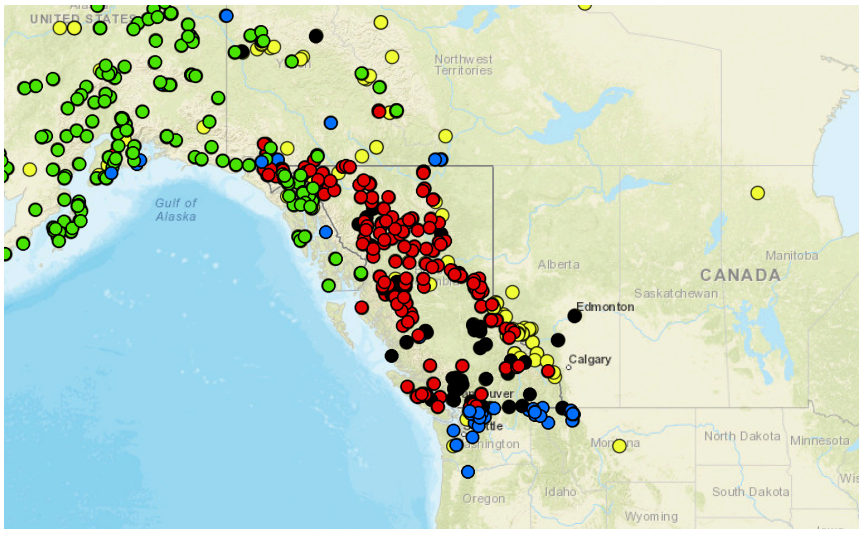
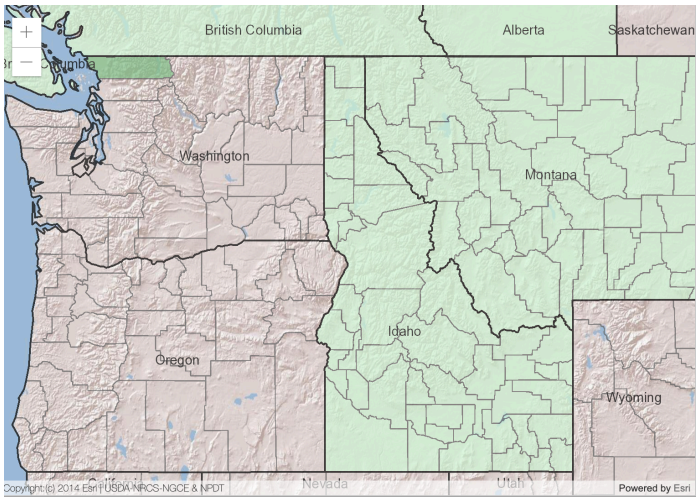
Plant Propagation Protocol for *Lycopodium alpinum*
ESRM 412 – Native Plant Production
URL: https://courses.washington.edu/esrm412/protocols/*2021/LYLAL3.pdf*



Klinkenberg, B. (2021, April 16). *Flora BC Distribution Map*. E-Flora BC. https://linnet.geog.ubc.ca/eflora_NewFullMap/index.html?sciname=Diphasiastrum+alpinum&BCStatus=yellow&synonyms=%27Lycopodium+alpinum%27&commonname=alpine+club-moss&PhotoID=25440&mapservice=Vascular



United States Department of Agriculture. (2014). *Lycopodium alpinum L.* Plants 3. https://plants.sc.egov.usda.gov/home/plantProfile?symbol=LYAL3

TAXONOMY	
Plant Family	
Scientific Name	Lycopodiaceae
Common Name	Clubmoss Family
Species Scientific Name	
Scientific Name	*Lycopodium alpine*
Varieties	*Lycopodium alpinum* L. var. *decipiens* Syme ex Druce Symbol: LYLAD
Sub-species	*Lycopodium alpinum* L. ssp. *issleri* (Rouy) Chassagne Symbol: LYLAI

Cultivar	N/A
Common Synonym(s)	*Diphasium alpinum* *Lepidotis alpina* *Stachygynandrum alpinum*
Common Name(s)	Alpine clubmoss Alpine ground-cedar
Species Code (as per USDA Plants database)	LYAL3
GENERAL INFORMATION	
Geographical range	Maps included above
Ecological distribution	Open, higher-elevation forests, rocky slopes, heath, and tundra. Dry and moist sites (MacKinnon 2004).
Climate and elevation range	Elevation range in meters: 209-3000; average 1753 (Klinkenberg 2020). Alpine tundra and boreal (Meidinger et al. 2008)
Local habitat and abundance	Associated with Mertens cassiope (*Cassiope mertensiana*), mountain luetkea (*Luetkea pectinata*), pink mountain heath (*Phyllodoce empetriformis*), and other oxylophytic species. Shade intolerant (Williams 1990).
Plant strategy type / successional stage	Bears mature cones in late July and August. Off-site colonizer with wind-carried spores (Williams 1990). Closely related species are facultative seral species (Matthews 1993).
Plant characteristics	Evergreen perennial (Douglas 1998). Horizontal stems are shallowly buried or slightly emerging, and can be up to 50 cm long. Leaves are a blueish-green color (MacKinnon 2004). Shoots are 6-14 cm tall. Branchelet leaves are have flared and rolled blades, and are compact at the base (Wagner 1993). Reproduces by wind-carried spores (Wilson 1970).
PROPAGATION DETAILS	
Propagation protocol for cultivation of *Lycopodium sp.* by vegetative cuttings (Benca 2014)	

Ecotype	Seattle, WA
Propagation Goal	Clonal mats
Propagation Method	Vegetative
Product Type	Propagules (cuttings)
Stock Type	Standard 1020 greenhouse trays placed into heavy-weight web flats
Time to Grow	6-8 months
Target Specifications	Noticeable shoot elongation and/or branching, generation of new roots, and resistance to uprooting
Propagule Collection Instructions	Use a trowel to excavate subterranean runners, then clip from the parent plant. The cutting should include one or more aerial branch, newly-produced roots, and branching of the subterranean runner system. The cutting should be between 20-30 cm in length.
Propagule Processing/Propagule Characteristics	N/A
Pre-Planting Propagule Treatments	Rinse cuttings with cool water to clean. Wrap a moist paper towel loosely in a spiral around each cutting. Place wrapped cuttings in a plastic bag on shelves under T-5 grow lights in a laboratory for two to three weeks at 20° to 22° C.
Growing Area Preparation / Annual Practices for Perennial Crops	Temperatures maintained in greenhouse from 22°C to 24°C. Planted in a variety of shallow Glad® and Ziploc® clear plastic food storage containers half-filled (2 to 3 cm deep) with peat-ammended medium, 3:1 pumice/sandy or clayey loam. Apply fertilizer every other day, alternating weekly between 17:5:17 N-P-K and 20:10:20 N-P-K solution.
Establishment Phase Details	Plant cuttings so that only aerial branches remain aboveground. Clear, vinyl propagation domes placed over greenhouse beds. Place in full sunlight. Water on alternating days.
Length of Establishment Phase	6-8 months

Active Growth Phase	Remove propagation domes. Water daily, alternating between tap water and fertilizer solution. Reorient runners to not grow beyond the confinements of the tray.
Length of Active Growth Phase	2-3 years
Hardening Phase	Remove sections of the colony that begin showing signs of aging or senescence.
Length of Hardening Phase	2-3 months
Harvesting, Storage and Shipping	Keep cuttings wrapped in a moist paper towel and in a sealable plastic bag
Length of Storage	N/A
Guidelines for Outplanting / Performance on Typical Sites	Only outplant once noticeable shoot growth has occurred as well as observing an established root system.
Other Comments	Establishment process may benefit from addition of mycorrhizal or Cyanobacterial associates (Byfield and Stewart, 2007).
INFORMATION SOURCES	

References	Benca, J. P. (2014). Cultivation Techniques for Terrestrial Clubmosses (Lycopodiaceae): Conservation, Research, and Horticultural Opportunities for an Early-Diverging Plant Lineage. *American Fern Journal*, *104*(2), 25–48. https://doi.org/10.1640/0002-8444-104.2.25 Byfield, A., & Stewart, N. (2007, February 14). *Marsh Clubmoss*. Plantlife International. https://www.plantlife.org.uk/uk/discover-wild-plants-nature/plant-fungi-species/marsh-clubmoss. Douglas, G. W. (1998). *Illustrated flora of British Columbia*. British Columbia, Ministry of Environment, Lands and Parks. Klinkenberg, B. (2020). *Diphasiastrum alpinum (L.) Holub*. Flora BC: Electronic Atlas of the Flora of British Columbia. http://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Lycopodium+alpinum. Klinkenberg, B. (2021, April 16). *Flora BC Distribution Map*. E-Flora BC. https://linnet.geog.ubc.ca/eflora_NewFullMap/index.html?sciname=Diphasiastrum+alpinum&BCStatus=yellow&synonyms=%27Lycopodium+alpinum%27&commonname=alpine+club-moss&PhotoID=25440&mapservice=Vascular. MacKinnon, A., Pojar, J., & Alaback, P. B. (2004). *Plants of coastal British Columbia including Washington, Oregon & Alaska*. Lone Pine Pub. Matthews, R. F. (1993). *Lycopodium annotinum*. Fire Effects Information System (FEIS). https://www.fs.fed.us/database/feis/plants/fern/lycann/all.html. Meidinger, D., Lee, T., Douglas, G. W., Britton, G., MacKenzie, W., & Qian, H. (2009). *BC Species Code Definitions*. British Columbia plant species codes and selected attributes. Version 6 Database. https://ibis.geog.ubc.ca/biodiversity/eflora/species_list_metadata.html#Climate.

References	United States Department of Agriculture. (2014). *Lycopodium alpinum L.* Plants 3. https://plants.sc.egov.usda.gov/home/plantProfile?symbol=LYAL3. Wagner, W. H., & Beitel, J. M. (1993). Diphasiastrum alpinum in Flora of North America @ efloras.org. http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=200002738. Williams, T. Y. (1990). *Species: Alpine Clubmoss: Lycopodium alpinum > Introductory*. Fire Effects Information System. http://reference.allrefer.com/wildlife-plants-animals/plants/fern/lycalp/introductory.html. Wilson, L. R. (1970, January 1). *[Cambridge, Mass., etc.]New England Botanical Club [etc.]*. Rhodora. https://www.biodiversitylibrary.org/part/122434.

Other Sources Consulted	Conard, H. S., & Redfearn, P. L. (1956). *How to know the mosses and liverworts: pictured-keys for determining many of the North American mosses and liverworts, with suggestions and aids for their study*. Brown (Wm. C.). Hildebrand, T. J. (2007). *Sectional revision, speciation, and population biology in Lycopodium (Lycopodiaceae)* (thesis). ProQuest Information and Learning Company, Ann Arbor. Horn, K., Franke, T., Unterseher, M., Schnittler, M., & Beenken, L. (2013, November 1). *Morphological and molecular analyses of fungal endophytes of achlorophyllous gametophytes of Diphasiastrum alpinum (Lycopodiaceae)*. Botanical Society of America. https://bsapubs.onlinelibrary.wiley.com/doi/full/10.3732/ajb.1300011. Kruckeberg, A. R. (1996). *Gardening with native plants of the Pacific Northwest*. Univ. of Washington. Schmid, E., & Oberwinkler, F. (2006, April 28). *Mycorrhiza-like interaction between the achlorophyllous gametophyte of Lycopodium clavatum L. and its fungal endophyte studied by light and electron microscopy*. New Phytologist Foundation. https://nph.onlinelibrary.wiley.com/doi/abs/10.1111/j.1469-8137.1993.tb03798.x. Viereck, L. A. (1966, July 1). *Plant Succession and Soil Development on Gravel Outwash of the Muldrow Glacier, Alaska*. The Ecological Society of America. https://esajournals.onlinelibrary.wiley.com/doi/abs/10.2307/1942416. World Flora Online. (2021). Lycopodium alpinum L. http://www.worldfloraonline.org/taxon/wfo-0001108980.

Other Sources Consulted	WTU Herbarium, B. M. (2007, August 4). *CPNWH Search Results - Diphasiastrum alpinum*. CPNWH Search Results. https://www.pnwherbaria.org/data/results.php?DisplayAs=WebPage&ExcludeCultivated=Y&GroupBy=ungrouped&SortBy=ScientificName&SearchAllHerbaria=Y&QueryCount=1&Genus1=Diphasiastrum&Species1=alpinum&Zoom=4&Lat=55&Lng=-135&PolygonCount=0
Protocol Author	Isabelle Biss
Date Protocol Created or Updated	05/26/21