Scientific Name: *Lupinus arcticus* **Common Names:** Arctic Lupine

Life Form: Forb

Site Preferences: Early successional ecosystems, moist to mesic meadows, gravel bars roadsides, open forest, dry slopes, disturbed areas, loam, sandy loam, or gravelly soil (Burton & Burton, 2003; Kinkenberg, 2017)

Tolerances: Low nutrients, limited drought (Matheus & Omtzigt, 2013)

Distribution: Yukon, Northern Northwest Territories and Nunavut, and British Columbia (iNaturalist.org, 2018; Kinkenberg, 2017)

Left: *Lupinus arcticus*. Alfred Cook, some rights reserved, CC BY, cropped from original, http://www.alaskawildflowers.us/Kingdom/Plantae/Magnoliophyta/Magnoliopsida/

Plant Identification:

This plant is a perennial herb comprised of several stems clumped together in a woody, persistent base. Stems are covered in short, silky hairs. 6 to 10 leaflets radiate from the end of the leaf stalk. In the northern subspecies, leaves originate at the base of the stem, while in the southern subspecies they originate along the stem (Burton & Burton, 2003). Flowers are purple-blue and pea-like, and run along the top potion of the stem. Plant height ranges from approximately 20 to 60 cm tall (Burton & Burton, 2003; Kinkenberg, 2017). Seeds are produced in dehiscent pods which turn black or dark brown when ripe (Banerjee, Creasey, & Gertzen, 2001). *Lupinus arcticus* can be confused with *Lupinus kuschei*, or Yukon Lupine. *Lupinus arcticus* has a fuller, brighter flowering head and less hair on the leaves and around the flower. The veins in the leaves are also more defined. Plants not edible!

Top left: L.arcticus leaf. Damontighe, Some rights reserved, CC BY-NC, cropped from original, https://www.inaturalist.org/observations/7991211
Top right: L. arcticus flower. Alfred Cook, some rights reserved, CC BY, http://www.alaskawildflowers.us/Kingdom/Plantae/Magnoliophyta/Magnoliopsida/Fabaceae/Lupinus_arcticus/Arcticus_20.html
Bottom left: L. kuschei leaf. kisbister, Some rights reserved, CC BY-NC, cropped from original, https://www.inaturalist.org/observations/6543291
Botto right: L. kuschei flower. nfirlotte Some rights reserved, CC BY-NC0, cropped from original, https://www.inaturalist.org/observations/6611597

Harvesting Considerations:

Harvest timing is very important as pods break apart very quickly when they become ripe. Pods ripen unevenly on stalk, but entire stalks can generally be clipped as soon as some pods begin to ripen and allowed to continue ripening on stalk. Harvest times fall between the middle of July and end of August in northern British Columbia (Burton & Burton, 2003). This may vary in the Yukon and should be determined by

forecasting earlier in the season (Banerjee et al., 2001). Determine sampling strategy based on size and makeup of population. If population is small, sample as randomly as possible. If 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)

Above: *Lupinus arcticus* pods, Alfred Cook, some rights reserved, CC BY, http://www.alaskawildflowers.us/Kingdom/Plantae/Magnoliophyta/Magnoliopsida/Fabaceae/Lupinus_arcticus/Arcticus_10.html

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).

Post-Harvest Handling:

Remove large debris from bags. Transfer seeds into cloth or heavy paper bags for transport to allow seeds to breath. Do not fill bags more than half full (Banerjee et al., 2001). 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, and inspect collections from different collectors before combining (Way & Gold, 2014). Seeds should be processed as soon as possible but can be temporarily stored in a well-ventilated area. When storing temporarily, seeds can be kept in bags or spread on trays to begin drying (Banerjee et al., 2001). Seeds should be sealed in containers overnight to prevent reabsorption of moisture (Way & Gold, 2014).

Seed Processing:

If some pods on stalk are not yet ripe, keep plants in similar conditions to those they would normally experience to allow continuation of ripening for 1 to 2 weeks (Probert, 2003). Caution pods explode when ripe. Cover pods when ripening and wear safety glasses when handling. When all pods are ripe, spread out to dry in a well ventilated area between 5°C and 20°C with low relative humidity (15% RH is recommended) (Hay & Probert, 2013). *Lupinus arcticus* seeds 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; Royal Botanic Gardens Kew, 2014). Once dry, remove large debris by hand. Pods and bulky debris can be screened away from seeds with a 4.9 mm screen. Move to a 4 mm screen to remove remaining debris. Screen though a 1.2 mm screen to remove dust (Burton & Burton, 2003). Seeds should be placed in labelled, air-tight containers for storage.

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 (Rao et al., 2006). Longevity of orthodox seeds increases with low moisture content and low temperatures (Rao et al., 2006).

Germination Pre-treatment:

Lupinus arcticus has a water-impermeable seed coat and requires scarification by scraping/chipping seed coat with a scalpel or forceps (Baskin & Baskin, 2014; Royal Botanic Gardens Kew, 2014; Smreciu, 1998). 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). If seeds have been dried prior to germination, 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 rehydration damage. If this treatment is not available, suspend dry seeds over water in a sealed container for 24 hours (Davies, Sacco, & Newton, 2015).

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 paper is 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) (Davies et al., 2015) at 20 °C(Royal Botanic Gardens Kew, 2014). Seeds should not be in direct sunlight but exposed to daylight for 8 hours and darkness for 16 hours per day. Monitor seeds daily and record proportion of seeds having germinated. Moisten filter paper as necessary. Seeds should germinate to 50% by about 2 weeks; however it is advisable to run germination tests for as long as possible to ensure all seeds are being germinated (Banerjee et al., 2001). 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). For germination in soil, plant at 1 cm in loam, sandy loam, or gravely soil (Banerjee et al., 2001).

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