Berry Monitoring Protocol

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PURPOSE and RATIONALE

To better understand natural variability in time and space in berry productivity across the Canadian Arctic and Sub-Arctic. There are two levels of sampling that can be performed. The first is a "minimal" level of sampling that should be done in as many sites as possible. It can be implemented in association with local communities or at any research site. It is meant to be easy and fast; use a site where you are already measuring vegetation and just pick the berries following the protocol below. The second level of sampling pertains to a group of measurements, most concerning pollination, associated with berry production. Northern students may be able to carry out many of these measurements

NOTE: This is a first draft and elements may be unclear or missing, thus we welcome any suggestion to improve this protocol.

SPECIES SELECTION:

The studies will focus on four common species generally found across the sub- and low Arctic and important to northern communities. Species should be selected according to abundance, the interest level of the local community in the species and accessibility. Even if only one species can be sampled, this will provide useful information. For ease of collection, if two species grow together, they can be measured in the same plot thus providing additional information. In addition, if you are already measuring the vegetation in an area where berries are present, you could simply collect berries in this stand. Please note if the area sampled is typical of the "best" berry habitat in your location or if it is representative of the general ground cover throughout the area.

The four species of interest are:

Species 1	**Abbreviation: VULI**	
Latin name	***Vaccinium uliginosum***	
Common English name	**Blueberry**	
Common French name	**Bleuet**	
Inuktitut name (Nunavut)	**Kegotangenak**	
Inuktitut name (Nunavik)	**Kigutangirnaq**	
Nunatsiavut name		
Inuvialuit name		
Métis name		
Species 2	**Abbreviation: VVIT**	
Latin name	***Vaccinium vitis-idaea***	
Common English name	**Mountain cranberry, redberry, partridgeberry**	
Common French name	**Airelle rouge**	
Inuktitut name (Nunavut)	**Kimminaq**	
Inuktitut name (Nunavik)	**Kimminaq**	
Nunatsiavut name	**kimimino'k, kiminu'k**	
Inuvialuit name		
Métis name		

Species 3	**Abbreviation: ENIG**	
Latin name	***Empetrum nigrum***	
Common English name	**Crowberry, Blackberry**	
Common French name	**Camarine noire**	
Inuktitut name (Nunavut)	**Paurngaq**	
Inuktitut name (Nunavik)	**Paurngaq**	
Nunatsiavut name	**paugnatwi'nuk**	
Inuvialuit name		
Métis name		
Species 4	**Abbreviation: RCHA**	
Latin name	***Rubus chamaemorus***	
Common English name	**Cloudberry, Bakeapple**	
Common French name	**Chicouté, plaquebière**	
Inuktitut name (Nunavut)	**Akpik**	
Inuktitut name (Nunavik)	**Arpik**	
Nunatsiavut name	**a'kpiq**	
Inuvialuit name	**Okpik**	
Métis name		

SITE SELECTION:

Sampling sites should be chosen in areas of homogeneous vegetation that is representative of the area, where berry picking occurs. A site should be a minimum of 20 m x 20 m in size. Once a site is chosen, it should be identified by marking the 4 corners of the plot, recording the GPS coordinates and photographing both general and close up views of the site.

There are 2 types of sampling: general vegetation sampling and berry plot sampling:

1. *General Vegetation Sampling and Description*: A baseline approach to vegetation sampling requires that a photograph be taken of the area and the vegetation characterised. Within the site to be studied, 10 to 30 quadrats should be randomly located. The % cover (using point frame method – See Point Frame protocol) and heights of all species found in the plot should be recorded and a photograph should be taken of each quadrat (including a reference frame: see protocol for photographs and heights of vegetation). The size of the quadrat is dependent on the plant community, but is generally 1 m x 1 m. Smaller quadrats such as 70 cm x 70 cm or 50 cm x 50 cm are sometimes used for prostrate vegetation (e.g. in the High Arctic). Note that if vegetation or berry sampling cannot be accomplished in 2008, the berry plots should still be established and berries could still be collected and vegetation description be done in 2009).

2. *Berry plots*: Within the berry plot sampling site randomly choose 25-30 plots (25 cm x 25 cm). It is within these plots that the berries will be collected using the protocol below. These plots do not need to correspond to the quadrats used for vegetation sampling; however they can overlap. An easy way to randomly choose plots within a designated area is to lay down two measuring tapes perpendicularly along the edges of the vegetation plot (e.g. 20 m x 20 m) so that they form an x and y axis. Select random numbers from a hat that represent the placement of the plot with respect to the measuring tapes. For example, you may draw a 2 and a 9, this would indicate that a plot should be located at meter 2 along one measuring tape and meter 9 along the other. The lengths of the tapes can be adjusted to fit the area used.

BERRY PICKING:

Equipment: plastic bags (label ahead of time with the species abbreviation, site, plot number and date), a reference quadrat, pegs and string pre measured to ~30 cm. Note: An easy way to mark berry plots is to use four pegs and a string pre-measured and tied at every 25 cm. Any other method may work as well (little plastic frames, rulers…).

- ALL the berries inside each small berry plot (25 cm X 25 cm) should be picked, ripe or not. The date and level of “ripening” should be recorded. The level of ripening is estimated by determining the number of berries at different stages of ripeness. For example, 30% of berries may be pink, 70% may be ripe. If you are unsure of the categories, just record the number of berries which are “ripe” or “not ripe.” Photographs of the different stages will be included with updates of this protocol.

- The berries should be put in plastic bags identified with the quadrat number : e.g. C1 for first quadrat of site C with a different code for each species (see abbreviations given with species name above) ;

- Please keep the berries cool until they can be measured;

- In the laboratory/classroom, the berries should be weighed and counted (ripeness categories (e.g. green, white, pink and ripe) counted separately). If for some reason this is not possible, please freeze them rapidly and ship them, mentioning that they were not weighed;

- The samples can then be shipped frozen in labelled plastic bags to the following address for further analyses;

N.B. if it is not possible to freeze the samples (which is the preferred method), these two alternative options are worth trying:

1) Preserved in alcohol: a relatively small amount of 70% alcohol is appropriate, however, be aware that alcohol may be considered a dangerous good so it may require particular permits, etc.

2) If neither of the previous options are possible, it is adequate to air dry the berries, making sure that they do not get mouldy. It is possible to use simple fruit dryers to do this (cheap and light). If the berries are put to dry in a drying oven, please keep the temperature low (max temperature should be 60ºC and leave space around trays; a fan may be used to help with the circulation of air; the oven door should always be opened a few cm) and record the temperature and duration.

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THANK YOU VERY MUCH FOR YOUR CONTRIBUTION TO THIS PROJECT! INPUT WELCOME!

IDEAS FOR ADDITIONAL MEASUREMENTS

In order to learn more about the role of pollinators on berry productivity, here are some experiments that may be conducted:

Test for self-pollination:
When a plant can reproduce (produce fruits) without pollen coming from another plant, it is able to self-pollinate. Generally, sexually reproducing species find it advantageous to be cross-pollinated, *i.e.* to receive pollen from a different individual (for the berry species, generally this is done by pollinating insects). This basic experiment allows the difference in berry productivity to be compared between plants that are visited by insects and plants that are manipulated so that a barrier prevents insects from visiting the plant (treatment with mesh bags: pollinator exclusion).

Protocol:
- The experiment should be conducted on at least three individuals of the berry species: *Vaccinium vitis-idea*, *Vaccinium uliginosum*, *Empetrum* and *Rubus*.

- Use mesh bags, or mesh socks that have holes small enough that insects are prevented from accessing the flower.
    - 3 visits are necessary:
        - Initially, visit the plant when plants are in bud (before flowering) mark 30-40 shoots/branches and count number of flowering buds
        - Set the mesh bags (or socks!) on half the shoots in a paired design
        - Visit the plants again once the berries are starting to form remove the mesh barriers. This should be done as soon as possible to limit negative impact of mesh bags (*e.g.* warming).
        - The final visit is to collect berries from both control and treated shoots when ripe. Count the berries from both treatments, weigh them fresh (and dry if they are dried instead of frozen), then freeze them and ship them south to the address above.
- For a more in depth study, a third treatment could be added. Plants could be hand-pollinated and covered in mesh barriers. This would allow for differences in seed-set in various species to be determined. This treatment will help to determine if the species' fruit-set/seed-set are constrained by low pollinator activity. Since hand-pollination of *Vaccinium* and *Empetrum* can be difficult, *Rubus* would be an ideal plant. We do not recommend doing this experiment unless students are willing and capable of doing the work involved. A large number of flowers (at least 30 and preferably many more) should be hand-pollinated for comparison with those not pollinated or simply insect-pollinated in order for relevant results to be found.

Insect activity monitoring

The purpose of insect activity monitoring is to compare the level of insect visits to flowers between different habitats or treatments (E.g. OTC vs. controls). This observational study will also give insight into the roles of insects as plant grazers and other plant insect interactions.

- Observe insect activity in plots (e.g. 1 m x 1 m) and record the flower species visited and time the insect spends on flower (chronometer). Plots should be monitored for 10 mins each only. Ideally, plots with and without treatment, and in different habitats should be measured as well. These observations should optimally be done in the morning and repeated in early afternoon.

Note: If people are interested we are contacting entomologists from the Insectarium in Montréal to have small kits prepared with the main types of pollinating insects that can be found in the North, these kits could be used with students, in summer camps, etc.

STILL IN DEVELOPMENT … Insect collection: net + trap

Another activity that could be done if time permits and that could contribute to various projects since the abundance of insects is poorly known or monitored in the North.

- Follow specific protocols depending if traps or nets are used (ideally both should be used), not forgetting water habitat for aquatic insects/larvae (Inuit have names for some);
- Kill insects by putting them in a freezer (remember these are Arctic insects: allow for a long period in the freezer!);
- To preserve insects, mount them with entomological pins on Styrofoam or store them in glassine envelopes with labels, for shipping;
- Check pollen diversity, prepare sticky slides for microscope and pass it on hairs of insect or use small cube of Beattie's gelatine that is dabbed on insect in various spots and then melted on a slide.

Reproductive Effort and Success

If possible, the number of flowers on each of the monitored plants should be counted when they are full (petals out and anthers with pollen). This number can be related to the number of berries produced as a percentage of flowers that produced fruit. The variation in these numbers over time will give us a sense of the reproductive effort (flowering) and success (berry production). Note that in *Rubus chamaemorus* the plant only produces one flower. In this case, please count the number of flowering plants and berries in the area being monitored.

Thank you for your participation and do not hesitate to contact us if you have any question, suggestion, etc.