

# How to grow, propagate and kill some of the native plants in the Kluane region, southwestern Yukon

## Abstract

During over 15 years of plant ecological research in the Kluane region of southwestern Yukon, our studies required us to grow, propagate, and sometimes kill, native plants for experimental purposes. Here we present observations on germinating, growing, propagating and transplanting some of the common native plant species in the Kluane region.

**Key words:** boreal forest, germination, propagation, transplants, understorey.

## The plants and the study area

In 1990 the decision was made to concentrate a number of plant ecological studies in one relatively small area of boreal forest understorey vegetation in southwestern Yukon. Since then, seven M.Sc. and three Ph.D. programs have been completed. The area, described by Turkington et al. (1998, 2001) and Krebs et al. (2001), is near Kluane Lake in the Shakwak Trench, a wide glacial valley in the rain shadow of the St. Elias Mountains (Figure 1). The area receives a mean annual precipitation of ca. 230 mm, mostly falling as rain during the summer months, but including an average annual snowfall of about 100 cm. The region is a closed-to-open spruce forest community and the dominant tree is *Picea glauca* (Moench) Voss (white spruce), interspersed with stands of *Populus tremuloides* Michx. (trembling aspen) and *Populus balsamifera* L. subsp. *balsamifera* (balsam poplar). The understorey

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Image: Roy Turkington

Figure 1. The study area, near Kluane Lake in the Shakwak Trench.

is dominated by *Salix glauca* L., *S. myrtillofolia* Anderss. and *S. reticulata* L. subsp. *reticulata* (shrub willows) (Figure 2), *Betula glandulosa* Michx. (dwarf birch), *Shepherdia canadensis* (L.) Nutt. (soapberry), and a well developed ground layer, chiefly *Lupinus arcticus* Wats. (arctic lupine)(Figure 3), *Festuca altaica* Trin. (northern rough fescue), *Linnaea borealis* L. subsp. *americana* (Forbes) Hultén var. *americana* (Forbes) Rehd. (twinflower), *Arctostaphylos uva-ursi* (L.) Spreng. (bearberry), *Mertensia paniculata* (Ait.) G. Don var. *paniculata* (bluebell)(Figure 4), *Achillea millefolium* L. subsp. *borealis* (Bong.) Breitung (yarrow), *Epilobium angustifolium* L. (fireweed) (Figure 5), *Senecio lugens* Richards. (groundsel), *Anemone parviflora* Michx. (anemone) and *Solidago multiradiata* Ait. (goldenrod). Other less common species include *Agrostis scabra* Willd. var. *scabra* (rough hair grass), *Anemone multifida* Poir. (cut-leaf anemone), *Artemisia norvegica* Fries subsp. *saxatilis* (Bess. Ex Hook.) Hall & Clem. (wormwood or sage), *Carex* sp. (sedge), *Danthonia intermedia* Vasey (timber oat grass), *Delphinium glaucum* S. Wats (tall larkspur), *Draba* spp., *Elymus* sp. (likely *trachycaulus* Link) Gould ex Shinners (wild

rye), *Epilobium latifolium* L. (broad-leaved willowherb), *Hedysarum boreale* Nutt. subsp. *mackenzii* Richards (liquorice-root), *Hordeum jubatum* L. (barley), *Linum lewisii* Pursh (wild blue flax), *Poa* sp. (likely *arctica* R. Br.) (arctic blue grass), *Polemonium acutiflorum* Willd. (Jacob's-ladder), and *Trisetum spicatum* (L.) Richt. Nomenclature follows Cody (1996). Hereafter, we will use generic names only.

Some of these studies required an ability to grow, propagate, and sometimes kill, native plants for experimental purposes, but few resources were available except information in the book, *Growing Alaskan Natives* (Baldwin, 1997) and in *A Manual for Growing and Using Seed from Herbaceous Plants Native to the Northern Interior of British Columbia* (Burton and Burton 2003). Traditional gardening books can help with general plant propagation principles, and for specifics on germinating seeds the reader can consult specialized texts (Baskin and Baskin, 1998). Here we present some observations, primarily from the work of one of us (MAT), arising from work to grow and propagate some of the more common native plant species in the Kluane region.

## Growing from seed

The germination rates of seeds collected from the Kluane region were quite variable both in terms of interspecies comparisons and interannual variability within a single species (Table 1). The interannual variability was likely due to variation in seed quality due to climatic conditions.

If we waited for natural seed dispersal, and therefore seed maturity, many of the species (*Achillea*, *Senecio*, and *Solidago*) needed no special treatment to achieve a relatively high percentage germination success. Other species had high germination in some years and low in others (for example *Lupinus*, *Epilobium* and *Festuca*).

The germination of *Lupinus* was quite variable from year to year. Typically there was a low germination rate, but an additional problem was to collect enough seed before insect larvae ate what was often a very large amount of seed. The predators were prob-



Image: Roy Turkington

Figure 2. *Salix reticulata* L. subsp. *reticulata* (shrub willows).



Image: Roy Turkington

Figure 3. *Lupinus arcticus* Wats. (arctic lupine).



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Figure 4. *Mertensia paniculata* (Ait.) G. Don var. *paniculata* (bluebell).



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Figure 5. *Epilobium angustifolium* L. (fireweed).

ably seed beetles (family Bruchidae) that are known to eat peas and other legumes. As is common with hard-coated legume seed, treatment in warm water for 24 hours before planting did not increase the germination rate (chipping the seed coat manually or sandpaper scarification may also be beneficial), but did speed up radical emergence of the radical. As soon as the radical emerged, the young seedlings were removed from the Petri plate before the onset of damping-off, which is the sudden death of the seedling due to the attack of fungi. Spraying the seedling with a product such as Plant Prod® NoDamp (2.5% oxine benzoate) (Sure-Gro Inc., Brantford, ON) helps control damping-off diseases.

*Mertensia* also benefited from additional treatment. Like *Lupinus*, *Mertensia* has a very tough seed coat that softens when soaked in warm water. It helped to remove the seed coat entirely with a pair of forceps and a scalpel, although this was very time consuming and still only increased germination from 4.4% (SE = 5.1) to 13.3% (SE = 8.8).

We tried to germinate seeds of other species (Table 2) found near the research site. Many of these species had quite high germination rates; however, seeds were collected only in 1999, so these results may not be representative given the high between-year variation seen in other species (Table 1).

**Table 1.** The mean percent germination ( $\pm 1$  SE) of the most common understorey species at the research site in Kluane. These data are for seeds collected from 1999 to 2002. Seeds were sown onto wet sand in Petri plates with 50 seeds per Petri plate ( $n = 3$  plates).

Species	Mean % germination
<i>Achillea millefolium</i>	63.2 $\pm$ 16.9
<i>Anemone parviflora</i>	21.6 $\pm$ 8.6
<i>Epilobium angustifolium</i>	23.6 $\pm$ 11.3
<i>Festuca altaica</i>	40.2 $\pm$ 17.3
<i>Lupinus arcticus</i>	18.7 $\pm$ 4.3
<i>Mertensia paniculata</i>	7.2 $\pm$ 2.8
<i>Senecio lugens</i>	69.8 $\pm$ 12.7
<i>Solidago multiradiata</i>	65.1 $\pm$ 5.0

**Table 2.** The mean percent germination ( $\pm 1$  SE) of some of the less common species collected near the research site in 1999. Seeds were sown onto wet sand in Petri plates with 50 seeds per Petri plate ( $n = 3$  plates).

Species	Mean % germination
<i>Agrostis scabra</i>	54.0 $\pm$ 4.2
<i>Anenome multifida</i>	63.3 $\pm$ 3.5
<i>Elymus</i> sp. (likely <i>trachycaulus</i> )	78.0 $\pm$ 7.2
<i>Epilobium latifolium</i>	36.0 $\pm$ 6.1
<i>Hedysarum boreale</i>	20.0 $\pm$ 1.9
<i>Hordeum jubatum</i>	82.6 $\pm$ 2.7
<i>Linum lewisii</i>	65.0 $\pm$ 14.4
<i>Poa</i> sp. (likely <i>arctica</i> )	30.0 $\pm$ 4.2
<i>Polemonium acutiflorum</i>	28.9 $\pm$ 11.3
<i>Trisetum spicatum</i>	83.3 $\pm$ 2.7

### Some general seed sowing procedures:

1. Wait for seeds to reach maturity before collection. This will ensure higher germination rate, but may not always be possible. For instance, *Achillea* seeds do not mature until late September and most researchers had left the area by this time. Therefore, we collected seeds the following spring from intact plants surviving from the previous year.

2. Most seeds should be dried before they are placed in storage. However, some species will not germinate if they are stored. For example, *Salix* seeds remain viable for only very short periods of time.

3. Store the seeds under “natural conditions.” This might normally be a frozen wet substrate, which is technically ‘dry’, but we had reasonable success keeping the air-dried seeds in plastic bags in a freezer from November until May. While storage in plastic bags may be convenient, storage in paper bags (usually at 3°C) may be better.

4. Day length may be important for germination success (Densmore, 1997). The germinating success in Vancouver in

May was lower than it was at Kluane in June, when and where daylength is significantly greater. We always germinated seeds in Yukon in early June. Normally, seedlings are seen in the field in late June to early July, so this seemed like a reasonable time to begin sowing. We started the seeds in closed Petri plates on moist coarse sand and transplanted them to peat plugs or seedling trays once both the shoot and root emerged. On occasion we also germinated seeds directly in peat plugs.

5. Sufficient water is very important to germinate many species (Oberbauer and Miller, 1982). Best results were attained when the germinating substrate was constantly moist. However, once a seedling established there may be problems with too much moisture and damping-off fungi can be a problem especially with *Lupinus* and *Mertensia*.

## Growing from cuttings

Woody species such as *Linnaea* and *Arctostaphylos* are reasonably easy to start from cuttings and after 2 weeks rooting had occurred in approximately 50% of the *Linnaea* and nearly 90% of the *Arctostaphylos*. We usually collected fresh growing tips approximately 5 cm long and removed the leaves from half of the length closest to the cut. The cutting was then dipped in a commercially available rooting compound (Wilson Roots® Liquid Root Stimulator, Sure-Gro Inc., Brantford, ON), placed in moist sand and kept in a moist environment. This is a gel formulation containing both root-promoting auxin (0.4% IBA) and a fungicide (0.01% etridiazole). Before dipping the cutting in the rooting compound, we sometimes used a clean, sharp razor blade to slice the bark of the cutting 4-6 times in the region where the leaves were removed; this increased the rooting response.

Some of the common non-woody understory species were also propagated from freshly collected cuttings (Table 3). Though rooting success ranged from zero to as high as 22.6%, some individual cuttings remained green, but did not develop new rooting tissue (ranging from 12% to 96%).

**Table 3.** The mean percentage rooting ( $\pm$  1SE) of fresh cuttings after 30 days. All cuttings were from new leaves. The cut end of the leaf was dipped into a commercially available rooting hormone (Wilson Roots® Liquid Root Stimulator) and cuttings were placed in planting trays filled with moist sand. The tray was covered with plastic and the sand kept moist. This experiment ran from July 8 to August 7, 2002.

Species	Mean % survival
<i>Achillea millefolium</i>	22.0 $\pm$ 2.0
<i>Anemone parviflora</i>	0.0
<i>Epilobium angustifolium</i>	17.3 $\pm$ 3.6
<i>Lupinus arcticus</i>	0.0
<i>Mertensia paniculata</i>	3.0 $\pm$ 3.0
<i>Senecio lugens</i>	15.2 $\pm$ 1.5
<i>Solidago multiradiata</i>	22.6 $\pm$ 0.5

## Transplanting

Transplanting whole plants was successful for all of the species used in our experiments. The problem with transplanting, and the key for success, is that a fairly large clump of soil must be moved with the transplant to avoid disturbing the plant's roots. The most problematic species was *Lupinus*. A clump of soil surrounding a lupine transplant with a diameter at least 2 times the height of the plant was necessary to ensure any chance of the transplant surviving. The clump also had to be as deep as it was wide. Many times during the transplanting of lupines, we noticed a large and broken tap root coming straight out from the bottom of our transplant sod. Within hours the entire transplant began to wilt. It is also critical to water transplants liberally during the first few weeks after transplanting. *Arctostaphylos*, *Festuca* and *Linnaea* were successfully transplanted as large sods. Species such as *Achillea*, *Epilobium*, *Festuca*, *Mertensia*, *Senecio* and *Solidago* could be transplanted as small plugs obtained with 4 cm soil cores, as long as they had sufficient roots attached, but the probability of survival increased with larger soil cores. Hicks and Turkington (2000) had very high success (>80%) transplanting *Festuca*, *Achil-*

*lea* and *Mertensia* as small soil cores (4.5 cm in diameter and 7 cm deep), but all were covered with plastic “tents” and watered twice daily during the first week to reduce evapotranspiration and keep humidity high.

## Killing with glyphosate

We used the herbicide glyphosate (RoundUp™; Monsanto, Winnipeg, Manitoba) to remove plants. This is a non-selective and systemic herbicide that is quickly broken down in the soil. It was effective at killing most plants although some were very

**Table 4.** The number of applications of a 1:20 (glyphosate to water) concentration necessary to see significant die back in the named plant species. Applications were approximately one week apart and were applied with a pump sprayer. This concentration and application rate was higher than usual to ensure effectiveness. The leaves were soaked with the solution until dripping wet. The higher the number beside the species, the higher the apparent resistance to the glyphosate.

Species	No. of applications
<i>Achillea millefolium</i>	2-3
<i>Anemone parviflora</i>	2-4
<i>Arctostaphylos uva-ursi</i>	4
<i>Artemisia norvegica</i>	>5
<i>Betula</i> sp.	1-2
<i>Carex</i> sp.	3-5
<i>Danthonia intermedia</i>	2-3
<i>Delphinium glaucum</i>	3
<i>Draba</i> sp.	2-3
<i>Epilobium angustifolium</i>	2-3
<i>Festuca altaica</i>	2
<i>Linnaea borealis</i>	2-3
<i>Lupinus arcticus</i>	1
<i>Picea glauca</i>	3-5
<i>Salix myrtillifolia</i>	5
<i>Salix reticulata</i>	3-5
<i>Senecio lugens</i>	3-4
<i>Solidago multiradiata</i>	3-4

resistant particularly woody shrubs (Table 4); regrowth was not a major issue. Glyphosate can be applied with a pump sprayer for a general kill, or can be applied with a paint brush when selectivity is required, although clonal plants can be difficult (see below). For example, it is almost impossible to selectively kill a single *Achillea* with glyphosate because many other individuals of *Achillea* within about 1m will also die because they are connected belowground. This applies to most of the species in the understory because they are almost all clonal. Most of the new growth and horizontal spread of the understory vegetation is probably due to clonal growth; we see relatively few seedlings in the understory. When using glyphosate to kill unwanted vegetation, great care must be exercised to prevent overspray on desirable plants. Glyphosate enters the plant via the stomata, travels throughout the plant and kills all shoots that are connected underground. The entire genet (group of connected ramets) will die if glyphosate is applied to one ramet. The surfactant in many glyphosate preparations in polyethoxylated tallow amine (POEA) has been implicated as being toxic to amphibians (Govindarajulu 2008). Summary information on glyphosate and its toxicity and health impact are provided by Giesy et al. (2000) and the US EPA and Oregon State University at [npic.orst.edu/factsheets/glyphotech.pdf](http://npic.orst.edu/factsheets/glyphotech.pdf).

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