

Biol 475, Laboratory 2

Relevé Sampling

Background

The relevé approach to vegetation sampling was developed by Braun-Blanquet for application to table analysis for vegetation classification. The primary goal of the relevé approach is to acquire a complete species list from each sample site. If other quantitative site and soil information are collected, the information can also be used for ordination analysis.

Reconnaissance and Entitation

Reconnaissance is essential (cannot be overemphasized) The better your initial knowledge of an area, the better will be the subsequent sampling. This reconnaissance phase should include establishment of the apparent relations of various vegetation types with topography (toposequences), history (chronosequences), geology, soil conditions, snow regimes, and major disturbance factors (animals, fire, storm surges, floods, avalanches, etc.)

The entitation process subjectively subdivides the vegetation into recognizable entities or vegetation types. The types defined during this process are a starting point for analysis of the vegetation. During analysis of the data, some of these units are likely to be subdivided into finer categories and other types may be eliminated or combined for various reasons (e.g. they may not be extensive enough to be important in the total landscape, or they may be poorly defined transitional communities).

Defining the final plant community types is an iterative process and may take several attempts at grouping the samples into recognizable, meaningful units

Requirements of a sample site for a relevé

The Braun-Blanquet approach is based on **centralized replicate sampling**. Plots locations are chosen in the central areas of homogeneous stands of vegetation, and numerous replicate samples are collected from other similar stands.

1. Each sample site should satisfy the following criteria:
2. Homogeneity of the vegetation canopy
3. Homogeneity of the soil and other site factors
4. Large enough to contain all the species in the
5. community
6. Should be recognizable as unit that is repeated in other areas of the landscape, i.e. a repeating assemblage of plant species.

If the data are to be analyzed using probability statistics, the selection of sample sites must be done randomly within an area of homogeneous vegetation (stratified random approach is preferred).

If the data are to also analyzed using ordination methods, then it is necessary to also collect environmental and soils information at each sample site.

The advantage of permanent plots

For long-term studies, it is highly desirable to establish permanent marked plots that can be revisited at later dates. This will allow the investigator to examine the species composition during different seasons to record plants that may be missed during the first visit. It will also permit collection of other types of information that were not collected during the first visit, for example, spectral information for remote sensing studies, observations regarding winter snow depth or other more detailed microclimate information, biomass information, or physiological information for individual plant species. Permanent plots also allow the investigator to examine changes due to successional processes, climate change, or disturbance.

It is desirable to mark the plots so they can also be found and identified in winter with snow on the ground. One approach for doing this is to pound 3/4" rebar in the center of the plot and slip a 60"x1" PVC pipe over the rebar. The pipe is marked with 10-cm stripes that can be used for monitoring snow depth or water depth in aquatic vegetation. The markers are also highly visible for locating the plots, particularly in winter, and provide a scale for photographing the vegetation.

Plot size

There are two main methods of determining plot size: minimal area technique, and tables of the appropriate plot size based on experience of other investigators. It is important that the sampling be carried out within an area of homogeneous vegetation and that community boundaries and ecotones are not sampled. The size is not as important as collecting a complete species list for the site.

Approach 1: Minimal area

The minimum sampling area is determined by finding the point where the species-area curve levels off (see Kent and Coker, p. 40-41). In practice, the point where the line levels off can be defined in a variety of ways. One approach is to arbitrarily define the optimum plot size as that where some objective percentage of the total species encountered in the community type occurs (e.g. 90 or 95%). The absolute total number of species in the community is unknown, but the curve often approaches an asymptote that can be used to estimate this number. The species-area curve does not level off in tropical and some other very complex communities.

Approach 2: Tables based on previous investigators' experience

The following minimal-area guidelines (in m²) have been suggested by Westhoff and van der Maarel (1978) for typical vegetation physiognomic types.

Epiphytic communities	0.1-0.4
Terrestrial moss communities	1-4
Hygrophyllous pioneer communities	1-4
Dune grassland	1-10
Salt marshes	2-10
Pastures	5-10
Mobile coastal dune communities	10-20
Hay meadows	10-25
Heathlands	10-50
Alpine meadow and dwarf shrubs	10-50
Calcareous grasslands	10-50
Chaparral, temperate sclerophyll shrubland	10-100
Weed communities	25-100
Scrub communities	25-100
Steppe communities	50-100
Temperate deciduous forest	100-500
Mixed deciduous forest	200-800
Tropical secondary rainforest	200-1000
Tropical swamp forest	2000-4000

Actual plot size should be somewhat larger than the minimal area and should remain constant within a vegetation type. This can have the disadvantage that it may not include some species that occur outside the plot but which are obviously part of the community type.

Approach 3: Hybrid

This is a practical approach whereby the investigator starts with a plot with marked boundaries following suggested guidelines as those of Westhoff and van der Maarel (1978) (Table above). This focuses the investigator's attention within the specified area. A complete list of species is made for the plot. If the canopy is complex with a moss, herbaceous, shrub, and tree layer, it may be necessary to use different sized plots for each layer or at least the tree-shrub, and moss layers. Often the investigator will notice species outside of the plot that should be considered part of the community. In this case, the collection of species should continue outward from the center of the plot within a homogeneous stand of vegetation, until the investigator is recognizing no new species. He then writes down the final dimension of the observed area. The main point is to obtain a complete species list for the stand. The guidelines

suggested above for various community types are kept in the back of the investigator's mind, but do not limit his area of search if many species are found outside the boundary of the plot. However, the investigator needs to be constantly aware of subtle transitions in the site. If many new species are suddenly encountered, there has likely been a shift in site conditions, and the area should be excluded from the plot.

Data collected

Site factors

The site should be described as completely as possible using a consistent set of quantitative variables that can later be used in ordination analyses. The site factor form used in the class releves contains a set of site factors that we use in arctic ecosystems.

Soils

The soil-vegetation relationships are a key to understanding vegetation patterns. If you have a background in soils, then it is desirable to obtain as complete soil information from each sample site as possible. This will usually include digging a soil pit, making a quick description of the soil (see relevé soil form), and collecting soil from each soil horizon for later analysis. At a minimum, a grab sample (large handful) of soil should be obtained from the rooting zone (generally 10 cm depth). This can later be analyzed for pH, percent soil moisture, soil texture, soil color, percent organic matter, soil nutrients (N, P, K) and other physical and chemical characteristics. In class, we will use a simplified soil description that is part of the site factor data sheet, and we will collect soil samples from the rooting zone (about 10 cm) or the top of the first mineral horizon in organic-rich (peaty) soils.

Species information

Species name

Collect a specimen of every plant species in each plot for later verification. Collect one complete plant, including roots, stem, leaves, flower and fruits, whenever possible of each plant species. These are placed into a plastic bag and the bag is labeled with the plot number. Unknown plant species should be labeled with a piece of tape giving a preliminary field name that can be used as a "handle" if the plant is seen again in other plots (e.g. yellow shrubby composite with broad sticky leaves). A thorough search of the plot is made to make sure that all plant species are recorded and collected. For cryptogams (mosses, liverworts, lichens), put each species in a separate bag. We will do our best in the field, but the plants should be verified in the herbarium. Label each bag with the plot number and a unique ID number, and your field name.

Cover estimates

(See relevé sheet). Once the list of species for the plot is complete, then cover estimates should be attached to each species. The most flexible method for later analysis is to estimate the percentage cover for each species. However, it is quicker to use **cover-abundance classes**. The disadvantage of using cover-abundance classes is that it is not possible to determine average cover of a species for a group of plots (although you can determine the average cover-abundance score). The great advantage is that the observer can very quickly estimate cover. Minor differences, and sometimes even relatively large differences in cover make little difference in the classification. Total species composition is a far more important variable, and the observer should focus on this aspect rather than minor differences in cover.

Sociability, vigor, and phenology

Purists of the Braun-Blanquet often add other information regarding species sociability, vigor, and phenology to provide a more detailed picture regarding the status of individual species. Sociability is a measure of the degree of clustering (contagion) of individuals of a plant species. Vigor is a measure of the vitality of the species in the plot. Phenology provides information regarding the reproductive status of the plant (vegetative, flowering, fruiting, senescing, etc.). However, this information is difficult to quantify and has only minimal value for table analysis or ordination methods.

Below is an example of a standard European relevé protocol that includes cover-abundance score (left column, left of decimal), sociability (left column, right of decimal), phonological state (middle column: v, vegetative; fr. Fruiting; fl. Flowering), and vigor (right column: black circle, well-developed; circle with dot in center, vegetative propagation only, not completing life cycle; open circle, no dot, Feeble, with low vegetative propagation).

TABLE III
Protocol of a relevé (translated from MELTZER & WESTHOFF 1942)

Nr. 39462. 1st August 1939. Terschelling, Bessenplak S of beacon near beach mark 6. Gridnr. G5.61.43 in IVON-system (Institute for Vegetation Research in the Netherlands). Stand very uniform, Empetrum heath on slope of 6 m tall parabolic dune, exposition NNE, inclination 30°.			
Habitat: shadowed, moist soil, by day not strongly heated and rarely desiccating. Slight shifting of sand. Little human and animal influence.			
Profile: A ₀ : 2 cm semi-decayed material.			
A ₁ : 5 cm dark humus containing sand.			
C: bright, white dune sand.			
Sample plot 100 sq m.			
Herb layer cover 100 %, 20–40 cm			
<i>Polypodium vulgare</i>	2.3	v.	●
<i>Empetrum nigrum</i>	4.4	fr.	●
<i>Hieracium umbellatum</i>	1.1–2	fl.	●
<i>Festuca rubra</i> subvar. <i>arenaria</i>	+ .1	fr.	●
<i>Hypochoeris radicata</i>	+ .1	fr.	●
<i>Calamagrostis epigeios</i>	+ .1	fl.	●
<i>Jasione montana</i>	+ .1	fl.	●
<i>Carex arenaria</i>	1.1	v.	○
<i>Ammophila arenaria</i>	2.2	v.	○
<i>Salix repens</i>	+ .2	fr.	●
<i>Viola canina</i> var. <i>dunensis</i>	r	v.	○
Moss layer cover 100 %, 2–5 cm			
<i>Hypnum cupressiforme</i> var. <i>ericetorum</i>	3.3	v.	○
<i>Pleurozium schreberi</i>	3.3	v.	○
<i>Dicranum scoparium</i>	2.3	v.	○
<i>Mnium hornum</i>	2.3	v.	●
<i>Lophocolea bidentata</i>	2.2	fr.	●
<i>Eurhynchium stokesii</i>	+ .3	v.	○
<i>Plagiothecium denticulatum</i>	+ .2	fr.	●
<i>Polytrichum juniperinum</i>	+ .3	v.	○
<i>Peltigera canina</i>	+ .2	v.	●
<i>Parmelia physodes</i>	+ .1	v.	○
<i>Cladonia alpicornis</i>	+ .2	v.	○

Photographs

Photographs can be extremely valuable for later reference. Generally three types of photographs should be taken: (1) the location of the plot within the general landscape, preferably with a stake marked with the plot number in the center of the plot; (2) one or more vertical close-ups of the vegetation; and (3) a photo of the soil profile that includes a label giving the plot number, a ruled tape for scale, and markers (e.g. nails) that delineate the boundaries between the soil horizons.

Lab Exercise

Sampling White-Spruce and Black-Spruce Stands in the UAF North Campus Lands

Introduction

We will sample two forest types within the UAF North Campus Lands (NCL): an area of white spruce near the northern end of the protected area and an area of black spruce northwest of Smith Lake. A history of the NCL (Fesler 1999) and a vegetation map of the area (Petersen 1979) are on reserve in the Biological Sciences Library.

Objectives

Sample each forest using the Braun-Blanquet relevé approach. The information from this year's sampling will be combined with data from last year's Biol 475 class, which described a birch forest in the bicycle bumps area.

Methods

Equipment

- *Lab description (this document)
- *Relevé data sheets
- *Site-factor sheets
- *Soil-sampling sheet
- *Notebook with sheets of paper for marking plots
- *Zippered notebook to keep and protect pencils, data sheets, etc.
- *Hand-held GPS unit
- *24 pieces of lath to mark the corners of the relevés
- *Pin flags to mark the corners of the moss plots
- *100-m tape
- *Meter stick
- *Shovel
- *Soil Knife
- *Soil can for collecting soil
- *Plastic bags for plant collection and soil collection
- *Post-it notes to label collection bags
- *Paper sacks for moss collections
- *Sharpie
- Pencil
- Camera

Sample sites, GPS coordinates marking method, plot id numbers, photographs

Twelve sites have been pre-selected for sampling, six in each forest type. The GPS coordinates of these sites are:

Forest type	Relevé No.	Latitude:	Longitude:
White Spruce	06-1	64°51'513''	147°51'668''
	06-2	64°51'534''	147°51'741''
	06-3	64°51'554''	147°51'754''
	06-4	64°51'589''	147°51'732''
	06-5	64°51'532''	147°51'872''
	06-6	64°51'538''	147°51'895''
Black Spruce	06-7	64°51'956''	147°52'459''
	06-8	64°51'954''	147°52'435''
	06-9	64°51'947''	147°52'387''
	06-10	64°51'933''	147°52'379''
	06-11	64°51'917''	147°52'379''
	06-12	64°51'936''	147°52'406''

You will work in two teams. During Lab 2 we will focus in the white-spruce forest, and during Lab 3 we will focus in the black-spruce forest. Each team will sample three relevés in each forest type.

Lay out a 10 x 10-m area in a homogeneous portion of the forest vegetation type that contains the pin flag with the plot number. These areas will be used to determine the density of the trees in a later lab. Mark the corners of the plot with pieces of lath, and label one of the corners with the plot number). We will leave these pin flags and lath in place for the next few labs and then remove them after we are finished sampling the forest. According to Westhoff and van der Maarel (1978) the minimal sampling area for temperate deciduous forests is about 200-500 m². We are probably at the low end of the range because our forest is species poor, so we will start with 200 m² plots and see if these enclose most of the species.

Within a homogenous portion of the moss canopy, lay out a 1 x 1-m plots for sampling the forest floor.

Dig a small soil pit (about 50 cm x 50 cm x 50 cm deep) adjacent to the plot but containing the same type of soil as in the majority of the plot. Remove an intact plug of soil from one side of the pit and lay it next to the pit. Label a Post-it note with the plot number and put it on the shovel adjacent to the plug of soil so the plot number is visible in photos. Put a tape measure or meter stick next to the plug for scale.

Make a label with the plot number that will be included in photos of the plot. Take several photographs of the location of the plot from a few meters away from the plot showing the forest and general situation. Include the location of the moss plot in some of the photos. Take a vertical photo of the moss plot with the plot ID tag in one corner of the photo. Take a couple of photos of the soil plug and the soil pit. Record the photo numbers on your relevé data sheet.

Relevé sampling

- **Relevé data sheets:** We will go over the data collection method of the relevé sites. Be sure to completely fill out the header information for each relevé.
 - Study site: Be sure to write White Spruce or Black Spruce site.
 - Relevé No.:
 - Don't forget to take photos of each relevé.
 - Under the heading "vegetation" record write a brief description of the vegetation, for example *Moist Betpap, Picgla, Rosaci, Equarv deciduous forest*. Be sure to note the dominant species in the forest layer and the understory, and the moss layer (if mosses are

- important). There will only be one microsite for each plot so ignore the A:, B:, C: parts of the description.
- For each species list the full name of the plant the first time you see it. After that use a six letter code (first three letters of the genus name and first three letters of the species name).
 - Put vascular plants, mosses and lichens in separate columns.
 - Record the cover –abundance score for each species.
- **Voucher collections:** These will be collected so you can be sure you have properly identified all the plants in the relevé, or you may have inadvertently failed to record all the species on your data sheet.
 - Collect one voucher specimen for each species in the relevé. Put all the vascular plants from the relevé in a plastic bag with the relevé number on the outside of the bag, and on a post-it inside the bag. When you go back to the lab, take the plants out of the bags and put them into a plant press and dry them in the oven. Be sure to label the plants in the press with the proper collection numbers.
 - For non-vascular plants (mosses and lichens), put these in a paper bag labeled with the relevé number. These collections will be air dried in the bags. Write the names of the species you have collected on the outside of the bag with a Sharpie. Use field names if you don't know the genus and species.
 - For totally unknown species, give the species a field name and collection number, put a piece of scotch tape (with the specimen number on it) around a good specimen of the plant (preferably with flowers, fruit, stem, leaves, and roots). Next time you see the plant you can use the field name. We will identify the collections in herbarium.
 - **Site description side of data sheets:** We will go over this in the field too. There may be other factors that we want to record for each plot.
 - **Soil collections.:** We will dig soil pit and measure thickness of each horizon, and collect a sample of soil for lab analysis.
 - Dig a small pit in the same vegetation type adjacent to the plot.
 - If possible pull out a plug of soil with soil shovel.
 - Put a Post-it on the soil with the plot number.
 - Photograph the soil. (Record the photo number on the front of the Relevé data sheet)
 - Measure the thickness of the organic horizons, and the A horizon. Record these values under “Notes” on the Site Description side of the data sheet.
 - Collect a soil can of soil from about 10 cm depth, or if there is a thick organic layer, collect it from the top of the first mineral horizon.
 - Put the collection of soil in a plastic bag. Label the outside of the bag with a Sharpie, put the Post-it with the plot number (for the soil photograph) inside the bag.
 - Replace the soil plug in the pit and restore the surface of the soil.

Be sure to preserve your relevé data sheets because these data will be used in much of the rest of the course.

References

- Fessler, S. 1999. North Campus Land: The land use history. Draft manuscript prepared for Dr. Richard Boone's class.
- Petersen, T. 1979. University of Alaska Boreal Arboretum vegetation covertype map (scale 1"=200'). Draft map.