Lecture 2: The Relevé Method of Sampling Plant Communities

1. Relevé sampling method.
2. Review results of minimal area sampling.
3. Lab 2 overview

Sampling methods

- Subjective vs. objective sampling
- Centralized replicate, random, and systematic sampling approaches
- The relevé method
- Cover estimates

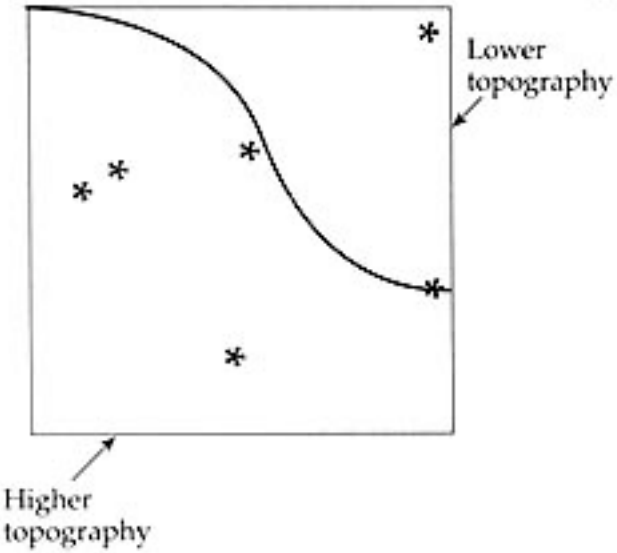
Subjective vs. objective sampling

- ***Subjective sampling***
  - Sample sites are consciously chosen as representative of predetermined vegetation classes.
  - Most flexible sampling scheme
  - Allows for experience and decision making ability of the investigator
  - Best used in areas where there are clear boundaries between plant communities
  - Good approach for vegetation classification
- ***Objective sampling***
  - Sample sites are chosen according to chance (i.e. random sampling)
  - Essential if probability statistics are to be used to back up the conclusions
  - Best used in areas where boundaries between communities are indistinct or where the objective is to determine the causes of variation within a single plant community
  - Good approach for ordination methods

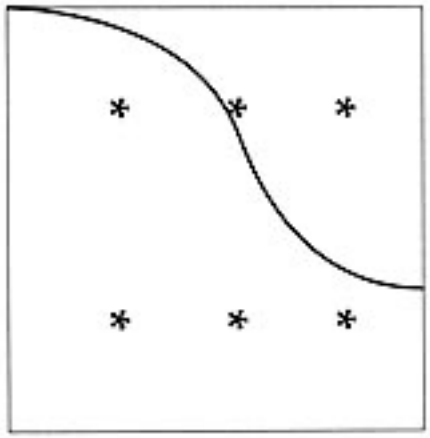
Centralized replicate, random, and systematic sampling approaches

- **Centralized replicate**
  - Sample sites are chosen subjectively and centrally located within representative homogeneous areas of predetermined vegetation types.
  - This method is used in the relevé approach (more on this later).
- **Random**
  - Sample sites are chosen according some randomizing method (e.g., dice, random numbers). Any point is a possible sample point.
  - In a **complete random** method plots are chosen completely randomly.
  - In a **stratified random** approach, the research areas is first divided into relatively similar classes based on some criteria, for example, landscape units (floodplains, hills, mountains) or mapped vegetation units. Sample sites are then randomly chosen in the various classes. This ensures that the most common units are not over-sampled and the uncommon units under sampled. The samples are dispersed throughout the entire survey area.
- **Systematic**
  - Plots are located according to a regular system such as a grid or regular intervals along a line. A **stratified systematic** approach is similar to the stratified random approach except the sample sites are chosen according to a systematic method (grids or linear transects) within each stratified class.

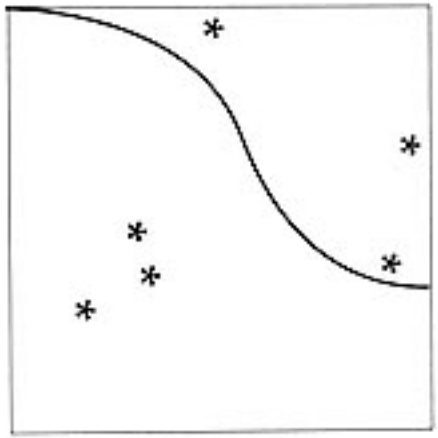
(a) Random



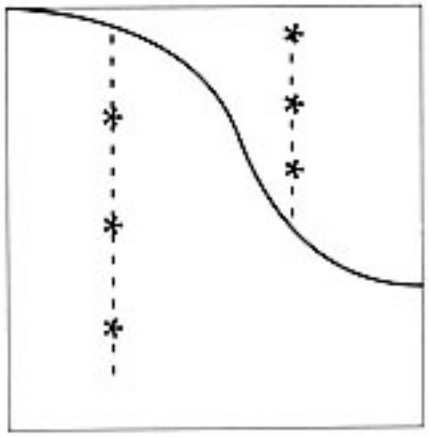
(c) Systematic



(b) Stratified random



(d) Stratified systematic



The relevé method

- French term meaning a collection of data. Often used in terms of surveys.
- Developed by Josias Braun-Blanquet as a standard method of sampling for vegetation classification according to the Zurich-Montpellier School of phytosociology.
- Recently has gained popularity in North America (e.g., Nature Conservancy, California Department of Fish and Game, Talbot and Talbot 1994, Walker et al. 1994, Komárková 1978, Rivas-Martinez 1997, Miyawaki et al. 1994, Klinka et al. 1996)
- The quickest way to obtain detailed community information.
- Does not necessarily involve sampling other components of the site such as soils and site factors, although these are often collected if environmental gradient analysis is part of the research.
- Subjective sampling (centralized replicate).
- Qualitative in the sense that species cover is estimated instead of measured.
- Quantitative in the sense that it gives a complete list of species for the plot.

Entitation and requirements of a relevé

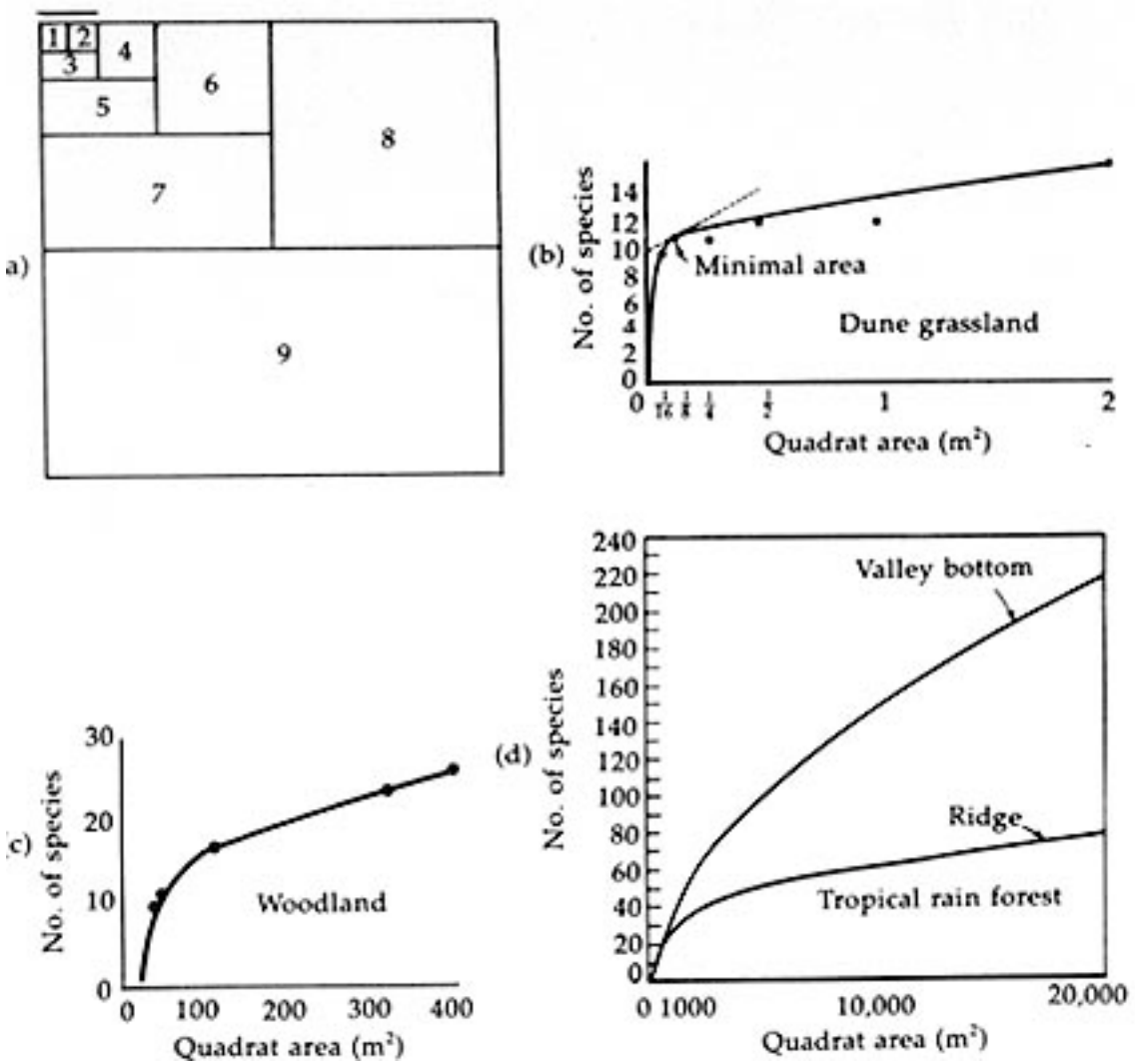
Entitation

- The process of subdividing the vegetation into recognizable entities or preliminary vegetation types
- Reconnaissance essential (cannot be overemphasized) The better your initial knowledge of an area, the better will be the subsequent sampling.
- Important to avoid sampling ecotones or breaks between distinct communities.
- Iterative process that may take several years to perfect description of the communities.

Requirements of a sample site for a relevé

- Should be recognizable as unit that is repeated in other areas of the landscape, i.e. a repeating assemblage of species.
- HOMOGENEITY of the vegetation canopy
- Homogeneity of the soil and other site factors
- Large enough to contain all the species in the community (where the minimal area sampling scheme comes in)

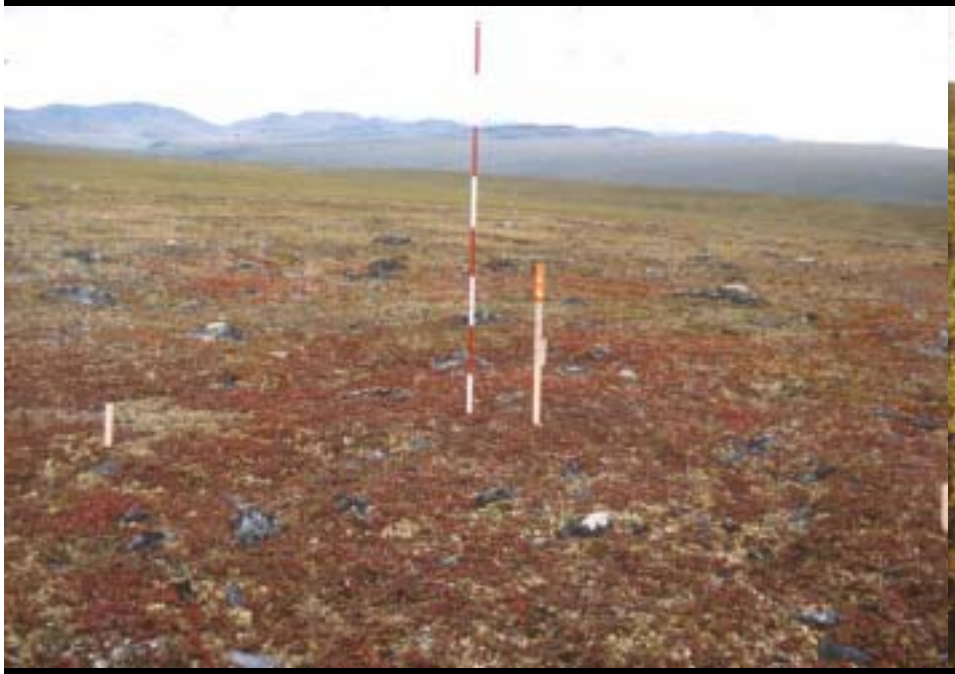
Size of plots: Minimal Area Method

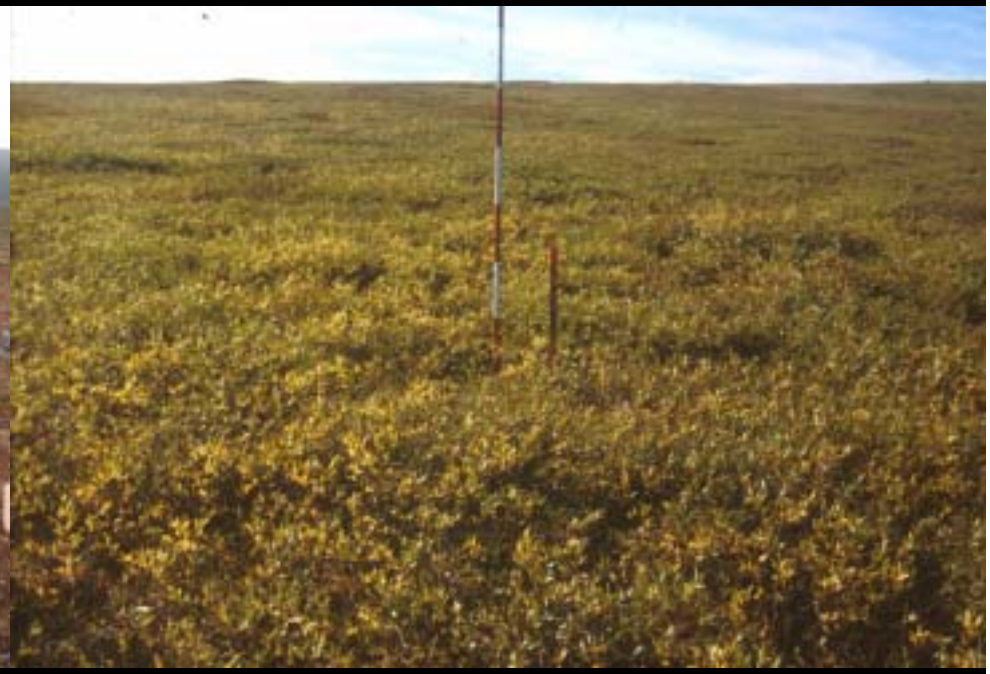


The advantage of permanent plots

- For long-term studies. It is highly desirable to establish permanent marked plots that can be revisited at later dates.
- Allows the investigator to examine the species composition during different seasons to record plants that may be missed during the first visit. Permits 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.
- Examine changes due to successional processes, climate change, or disturbance.
- *In our studies, we 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.*

Relevé sites:
Homogeneity of vegetation



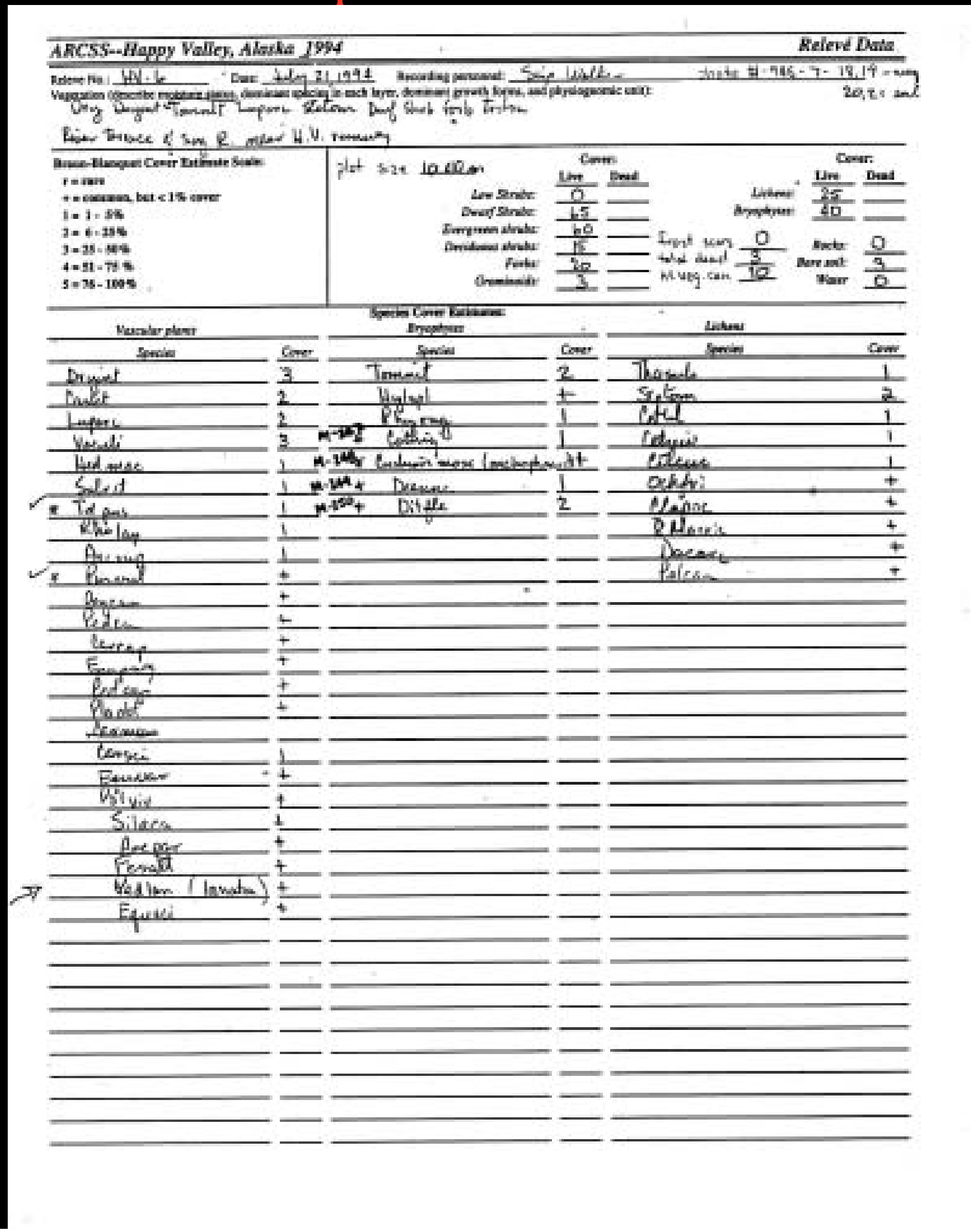


Minimum area for common vegetation types

Table 9-1 Minimal areas for various vegetation types. From *Aims and Methods of Vegetation Ecology*. Mueller-Dombois and Ellenberg. Copyright © 1974 John Wiley and Sons, Inc. Reprinted by permission.

Type	Minimal area (m^2)
Tropical rain forest	1000–50,000
Temperate forest:	
Overstory	200–500
Undergrowth	50–200
Dry temperate grassland	50–100
Heath	10–25
Wet meadow	5–10
Moss and lichen communities	0.1–4

Example Relevé data sheet



ARCSS--Happy Valley, Alaska 1994 — *Relevé Data*

Relevé No.: HV-6 Date: July 21, 1994 Recording personnel:

Vegetation (describe moisture status, dominant species in each layer, dominant growth forms, and physiognomic unit):

Braun-Blanquet Cover Estimate Scale:
- r = rare
- + = common, but < 1% cover
- 1 = 1 - 5%
- 2 = 6 - 25%
- 3 = 26 - 50%
- 4 = 51 - 75%
- 5 = 76 - 100%

plot size 10x10m

	Cover: Live	Dead
Low Shrubs:	0	
Dwarf Shrubs:	65	
Evergreen shrubs:	60	
Deciduous shrubs:	15	
Forbs:	30	
Graminoids:	3	

	Cover: Live	Dead
Lichens:	25	
Bryophytes:	40	
Rocks:	0	
Bare soil:	3	
Water:	0	

Species Cover Estimates:

Vascular plants: Species	Cover	Bryophytes: Species	Cover	Lichens: Species	Cover
	3		2		1
	2		+		2
	2		1		1
	3		1		1
	1		+		1
	1		1		+
	1		2		+
	1				+
	1				+
	+				+
	+				
	+				
	+				
	+				
	+				
	+				
	1				
	+				
	+				
Silene	+				
	+				
	+				
	+				
	+				

Cover

The area of ground covered by the vertical projection of the aerial parts of plants of one or more species.

- An easily obtained index of plant biomass.
- **Estimates** of cover can be obtained by using cover-abundance scores.
- **Measures** of cover can be made using point sampling methods, line transect method, or photos and planimeter or other direct measure of cover.

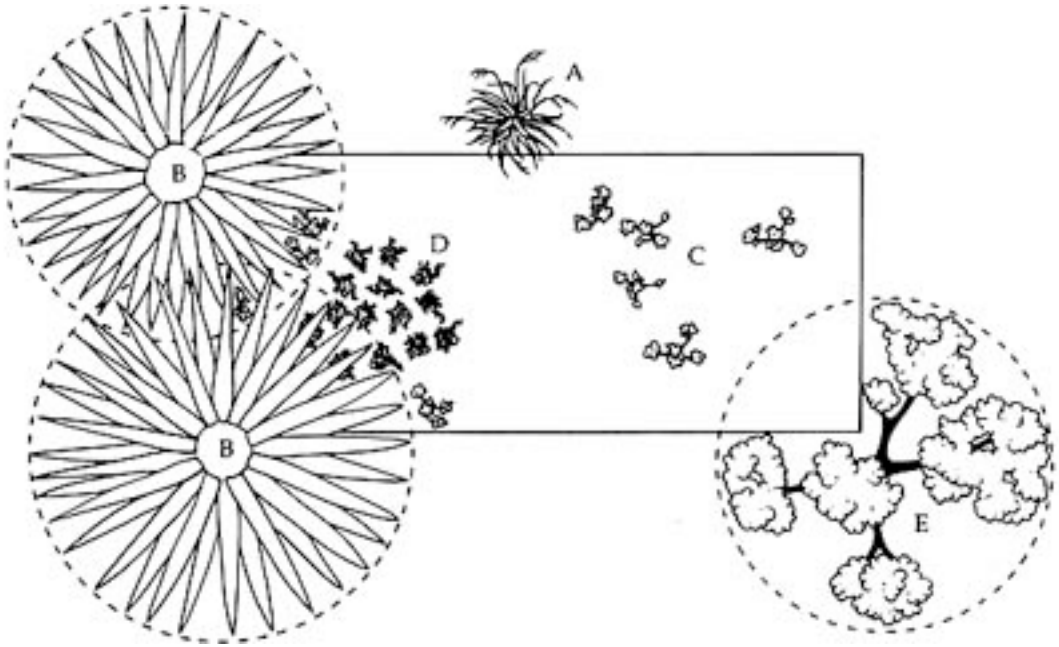
Cover-abundance classes

Table 9-2 Cover classes of Braun-Blanquet, Domin-Krajina, and Daubenmire. From *Aims and Methods of Vegetation Ecology*. Mueller-Dombois and Ellenberg. Copyright © 1974 by John Wiley and Sons, Inc. Reprinted by permission.

Braun-Blanquet			Domin-Krajina			Daubenmire		
Class	Range of cover (%)	Mean	Class	Range of cover (%)	Mean	Class	Range of cover (%)	Mean
5	75–100	87.5	10	100	100.0	6	95–100	97.5
4	50–75	62.5	9	75–99	87.0	5	75–95	85.0
3	25–50	37.5	8	50–75	62.5	4	50–75	62.5
2	5–25	15.0	7	33–50	41.5	3	25–50	37.5
1	1–5	2.5	6	25–33	29.0	2	5–25	15.0
+	<1	0.1	5	10–25	17.5	1	0–5	2.5
r	<<1	*	4	5–10	7.5			
			3	1–5	2.5			
			2	<1	0.5			
			1	<<1	*			
			+	<<<1	*			

*Individuals occurring seldom or only once; cover ignored and assumed to be insignificant.

Estimating percentage 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 classification or ordination methods.

Example of a European relevé protocol

TABLE III

Protocol of a relevé (translated from MEIJER & 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.

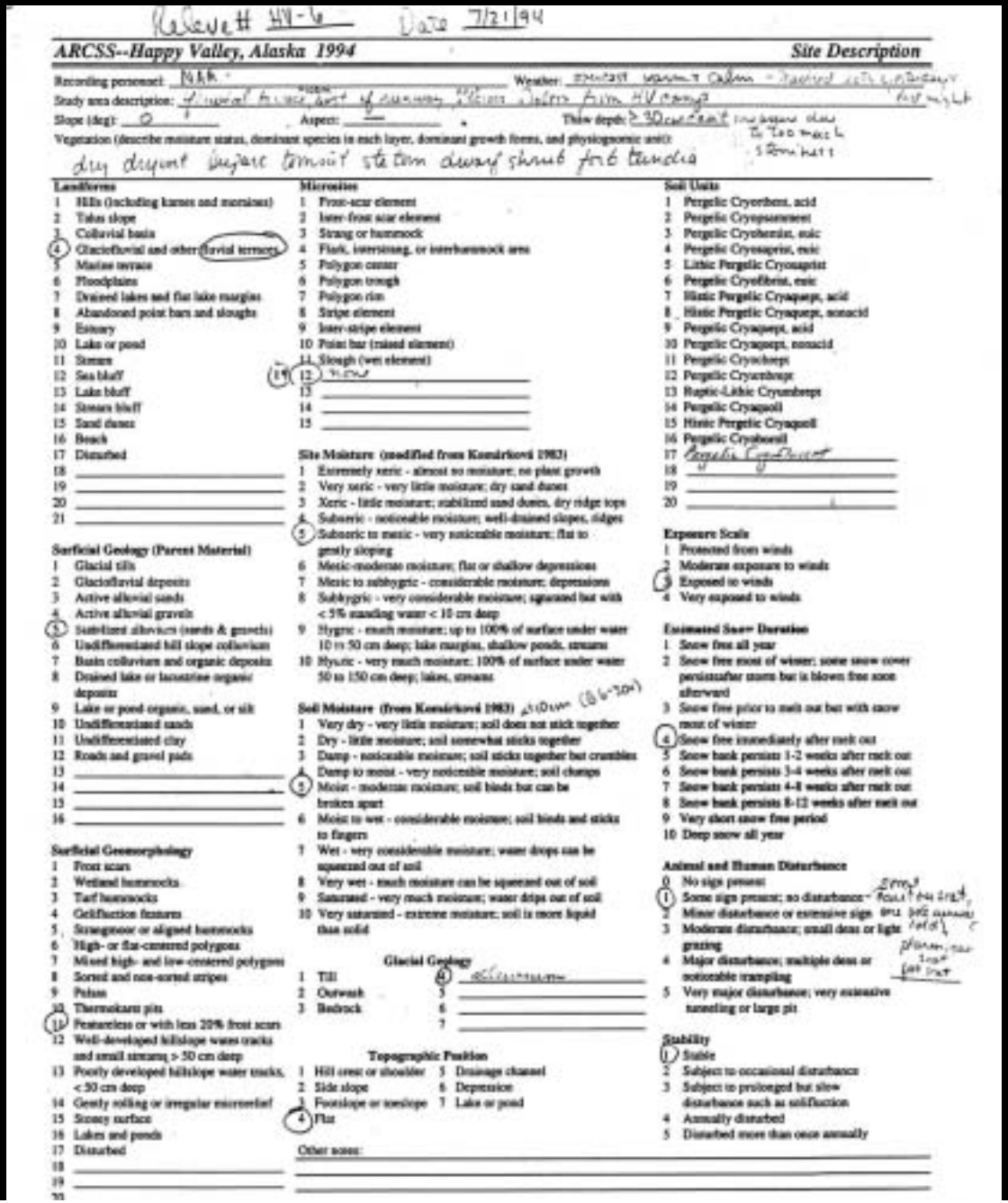
Profile: A_0: 2 cm semi-decayed material.
A_1: 5 cm dark humus containing sand.
C: bright, white dune sand.

Sample plot 100 sq m.

Herb layer cover 100 %, 20–40 cm			
Polypodium vulgare	2.3	v.	●
Empetrum nigrum	4.4	fr.	●
Hieracium umbellatum	1.1–2	fl.	●
Festuca rubra subvar. arenaria	+.1	fr.	●
Hypochoeris radicata	+.1	fr.	●
Calamagrostis epigeios	+.1	fl.	●
Jasione montana	+.1	fl.	●
Carex arenaria	1.1	v.	○
Ammophila arenaria	2.2	v.	○
Salix repens	+.2	fr.	●
Viola canina var. dunensis	r	v.	○
Moss layer cover 100 %, 2–5 cm			
Hypnum cupressiforme var. ericetorum	3.3	v.	○
Pleurozium schreberi	3.3	v.	○
Dicranum scoparium	2.3	v.	○
Mnium hornum	2.3	v.	●
Lophocolea bidentata	2.2	fr.	●
Eurhynchium stokesii	+.3	v.	○
Plagiothecium denticulatum	+.2	fr.	●
Polytrichum juniperinum	+.3	v.	○
Peltigera canina	+.2	v.	●
Parmelia physodes	+.1	v.	○
Cladonia alcicornis	+.2	v.	○

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).

Sample site-factor data form



Release # HH-6 Date 7/21/94

ARCSS--Happy Valley, Alaska 1994 — **Site Description**

Recording personnel: N.R.K. Weather: [illegible]

Study area description: [illegible]

Slope (deg): 0 Aspect: — Thaw depth: >30 cm at least

Vegetation (describe moisture status, dominant species in each layer, dominant growth forms, and physiognomic unit):
dry dryas heath moist tussock dwarf shrub forb tundra

Landforms
1 Hills (including kames and moraines)
2 Talus slope
3 Colluvial basin
(4) Glaciofluvial and other fluvial terraces
5 Marine terrace
6 Floodplains
7 Drained lakes and flat lake margins
8 Abandoned point bars and sloughs
9 Estuary
10 Lake or pond
11 Stream
12 Sea bluff
13 Lake bluff
14 Stream bluff
15 Sand dunes
16 Beach
17 Disturbed
18 _____
19 _____
20 _____
21 _____

Surficial Geology (Parent Material)
1 Glacial till
2 Glaciofluvial deposits
3 Active alluvial sands
4 Active alluvial gravels
(5) Stabilized alluvium (sands & gravels)
6 Undifferentiated hill slope colluvium
7 Basin colluvium and organic deposits
8 Drained lake or lacustrine organic deposits
9 Lake or pond organic, sand, or silt
10 Undifferentiated sands
11 Undifferentiated clay
12 Roads and gravel pads
13 _____
14 _____
15 _____
16 _____

Surficial Geomorphology
1 Frost scars
2 Wetland hummocks
3 Tarf hummocks
4 Gelifluction features
5 Stringmoor or aligned hummocks
6 High- or flat-centered polygons
7 Mixed high- and low-centered polygons
8 Sorted and non-sorted stripes
9 Pingos
10 Thermokarst pits
(11) Featureless or with less 20% frost scars
12 Well-developed hillslope water tracks and small streams > 50 cm deep
13 Poorly developed hillslope water tracks, < 50 cm deep
14 Gently rolling or irregular microrelief
15 Stoney surface
16 Lakes and ponds
17 Disturbed
18 _____
19 _____

Microsites
1 Frost-scar element
2 Inter-frost scar element
3 Strang or hummock
4 Flark, interstrang, or interhummock area
5 Polygon center
6 Polygon trough
7 Polygon rim
8 Stripe element
9 Inter-stripe element
10 Point bar (raised element)
11 Slough (wet element)
(12) [illegible]
13 _____
14 _____
15 _____

Site Moisture (modified from Komárková 1983)
1 Extremely xeric - almost no moisture; no plant growth
2 Very xeric - very little moisture; dry sand dunes
3 Xeric - little moisture; stabilized sand dunes, dry ridge tops
4 Subxeric - noticeable moisture; well-drained slopes, ridges
(5) Submesic to mesic - very noticeable moisture; flat to gently sloping
6 Mesic-moderate moisture; flat or shallow depressions
7 Mesic to subhygric - considerable moisture; depressions
8 Subhygric - very considerable moisture; saturated but with < 5% standing water < 10 cm deep
9 Hygric - much moisture; up to 100% of surface under water 10 to 50 cm deep; lake margins, shallow ponds, streams
10 Hyxric - very much moisture; 100% of surface under water 50 to 150 cm deep; lakes, streams

Soil Moisture (from Komárková 1983) 10cm (5/6-7/24)
1 Very dry - very little moisture; soil does not stick together
2 Dry - little moisture; soil somewhat sticks together
3 Damp - noticeable moisture; soil sticks together but crumbles
4 Damp to moist - very noticeable moisture; soil clumps
(5) Moist - moderate moisture; soil binds but can be broken apart
6 Moist to wet - considerable moisture; soil binds and sticks to fingers
7 Wet - very considerable moisture; water drops can be squeezed out of soil
8 Very wet - much moisture can be squeezed out of soil
9 Saturated - very much moisture; water drips out of soil
10 Very saturated - extreme moisture; soil is more liquid than solid

Glacial Geology
1 Till
2 Outwash
3 Bedrock
(4) [illegible]
5 _____
6 _____
7 _____

Topographic Position
1 Hill crest or shoulder
2 Side slope
3 Footslope or toeslope
(4) Flat
5 Drainage channel
6 Depression
7 Lake or pond

Other notes: _____

Soil Units
1 Pergelic Cryorthent, acid
2 Pergelic Cryopsamment
3 Pergelic Cryohemist, eutic
4 Pergelic Cryosaprist, eutic
5 Lithic Pergelic Cryosaprist
6 Pergelic Cryofibrist, eutic
7 Histic Pergelic Cryaquept, acid
8 Histic Pergelic Cryaquept, nonacid
9 Pergelic Cryaquept, acid
10 Pergelic Cryaquept, nonacid
11 Pergelic Cryochrept
12 Pergelic Cryorthrept
13 Ruptic-Lithic Cryumbrept
14 Pergelic Cryaquoll
15 Histic Pergelic Cryaquoll
16 Pergelic Cryoboroll
17 Pergelic Cryofluvent
18 _____
19 _____
20 _____

Exposure Scale
1 Protected from winds
2 Moderate exposure to winds
(3) Exposed to winds
4 Very exposed to winds

Estimated Snow Duration
1 Snow free all year
2 Snow free most of winter; some snow cover persists after storm but is blown free soon afterward
3 Snow free prior to melt out but with snow most of winter
(4) Snow free immediately after melt out
5 Snow bank persists 1-2 weeks after melt out
6 Snow bank persists 3-4 weeks after melt out
7 Snow bank persists 4-8 weeks after melt out
8 Snow bank persists 8-12 weeks after melt out
9 Very short snow free period
10 Deep snow all year

Animal and Human Disturbance
0 No sign present
(1) Some sign present; no disturbance
2 Minor disturbance or extensive sign
3 Moderate disturbance; small areas or light grazing
4 Major disturbance; multiple areas or noticeable trampling
5 Very major disturbance; very extensive tunneling or large pit

Stability
(1) Stable
2 Subject to occasional disturbance
3 Subject to prolonged but slow disturbance such as solifluction
4 Annually disturbed
5 Disturbed more than once annually

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. Or work in conjuction with a soil scientist.
- The effort should 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 our sampling, 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.*

Sample soil description form

Photo # 945-7-20×21

[illegible] all soil samples are grab samples – not bulk density samples

ARCSS–Happy Valley, Alaska 1994 **Soil Description**

Soil Description: Location [illegible]

Site no. HV-6 Date 7/21/94 Time [illegible] Vegetation [illegible]

Elevation ____ Slope 0 Aspect — Geomorphic Surface [illegible]

Parent Material(s) [illegible] Described by [illegible]

Depth (cm)	Horizon	Color moist / dry	Structure	Gravel (%)	Consistence Wet / Mst / Dry	Texture	pH	Clay films	Boundaries	notes
0-½	surface moss		m vf gr sg f pl 1 m pr 2 c cpr 3 vc abk sbk	0 50 <10 75 10 >75 25	so po lo lo ss ps vfr so s p fr sh vs vp fi h vfi vh efi eh	S SiCL LS SiL SL Si SCL SiC L C CL SC		vl f pf 1 d po 2 p br 3 co cobr	a s c w g i d b	
½-2	S-82 Oa	10YR2/2 v. dk. brown	m vf gr sg f pl 1 m pr 2 c cpr 3 vc abk sbk	0 50 <10 75 10 >75 25	so po lo lo ss ps vfr so s p fr sh vs vp fi h vfi vh efi eh	S SiCL LS SiL SL Si SCL SiC L C CL SC		vl f pf 1 d po 2 p br 3 co cobr	a s c w g i d b	many fine and very fine roots in Oa, A, IIOa; cobbles to 14 cm in diameter
2-4	A S-83	10YR2.5/1 v. dk. gray black	m vf gr sg f pl 1 m pr 2 c cpr 3 vc abk sbk	0 50 <10 75 10 >75 25	so po lo lo ss ps vfr so s p fr sh vs vp fi h vfi vh efi eh	S SiCL LS SiL SL Si SCL SiC L C CL SC		vl f pf 1 d po 2 p br 3 co cobr	a s c w g i d b	cobbles to 14 cm in diameter
4-6	IIOa S-84	10YR 2/1 black	m vf gr sg f pl 1 m pr 2 c cpr 3 vc abk sbk	0 50 <10 75 10 >75 25	so po lo lo ss ps vfr so s p fr sh vs vp fi h vfi vh efi eh	S SiCL LS SiL SL Si SCL SiC L C CL SC		vl f pf 1 d po 2 p br 3 co cobr	a s c w g i d b	cobbles to 14 cm in diameter
6-30	S-85 IIB	10YR3/1 v. dk. gray	m vf gr sg f pl 1 m pr 2 c cpr 3 vc abk sbk	0 50 <10 75 10 >75 25	so po lo lo ss ps vfr so s p fr sh vs vp fi h vfi vh efi eh	S SiCL LS SiL SL Si SCL SiC L C CL SC		vl f pf 1 d po 2 p br 3 co cobr	a s c w g i d b	common fine and very fine roots in IIB; cobbles to 21 cm in diameter
30	very stony stopped digging here [illegible] permafrost		m vf gr sg f pl 1 m pr 2 c cpr 3 vc abk sbk	0 50 <10 75 10 >75 25	so po lo lo ss ps vfr so s p fr sh vs vp fi h vfi vh efi eh	S SiCL LS SiL SL Si SCL SiC L C CL SC		vl f pf 1 d po 2 p br 3 co cobr	a s c w g i d b	
			m vf gr sg f pl 1 m pr 2 c cpr 3 vc abk sbk	0 50 <10 75 10 >75 25	so po lo lo ss ps vfr so s p fr sh vs vp fi h vfi vh efi eh	S SiCL LS SiL SL Si SCL SiC L C CL SC		vl f pf 1 d po 2 p br 3 co cobr	a s c w g i d b	
			m vf gr sg f pl 1 m pr 2 c cpr 3 vc abk sbk	0 50 <10 75 10 >75 25	so po lo lo ss ps vfr so s p fr sh vs vp fi h vfi vh efi eh	S SiCL LS SiL SL Si SCL SiC L C CL SC		vl f pf 1 d po 2 p br 3 co cobr	a s c w g i d b	
			m vf gr sg f pl 1 m pr 2 c cpr 3 vc abk sbk	0 50 <10 75 10 >75 25	so po lo lo ss ps vfr so s p fr sh vs vp fi h vfi vh efi eh	S SiCL LS SiL SL Si SCL SiC L C CL SC		vl f pf 1 d po 2 p br 3 co cobr	a s c w g i d b	
			m vf gr	0 50	so po lo lo	S SiCL		vl f pf	a s	

Lab 2: Relevé Sampling Method

- Meet here at 2:15 next Wed.
- Walk to bicycle bump area.
- Bring back pack, hand lens, notebook, scotch tape, warm clothing, water, snack. I will provide data sheets.
- Read over lab and data sheets. These will be on the web site next Monday.
- Read Fesler, S. 1999. *North Campus Land: a land-use history*. Paper submitted to Dr. Richard Boone's class; focus on pages 12-15 "Potato Field". This is on 2-hr loan in the Biosiences Library.