Scientific Name: *Hedysarum alpinum L.* **Common Names:** Bear root, Alpine Sweetvetch, Alpine hedysarum, alpine sweet-broom, pink hedysarum, purple sweetvetch

Life Form: Forb

Site Preferences: Mesic to moist grasslands, open woods, rocky slopes, roadsides (Pahl & Smreciu, 1999) Coarse textured soil, medium textured soil (USDA NRCS, 2018)

Tolerances: Moderate drought tolerance, medium fire tolerance, cold tolerant, nutrient poor soil, pH 4.5 to 8.4 (Gucker, 2007; Matheus & Omtzigt, 2013; USDA NRCS, 2018)

Distribution: Across Canada (Gucker, 2007; International Union for Conservation of Nature and Natural Resources., 2000)

Left: *Hedysarum alpinum*. Alfred Cook, some rights reserved, CC BY, http://www.alaskawildflowers.us/Kingdom/Plantae/Magnoliophyta/Magnoliopsida/Fabaceae/Hedysarum_alpinum/Alpinum_06.html

Plant Identification:

H. alpinum is a perennial comprised of several stems clumped together in a woody, persistent base with deep tap roots and rhizomes (Carter, 2014; Gucker, 2007). It produces purple to pink pea-like flowers attached by short, equal stalks in a dense line along the top portion of each stem (raceme). The average height of the plant is 20-70 cm (Gucker, 2007; Smreciu, Gould, & Wood, 2013). Leaves are long and narrow, with an odd number of leaflets arranged in an alternating pattern. The plant produces flat, sectioned pods that hang from stems and do not split open when ripe (Gucker, 2007), however pods can break between sections. Individual seeds are kidney shaped and range from brown to very dark purple in color (Smreciu et al., 2013). This plant can be very difficult to differentiate from *H. boreale*, however two can be differentiated by their leaves. The veins in the leaves of *H. boreale* are much less visible, and the underside of the leaf is harrier. *H. alpinum* leaves have quite distinct veins and have very little hair on the underside.

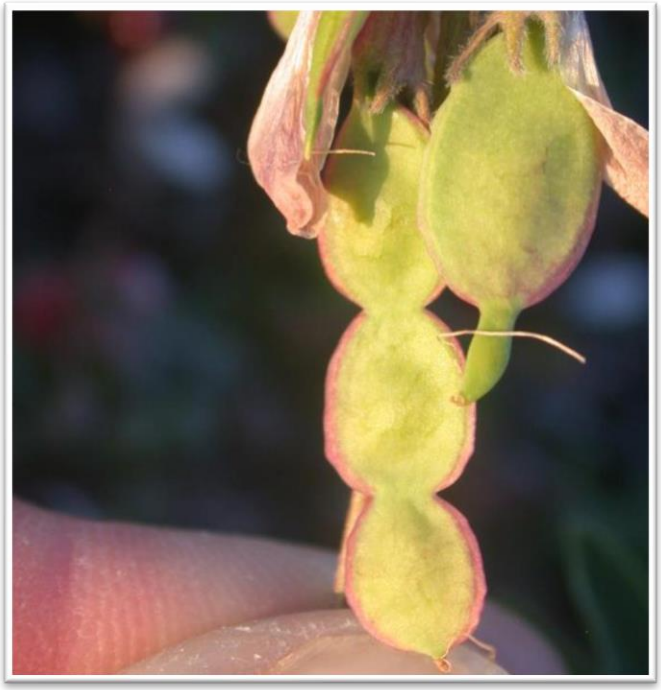
Above left: H. alpinum leaf. Note visibility of veins and minimal hair.
Above right: H. alpinum flower
Below left: H. boreale leaf. Note leaves have less visible veins.
Below right: H boreale flower
Photos: Mary Ellen Harte, bugwood.org, some rights reserved CC BY-NC

Harvesting Considerations:

The seeds are ready to be collected when green pods start to turn brown and fragment (Burton & Burton, 2003; Hunt & Wright, 2007). This can vary depending on location. For example, seeds ripen mid-July to mid-September in the Athabasca Oil Sands region of Alberta (Smreciu et al., 2013), and between July and August in Alaska (Carter, 2014). *Hedysarum alpinium L*. produces hermaphroditic flowers and commonly cross-pollinates, but can self-pollinate between two flowers on the same plant. It can also spread through rhizomes (Gucker, 2007). When choosing individuals to sample in a population, consider that side by side plants may be clones of the same individual. To reduce chances of collecting from an individual resulting from self-pollination or spread of rhizomes, inspect population and set a minimum collection distance between plants. Determine sampling strategy based on size and makeup of population. If population is small, sample as randomly as possible. If the population is large and has little variation, use a grid or transect to sample individuals. If there is variation in environmental features within the population, break the population into groups based on this and sample individuals randomly within each group, choosing a proportional number of individuals based on its size relative to the entire population (Way, 2003). This species is prone to hollow seeds due to failure of pollination. Collect 10-20 seeds, cut open with a sharp blade or crush, and examine the inside with a 10x or 20x hand lens to determine proportion of hollow, damaged or infested seeds. These seeds are small (3mm) (Smreciu et al., 2013), so it is recommended to place seeds on a piece of tape when cutting open for ease of handing. If possible, increase harvest to accommodate for proportion of hollow seeds. Ensure your harvest plans will not remove more than 20% of the available seeds (Way & Gold, 2014).

Seed Collection:

Assess ripeness of pods before collection. Collect seeds by placing entire seed head over a bucket and clip with sharp hand clippers. Alternatively, a bag can be placed over the seed head before clipping (Burton & Burton, 2003)



Above: *Hedysarum alpinum* seed pod. Photo by: Mary Ellen Harte, bugwood.org,

Post-Harvest Handling:

Transfer seeds into cloth or heavy paper bags for transport to allow seeds to breath. Tie cloth bags or staple tops of paper bags to prevent seed loss. Ensure seeds do not overheat in direct sunlight or in a parked car. Label all bags inside and out. Inspect collections from different collectors before combining (Way & Gold, 2014). If seeds must be temporarily stored in the field, they should be kept in cool, dry, well ventilated conditions. When storing temporarily, seeds can be kept in bags or spread on trays to begin drying (Banerjee, Creasey, & Gertzen, 2001). Seeds should be sealed in containers overnight to prevent reabsorption of moisture (Way & Gold, 2014).

Seed Processing:

Hedysarum alpinium L. often produces seeds which ripen unevenly (Carter, 2014; Gucker, 2007). Spread out to dry in a well ventilated area between 5°C and 20°C with low relative humidity (15% RH recommended) (Hay & Probert, 2013) for 6 to 8 weeks (Smreciu, 1998). *Hedysarum alpinium L*. seeds likely have orthodox seed behavior and should be dried down to 15% equilibrium relative humidity (eRH), or 3-7% of their initial fresh weight moisture content before storing. eRH is a measure of the relative humidity of seeds at equilibrium with air in a sealed chamber and can be measured with a hygrometer (Linington & Manger, 2014). Remove pods by hand or with thresher. Pods can be broken open by pounding against corrugated rubber with a flat, circular piece of plywood with a handle (Smreciu, 1998), or by crushing against a screen with a rubber stopper. Seeds can also be placed in a cloth bag and agitated (Terry & Sutcliffe, 2014). Use screens to remove unwanted material from seeds. Recommended screen sizes are a 2.8 mm to 3 mm round hole top screen and a 1.7 mm round hole bottom screen (Pahl & Smreciu, 1999). Seeds should be placed in labelled, air-tight containers for storage. Ensure containers are clearly labelled.

Seed Storage:

Store seeds in freezer at -18 °C ± 3 °C for long-term conservation (FAO, 2014). For active collections being stored for 10 years or less, seeds can be stored between 0°C and 10°C. Longevity of orthodox seeds increases with low moisture content and low temperatures (Rao et al., 2006).

Germination Pre-Treatment:

Hedysarum alpinum seeds germinate best with light scarification (Hunt & Wright, 2007). Rub seed back and forth once with 150 fine grit sandpaper (Moor, Ross, & Hunt, 2004). Be careful during scarification as seeds have varying strength of seed coat and can be lost due to breakage. This treatment speeds germination but seeds used for reclamation in the Athabasca Oil Sands region of Alberta have been found to germinate with no pre-treatment (Smreciu et al., 2013). Cold stratification not required (Baskin & Baskin, 2014; Burton & Burton, 2003). When attempting to germinate seeds, it is important to note that seeds of the same species can have different germination requirements based on their location of growth. Dormancy can also vary based on storage conditions. For example, drying seeds can induce dormancy in some seeds, while others lose their dormancy during storage (Basey, Fant, & Kramer, 2015; Probert, Manger, & Adams, 2003). Seeds that have been dried to low moisture content can suffer rehydration damage. Soaking seeds in a solution of 0.5% sodium hypochlorite (NaOCl) for 10 minutes, then rinsing with water for 1 minute prior to germination will reduce the chance of this. If this treatment is not available, suspend dry seeds over water in a sealed container for 24 hours (Davies, Sacco, & Newton, 2015).

Seed Germination:

For germination testing, label germination containers with collection number, species, germination conditions, start date, and number of seeds. Place germination paper into petri dishes. Wet paper just enough so that it moist but there is no standing water. Place a representative sample of seeds into Petri dish and space in an even grid. Multiple dishes may be required. Place lids on Petri dishes and place in germination chamber (or area with stable temperature) at 22°C

(Baskin & Baskin, 2014; Davies et al., 2015). Seeds should not be in direct sunlight but exposed to daylight. Monitor seeds daily and record proportion of seeds having germinated. Moisten filter paper as necessary. Most seeds should have germinated within 2 weeks; however is advisable to run germination tests for as long as possible to ensure all seeds are being germinated (Pahl & Smreciu, 1999). Continue test until no more seeds germinate or all seeds have germinated. 42 days is the recommended time for germination testing unless slow germination is expected (Davies et al., 2015). Seeds that have not been germinated should be assessed. If seeds look healthy inside, it is possible that gemination conditions or length of germination is not suitable for a portion of the seeds. A tetrazolium test can be used to determine viability of remaining seeds to determine if germination is due to inappropriate conditions or seeds that are unviable (Hay & Probert, 2013). To germinate in soil, seed at a depth of 0.6 to 0.9 cm. Seeds should be spaced at least 1 cm apart in a row. For cultivation, rows paced at 60 to 90 cm is recommended (Smreciu et al., 2013).

References:

Banerjee, S. M., Creasey, K., & Gertzen, D. D. (2001). *Native Woody Plant Seed Collection Guide for British Columbia*. British Columbia Ministry of Forests Tree Improvement Branch.

Basey, A. C., Fant, J. B., & Kramer, A. T. (2015). Producing native plant materials for restoration: 10 rules to collect and maintain genetic diversity. *Native Plants Journal*, *16*(1), 37–53. https://doi.org/10.3368/npj.16.1.37

Baskin, C. C., & Baskin, J. M. (2014). *Seeds: Ecology, Biogeography, and Evolution of Dormancy and Germination* (Second Edi). Elsevier.

Burton, C. M., & Burton, P. J. (2003). *A Manual for Growing and Using Seed from Herbaceous Plants Native to the Northern Interior of British Columbia*. Smithers, BC: Symbiosis Research & Restoration.

Carter, R. (2014). Field Guide: Revegetation Plant Identification. Alaska Plant Materials Centre.

Davies, R., Sacco, A. Di, & Newton, R. (2015). Germination testing: procedures and evaluation. Royal Botanic Gardens, Kew.

FAO. (2014). *Genebank standards for Plant Genetic Resources for Food and Agriculture* (Rev. ed.). Rome.

Gucker, C. L. (2007). Hedysarum alpinium L. *Fire Effects Information System*. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Retrieved from http://www.fs.fed.us/database/feis/

Hay, F., & Probert, R. (2013). Advances in seed conservation of wild plant species: a review of recent research. *Conservation Physiology*, *1*(1), cot030-cot030. https://doi.org/10.1093/conphys/cot030

Hunt, P., & Wright, S. (2007). Paxson Germplasm alpine sweetvetch. Alaska Plant Materials Centre.

International Union for Conservation of Nature and Natural Resources. (2000). Juniperus horizontalis: The IUCN red list of threatened species. IUCN Global Species Programme Red List Unit. Retrieved from http://www.iucnredlist.org/details/42237/0

Linington, S., & Manger, K. (2014). Seed bank design : seed drying rooms. Royal Botanic Gardens, Kew.

Matheus, P., & Omtzigt, T. (2013). Yukon Revegetation Manual, 182. Retrieved from yukonrevegetatiomanual.ca

Moor, N. J., Ross, D. R., & Hunt, P. (2004). Guidelines for planting seeds of Alaska native plants from the native plant nursery, 2004. Alaska Plant Materials Centre. Retrieved from http://plants.alaska.gov/publications/pdf/GuidelinesShortProtocolsfor2004Seed.pdf

Pahl, M. D., & Smreciu, A. (1999). *Growing native plants of western Canada : common grasses & wildflowers*. Edmonton : Alberta Agriculture, Food and Rural Development ; Alberta Research Council.

Probert, R., Manger, K., & Adams, J. (2003). Chapter 20: Non-destructive measurement of Seed Moisture. In R. D. Smith, J. B. Dickie, S. H. Linington, H. W. Pritchard, & R. J. Probert (Eds.), *Seed Conservation: Turning Science into Practice* (pp. 369–387). Royal Botanical Gardens, Kew.

Rao, K., Hanson, J., Dulloo, E., Ghosh, K., Nowell, D., & Larinde, M. (2006). *Manual of seed handling in genebanks. Handbooks for Genebanks No. 8.* https://doi.org/10.1093/aob/mcp082

Smreciu, A. (1998). *Native Legumes for Reclamation in Alberta*.

Smreciu, A., Gould, K., & Wood, S. (2013). Boreal Plant Species for Reclamation of Athabasca Oil Sands Disturbances, (December), 23. https://doi.org/10.7939/R3MC8RK9B

Terry, J., & Sutcliffe, V. (2014). Cleaning seed collections for long-term conservation. Royal Botanic Gardens, Kew.

USDA NRCS. (2018). The PLANTS database: Hedysarum alpinum L. (alpine sweetvetch). Greensboro, NC 27401-4901 USA: National Plant Data Team. Retrieved from https://plants.usda.gov/java/charProfile?symbol=HEAL

Way, M. (2003). *Collecting seed from non-domesticated plants for long-term conservation*. (R. Smith, J. Dickie, S. Linington, H. Pritchard, & R. Probert, Eds.), *Seed conservation: Turning science into practice*. London: The Royal Botanical Gardens, Kew.

Way, M., & Gold, K. (2014). Assessing a population for seed collection. Royal Botanic Gardens, kew.