or if space is available at Gallup, would like to do meadow near Eielson, if the area isn't closed. (Original reservations were for July 10-12)

July 15-16 Front country

July 17-22 not in Denali NPP

July 23not sure if I'll have to drive out to west side to get a helicopter pickup the next day for Glenn Creek or where I'll need to get picked up (east or west end)

July 24-25 helicopter out of Glenn Creek - a couple locations within about a 35-km radius to the west are being considered, mostly on sites sampled by USFS in 1982-83. This is being left flexible to work with wherever the helicopter will be going with Mark Clark et al.. However, my preference is to sample near the old plots to evaluate vegetation change since 1982. Several of their plots appear successional. [Latitude, longitude of central point are (63.394, -151.599) plot MMC094 near Birch Creek, (63.752, -151.581) plot MMC038, (63.752, -150.728) with the first one near Birch Creek having the highest preference (plot numbers are USFS plot numbers). It is black spruce but also has some successional components.]

July 26USFS plot near Turtle Hill (63.383, -150.799, plot MMC098, low shrub and herbaceous, but uncertain if accessible via foot) or meadow near Eielson on way back from Glenn Creek if these weren't already done earlier.

(July 23 and 26 could be spent at west end out of Gallup, depending upon whether I need to be at west end to get to Glenn Creek or whether the helicopter would be coming back to east end for pickup)

July 27-31 Continue testing in the Front Country area or Kantishna. At this point, I anticipate we will be filling in gaps. For instance, we may not have gotten enough sampling in a particular stand structure, such as tussock tundra or meadow or black spruce. If berries are ripe, I'll start evaluating using photo techniques. Otherwise berry sampling may flop over into August. (Originally, I had planned on being at the west end during this time period and had made reservations at Gallup. However, I'm not sure if there is space for a 2nd person out there for these comparisons. If I'm not at Gallup, I'm not sure if there is space in C camp.)