Biol 697, Laboratory 1

Relevé sampling in the Bicycle Bumps forest, 2017

Part I: Field sampling

History of the bicycle bumps

Figure 1. Google image of Potato Field and Bicycle Bumps area.

We will sample the forest that has established in an area known as the "bicycle bumps" in the UAF Arboretum. The forest developed in the eastern part of the Potato Field, which was originally cleared for agriculture in 1908. This portion of the field was abandoned from potato farming after it developed large thermokarst mounds (high-centered polygons) when sub-surface ice-wedges melted as a result of changes to the thermal regime of the soil. The area was temporarily planted in grass and transitioned to pastureland until 1926. There was an attempt to level the area in 1938 with a bulldozer, but the mounds quickly reestablished, and the area was then abandoned altogether for agricultural purposes, and the vegetation started changing to a deciduous forest. An aerial photo of the area taken in 1938 clearly shows the well-developed mounds in the eastern portion of the Potato Field in contrast to a relatively smooth western portion of the field. The area was still unforested at this time. A more full history is contained in references cited by Sunna Fessler (1999), particularly Troy Pewé's reports on geologic hazards in the Fairbanks areas (Pewé 1982, U.S. Geol. Surv. Bull. 989-F; and National Academy of Sciences 1965).

Today the area is known as the "bicycle bumps" and has a popular ski and hiking trail running the length of the area. A spectacular group of high-centered polygons is hidden beneath the forest canopy. The

vegetation is mainly a successional birch forest consisting of paper birch (*Betula papyrifera*) with some of balsam poplar (*Populus balsamifera*), white spruce (*Picea glauca*) and tall willows (mainly *Salix bebbiana*). The patchy understory consists of horsetails (*Equisetum arvense*), rose (*Rosa acicularis*), grasses (*Calamagrostis canadensis*), aspen (*Populus tremuloides*), and other species. Numerous research projects have been done in the bicycle bumps but apparently no attempt to thoroughly describe the forest, with the possible exception of class paper for Fred Dean's Ecology class in 1961 (Burns 1961).

Objectives

1. Sample the forest using the Braun-Blanquet relevé approach.
2. Determine the biomass of the trees on the plot using allometric equations.
3. Use the information from this field exercise to describe the site we sampled.

Methods

Equipment

Clothing etc.

1. Day pack
2. Rain jacket and pants, hiking boots, or rain boots if you have them,
3. Warm jacket, gloves, ski cap
4. Camera
5. Feld book and pencils
6. Lunch and water

Equipment list for Relevés:

1. Relevé data sheet on write in the rain paper (includes data sheet for species, and environmental information)
2. Rainproof notebook to contain data sheets, pencils, markers, and sampling gear
3. GPS unit
4. Compass
5. Maps and aerial photos of field area
6. 2 Pencils
7. 2 sharpie markers
8. 4 pins for plot corners
9. Cord frames with pre-knotted corner loops for plot boundaries, 4 sizes (1 x 1 m, 2 x 2 m, 5 x 5 m, 10 x 10 m)
10. Meter stick
11. 1-gal zip-lock bags (for vascular-plant voucher collections)
12. Small paper sacks (for lichen and moss collections)
13. Post-It notes, 2 sizes (small and large)
14. Umbrella
15. Canvas grocery sack to contain samples and sampling gear

For soil descriptions:

16. Sharp Shooter shovel
17. 10d nails to mark soil horizons
18. Color book
19. Soil description book
20. Trowel
21. Small soil cans
22. Bread knife (to cut out soil samples from soil block)
23. Gallon plastic sacks to double bag soils
24. Post-It notes
25. Sharpie

Plot-count measurement of trees:

26. Biltmore stick for measuring tree diameters
27. Inclinometer for measuring tree heights
28. Data sheet to record tree survey

If plots are to be permanently marked:

29. Wooden stakes for corners
30. Weatherproof and animal-proof plot-id tags.

Potato Field

We will first visit the cleared portion of the Potato Field to examine the succession that is occurring in this area, which was mowed until recently – in contrast to the bicycle-bumps area which was allowed to reforest after 1938. The full history of this field after it was planted in potatoes in 1908 is not entirely clear from Fessler's report. Until recently it was a grass meadow. Within the last 5 years, the introduced vetch *Vicia cracca* has nearly taken over the field. There are many small thermokarst features scattered across the meadow, evidence of the subsurface massive ground ice.

Bicycle bumps

Reconnaissance and site selection

We will first walk around the area and discuss the various habitat types within the forest. Is it homogeneous or not? And what might be a good sampling strategy to sample the forest. We will only do one relevé, so we will select what we feel is a good representative of the most common habitat in the forest.

Considerations for the plot include (a) homogeneity of the site, (b) representative of the most common vegetation on the polygon tops, (c) large enough to establish a homogeneous plot. We will discuss habitat types, and minimal-area considerations. Generally forest sites require 25-m^2 to 100-m^2 plots. We will have decide what size plot is most appropriate to contain all the species in the habitat type without moving into another habitat.

Relevé sampling

- **Plot boundaries:** Mark plot boundaries with the pre-sized 5 x 5-m cord plot boundary. Adjust the boundaries to keep the plot as homogeneous as possible. Find another site if the area is too small to hold a homogeneous plot.
- **Plot coordinates:** Obtain the longitude and latitude coordinates and elevation of the site, using the GPS unit.
- **Photographs:** Write the plot number on a large post-it or sheet of paper and photograph the plot with plot number in the photo. Include a landscape view showing the plot in the forest and general location of the ploto; then take a vertical photo of the understory vegetation. Record the photo numbers on your relevé data sheet. You will also need photos of the soil with the plot number in the photo.
- **Relevé data sheets:** These will be provided. We will go over the data collection method of the relevé sites. Be sure to completely fill out the header information for each relevé.
- **Voucher collections**: Specimens of all species 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 or more sample voucher specimens for each species in the relevé. Really common things that you are sure of require only a small sample that you can use to confirm the presence of the species when you go over your data sheets. Species you are are unsure should be collected with roots, flowers, leaves, stems, and whatever may help to identify it in the lab. A good photo of the plant in its field setting will also be helpful. Put all the vascular plants from the relevé in a plastic bag with the relevé number on the bag, and on a post-it inside the bag also with the plot number. 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 separate paper bags labeled with the relevé number and "moss" or "lichen". 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. These collections will be air dried in the bags and sorted in the lab.
    - 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.
    - Mark the major soil horizone with 10d nails.
    - Put a Post-it on the soil plug with the plot number, and ruler along side of the plug for scale.
    - 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.

Tree sampling, plot-count method:

In your field book record every tree >2 m tall in the plot:

1. Species
2. Diameter at breast height using the Biltmore stick or diameter tape.
3. Height using the inclinometer or estimate once you have calibrated your estimate with measurements.
4. Count all the saplings less than 2 m tall for each species.
5. Determine mass of each tree using allometric equations (Zianis and Mencuccini 2004): $M = aD^b$, where M = dry biomass (kg), D = diameter (cm) at breast height, a and b are allometric coefficient specific to tree species.
   Note: See Zianis and Mencuccini for explanation of allometric approach for determining tree biomass.
   Betula papyrifera: $a = 0.0612$, $b = 2.6634$
   Populus balsamifera and *P. tremuloides:* $a = 1.049$, $b = 2.391$
   Picea glauca: $a = 0.0635$, $b = 2.484$

Table 1. Tree field data sheet

Tree nr.	Species name	Dbh (cm)	Basal area (cm^2)	Height (m)	Mass* (kg/tree)
Sapling tally:					
	Species name	**Sapling count**			

* Calculate the approximate biomass of the trees using the following allometric equation (Zianis and Mencuccini 2004): $M = aD^b$, where M = dry biomass (kg), D = diameter (cm) at breast height, a and b are allometric coefficient specific to tree species.

Betula papyrifera: $a = 0.0612$, $b = 2.6634$

Populus balsamifera and *P. tremuloides:* $a = 1.049$, $b = 2.391$

Picea glauca: $a = 0.0635$, $b = 2.484$

Note: See Zianis and Mencuccini for explanation of allometric approach for determining tree biomass.

Zianis, D., & Mencuccini, M. (2004). On simplifying allometric analyses of forest biomass. *Forest Ecology and Management*, *187*(2-3), 311–332. http://doi.org/10.1016/j.foreco.2003.07.007

Calculate the following from the information in Table 1:

1. Total basal area for each species.
2. Convert basal area for each species in $cm^2/25\ m^2$ (Area of our plot) to m^2/ha.

Table 2. Summary data sheet

Summary by species:				
Species Name	**Total basal area per species (cm^2/ 25 m^2)**	**Basal area per species (m^2/ ha)**	**Biomass (kg/ha)**	
Sapling tally:				
Species name	**Number of samplings**			

References

Burns, J.J. 1961 (cited in Fessler 1999). An aspen-birch community in interior Alaska. Class paper for Fred Dean's class .

Fessler, S. 1999. North Campus Land: The land use history. Draft manuscript prepared for Dr. Richard Boone's class.

Pewé, T. L. 1982. Geologic hazarsd of the Fairbanks area: Alaska Division of Geologic and Geophysical Surveys, Special Report 15, 36 pp.

Pewé, T.L. date? (cited in Fessler 1999). Effect of permafrost on cultivated fields in the Fairbanks area, Alaska. U.S. Geological Survey Bulletin, 989-F, 322 pp.

National Academy of Sciences. 1965 (cited in Fessler 1999). Guidebook for Field Conference for Central and Southcentral Alaska. From: International Association for Quaternary Research VII Congress, August-September 1965. National Academy of Sciences: Lincoln Nebraska.

Part II. Vegetation Descriptions

The main point of the exercise is to familiarize you with the main elements of describing a plant community and the language used to describe them.

Use your notes and the relevé information on the field sheets to describe the plant community. There is no single correct way to do this. Initially it can be either a narrative or an outline form. Eventually, you will want to organize this information into a short narrative that describes the plant community of our study, with a consistent form that can include several sections. Your description should contain the elements listed below.

(Note: These descriptions will be of a single relevé. Usually we do not make a formal description of each relevé, but often it is necessary to make descriptions of plant community types based on information summarized from several relevés and contained in the relevé data sheets, photos, table analyses, soil analyses and your field notes.)

I. Field name for the plant community: This can be a simple 2-species name with a dominant species and a characteristic species (as in the Braun-Blanquet approach) or a more complex name consisting of components from the different layers (as the approach used in the USNVC).

In the Arctic I use an informal name consisting of four parts:

a. site moisture (dry, moist, wet, aquatic),
b. dominant 1-2 species in each layer of the plant canopy (tree, shrub, dwarf-shrub, herbaceous (graminoid/forb), and moss/layer layers).
c. Dominant plant functional types: Evergreen, deciduous or mixed (for forests), tall shrub (>200 cm), low shrub (50-200 cm), dwarf shrub (5-50 cm), prostrate shrub (creeping shrubs), graminoid (includes grasses, sedges, rushes), forb, moss, lichen.
d. physiognomic term describing the general outward appearance of the vegetation (forest, open forest, woodland, savanna, shrubland, grassland, meadow, tundra, marsh, etc., best to use a term that is descriptive of the dominant plant growth forms.)

Examples:

Moist *Picea glauca, Equisetum pretense, Cornus canadensis, Hylocomium splendens* closed evergreen needleleaf forest (or closed coniferous forest)

Moist *Picea mariana*, *Ledum groenlandicum*, *Hylocomium splendens, Sphagnum* spp. open evergreen needleleaf forest (or open coniferous forest)

Moist/wet *Eriophorum vaginatum, Betula nana, Ledum groenlandicum, Pleurozium schreberi* tussock-sedge, dwarf-shrub, moss tundra

II. Site description:

1. General:
   a. Location, (Lat. Long. Coordinates) + general location name (e.g., University of Alaska North Campus Lands, white spruce stand, just east of upper T-Field.) It also good to include an aerial photo or Google image of the general location with the exact labled locations of the plots.
   b. Size of plot
   c. Photos: Showing the position of the plant community within the landscape, and close up(s) showing details of the plant community structure and composition. Note in the caption, the key species, and credit the photographer and photo numbers.
   d. Observors:
2. Geology, landforms, soils, disturbance history:
   a. General habitat description using common names: These can be informal descriptions of the general habitat. For example: Closed white spruce forest, Open black spruce forest, Cottongrass-dwarf shrub meadow (or fen), Cassiope early melting snowbed, Wet sedge

tundra, low-centered polygon complex, Dwarf birch - lichen shrubland on river terrace, Elymus sand dune grassland, Alder riparian shrubland, Closed balsam poplar forest on river terrace, Forb-rich early succession river floodplain, Forb-grass community surrounding animal dens, Dry dryas—cushion -forb fellfield on limestone.

b. Landform (mountain, hill, plain, floodplain, coastal salt flat, sand dunes, river terrace, etc.)
c. Surficial geomorphology: presence of hummocks, or patterned ground, or other surface feature. Specify size of features, height and horizontal dimension. In patterned-ground landscapes with distinctive communities on the different elements of the p, it is best to describe the plant communities on the different elements of the patterned-ground features, e.g. the hummocks tops, and areas between hummocks.
d. Position along the toposequence if on a hill (hill crest, shoulder, upper middle or lower side slope, foot slope, toe slope)
e. Aspect and slope (˚)
f. Typical snow conditions if known or obvious (e.g., deep snowbed, or windblown site).
g. soil characteristics: Use U.S. soil classification units if known. Include information on soil texture of top mineral horizon, soil field moisture conditions, depth of organic layers, soil pH, evidence of fire in the horizon if present.
h. Disturbance history if known, evidence of fire, use by animals, human disturbance, past land-use, glacial history if known, frequency of disturbance and stability of the site.

III. Plant community structure:

a. Vertical structure: height of major layers of the plant canopy (Upper tree layer, Lower tree layer, tall shrub layer, dwarf-shrub layer, herbarceous layer, moss/lichen layer).
b. Horizontal structure: spacing of trees (estimate of number of trees in the plot)
c. Drawings if useful: If the relevé contains several micro-communities in distinct micro-habitats, describe the spacing of the micro-habitats. It may be useful to include a hand-drawn map if there are distinctive features within the relevé, such as single trees or a few trees, or ice-wedge polygons with distinctive microhabitats, or areas with different dominant species. It may also be useful to include a drawing of the position of the relevé within the larger landscape, such as location on a series of river terraces, or snowbed, or large feature such as pingo or small hill.

IV. Plant community composition:

a. Dominate plant species in the main layers of the plant canopy (in some plant-community descriptions for some agencies or organization you may have to use common plant names with the Latin names in parentheses).
b. Other common species.

Note: In a general description of a plant-community type, much of the detail regarding the individual relevés mentioned in parts I and II above would not be included. In this case you would include only information that is relevant to the plant-community type as a whole. You would, would also note the relevé that is most characteristic of the plant community (the type relevé), and which relevé numbers are included in this plant-community type.

Vegetation Description

Plot no.:_____ Observers: _____Date plot described:_____

I. Field name for vegetation type:_____
Name should consist of following parts: a) site moisture (dry, moist, wet, aquatic), b) dominant 1-2 species in major layers of the plant canopy (tree, shrub, dwarf-shrub, herbaceous (graminoid/forb), and moss/lichen layers). c) Dominant plant functional types: Evergreen, deciduous or mixed (for forests), tall shrub (>200 cm), low shrub (50-200 cm), dwarf shrub (5-50 cm), prostrate shrub (creeping shrubs), graminoid (includes grasses, sedges, rushes), forb, moss, lichen. d) physiognomic term describing the general outward appearance of the vegetation (forest, open forest, woodland, savanna, shrubland, grassland, meadow, tundra, marsh, etc., best to use a term that is descriptive of the dominant plant growth forms.) Examples:

Moist *Picea glauca, Equisetum pratense, Cornus canadensis, Hylocomium splendens* closed evergreen needleleaf forest (or closed coniferous forest)

Moist *Picea mariana, Ledum groenlandicum, Hylocomium splendens, Sphagnum* spp. open evergreen needleleaf forest (or open coniferous forest)

Moist/wet *Eriophorum vaginatum, Betula nana, Ledum groenlandicum, Pleurozium schreberi* tussock-sedge, dwarf-shrub meadow

Equivalent Viereck et al. (1992) Level IV name:_____
See: http://www.treesearch.fs.fed.us/pubs/6941 to download the classification.

II. Site description:

a. **Location:** (latitude, longitude in decimal minutes) **_____**
b. **Location description:** _____
c. _____
(e.g., University of Alaska North Campus Lands, white spruce stand, just east of upper T-Field.) It also good to include an aerial photo or Google image of the general location with the exact labeled locations of the plots.)
d. **Size of plot: _____**
e. **Photos:** Showing (a) the position of the plant community within the landscape, (b) close up(s) showing details of the plant community structure and composition and (c) the soil. Note in the caption, the key species, and soil classification, and credit the photographer and photo numbers.
f. **General habitat description:_____**
For example: Closed white spruce forest, Open black spruce forest, Cottongrass-dwarf shrub meadow (or fen), Cassiope early melting snowbed, Wet sedge tundra, low-centered polygon complex, Dwarf birch - lichen shrubland on river terrace, Elymus sand dune grassland, Alder riparian shrubland, Closed balsam poplar forest on river terrace, Forb-rich early succession river floodplain, Forb-grass community surrounding animal dens, Dry dryas—cushion -forb fellfield on limestone.
g. **Landform:** _____
(mountain, hill, plain, floodplain, coastal salt flat, sand dunes, river terrace, etc.)
h. **Surficial geomorphology:** _____
presence of hummocks, or patterned ground, or other surface feature. Specify size of features, height and horizontal dimension. In patterned-ground landscapes with distinctive communities on the different elements, it is best to describe the plant communities on the different elements of the patterned-ground features, e.g. the hummocks tops, and areas between hummocks.
i. **Position along the toposequence**:_____
If on a hill (hill crest, shoulder, upper middle or lower side slope, foot slope, toe slope)
j. **Aspect and slope (˚):**_____
k. **Typical snow conditions:** _____
(e.g., average, deep snowbed, shallow snowbed, or windblown site).

l. **Soil type:** _____
U.S. soil classification name if known. See:
http://soildatamart.nrcs.usda.gov/Manuscripts/AK610/0/GreaterFairbanks.pdf
Parent material: _____
Site moisture (subjective rating) _____
Depth of O horizon: _____
Depth of thaw:_____
Soil texture of top mineral horizon: _____
Soil pH of top mineral horizon:_____
Soil moisture of top mineral horizon (subjective rating):_____
Other notes: _____
_____

m. **Disturbance history**:
_____
_____
_____
Evidence of fire, use by animals, human disturbance, past land-use, glacial history if known, frequency of disturbance and stability of the site.

IV. Vegetation description (structure and composition):
Include height and horizontal spacing of major plant growth forms with dominant, subdominant, common, and other species and estimates of cover. See example below.

Tree layer:

Tall shrub layer:

Low shrub layer:

Dwarf shrub (including prostrate dwarf shrub) layer:

Herb (graminoid and forb) layer:

Moss/lichen layer:

Example vegetation description of the structure and composition for a hypothetical plot:
Tree layer: One *Picea mariana* seedling (<1m tall) within the plot. Scattered small *Picea mariana* to about 1-2 m tall in surrounding tundra.

Tall shrub layer: none

Low shrub layer: Deciduous shrubs, dominated by *Betula nana* (est. 15% cover) and *Salix pulchra* (est. 3% cover) to about 50 cm tall. Evergreen shrubs, dominated by *Ledum groenlandicum* (est. 15% cover) to about 50 cm tall.

Dwarf shrub layer: Dwarf evergreen shrubs, dominated by *Chamaedaphne calyculata* (est. 3% cover), with *L. decumbens* and *Vaccinium vitis-idaea* (est. 1% cover). Dwarf deciduous shrubs include *Vaccinium uliginosum* and *Rubus chamaemorus* (<1% combined cover).

Herb layer: Closely spaced large (35-50 cm tall) *Eriophorum vaginatum* tussocks (___ tussocks/10 m^2, est. 60% cover). Other graminoids include the grasses *Calamagrostis canadensis* and *Arctagrostis latifolia* (est. 10% combined cover). Forbs are rare. Only *Pyrola secunda* was noted.

Moss layer: Low cover of mosses and lichens mainly in inter-tussock spaces (est. <2% cover). Dominant mosses include *Pleurozium schreberi* and *Hylocomium splendens* (est. 2% combined cover). Other mosses include *Drepanocladus* sp., *Dicranum* sp. and *Polytrichum strictum*. The dominant lichen is *Peltigera aphthosa* (est. <1% cover).

V. Other notes:

Here you might add other observations, a drawing showing landscape relationship of the plot, distribution of some key plants within the plot, etc.