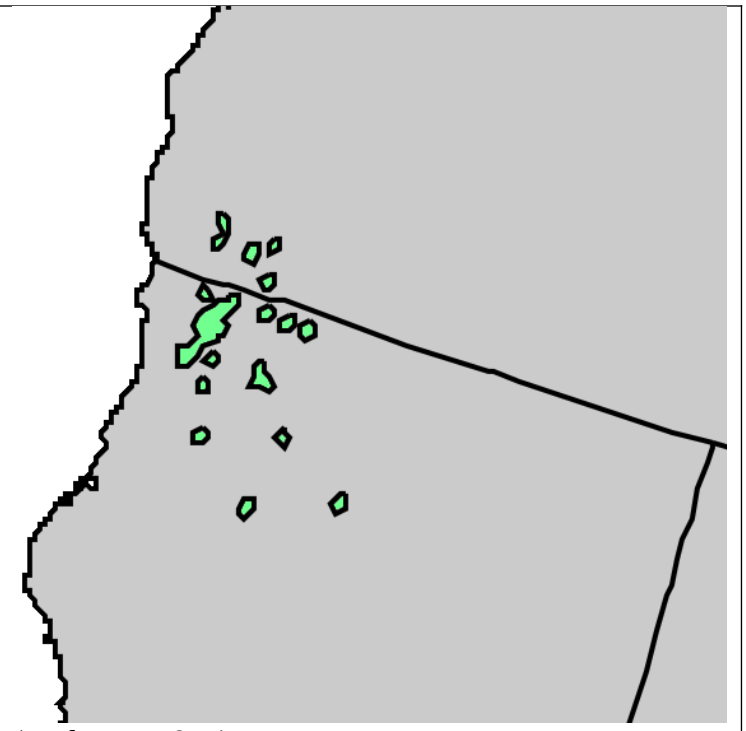
Plant Propagation Protocol for Brewer spruce (*Picea breweriana)*
ESRM 412 – Native Plant Production
Protocol URL: https://courses.washington.edu/esrm412/protocols/PIBR.pdf

(Image from Hilton 2013)

TAXONOMY	
Plant Family	
Scientific Name	Pinaceae
Common Name	Pine
Species Scientific Name	
Scientific Name	*Picea breweriana* - S. Watson, 1885
Varieties	No entry
Sub-species	No entry
Cultivar	No entry
Common Synonym(s)	No entry
Common Name(s)	Brewer Spruce, Brewer's Spruce, Weeping Spruce
Species Code (as per USDA Plants database)	PIBR
GENERAL INFORMATION	
Geographical range	Endemic to northern California and southern Oregon at mid- to high-elevations in the Klamath Mountains (Kruckeberg 1996, Earle 2019). 

	 (Little, Jr., 1971)
Ecological distribution	Uncommon to rare in mixed conifer forests in the Klamath mountains (Kruckeberg 1996, USDA 2019, Earle 2019, Ledig, et al. 2005).
Climate and elevation range	Moist, north-facing slopes and canyons from 4,000 to 8,000 feet (Kruckeberg 1996, Earle 2019, Ledig, et al. 2005).
Local habitat and abundance	Most commonly associated with Douglas fir and Shasta red fir, as well as Port Orford cedar, and western white pine (Ledig, et al. 2005 and Kruckeberg 1996). Tolerates nutrient-poor, basic, and rocky conditions typical of serpentine soils found in the region (Earle 2019).
Plant strategy type / successional stage	Subdominant with other conifers that typically grow larger and live longer (Ledig, et al. 2005). Low drought and fire tolerance (USDA 2019).
Plant characteristics	Evergreen coniferous tree growing to 40 meters (maximum 54 m) and up to 900 years of age (Ledig, et al. 2005). Very slow growing compared to most other conifers (Kruckeberg 1996). Pendulous branches with sharp needles 1.5-3 cm in length arranged radially on the stem (Taylor 1993, Earle 2019). Cylindrical cones 6.5-12 cm in length (Taylor 1993).
PROPAGATION DETAILS	
Ecotype	Klamath region
Propagation Goal	Plants

Propagation Method	Seed
Product Type	Container and Bareroot (USDA 2019).
Stock Type	Individual pots or plugs.
Time to Grow	2 to 3 years is recommended for most *Picea sp.* from germination to outplanting (McVicar 2008, Schopmeyer 1974). *Picea breweriana* grows very slowly, so more time may be needed before outplanting (Kruckeberg 1996, USDA 2019).
Target Specifications	Woody stems, vigourous root structure.
Propagule Collection Instructions	Collect seeds from September to October from mature cones (McVicar 2008, Schopmeyer 1974). Ripe seeds of *Picea breweriana* are brown to black in color (Schopmeyer 1974). Seeds of most *Picea sp.* can be separated from chaff and wings by soaking seeds in a bowl, allowing to dry, and sorting with a screen. An aspirator or flotation in alcohol can then be used to separate empty seeds (Morgenstern 1968 (via Schopmeyer 1974).
Propagule Processing/Propagule Characteristics	Cleaned seed density of *Picea breweriana*: 51,000 and 74,000 seeds per pound (112,500-163,000 seeds/kg) (Schopmeyer 1974, USDA 2019) Seeds viable several years after storage (Schopmeyer 1974).
Pre-Planting Propagule Treatments	*Picea* seeds may be cleaned and stored with pellets of fungicide, insecticide, and aluminum flakes to discourage animals (Schopmeyer 1974). Commonly stored over winter in damp cool conditions, such as in a refrigerator (McVicar 2008).
Growing Area Preparation / Annual Practices for Perennial Crops	Sand and/or Potting soil with ¼ to 3/8 inch of peat moss as mulch over the top of the seed (Schopmeyer 1974 and McVicar 2008).
Establishment Phase Details	Stratification in a moist medium from 34˚ -41˚F for a period of 30 to 90 days (Schopmeyer 1974, USDA 1948).
Length of Establishment Phase	Germination of most *Picea* typically takes place within 1 to 4 months or longer (McVicar 2008). Spring sowing is recommended (Schopmeyer 1974). Detailed germination data is missing, but previous small-scale trials found an average germination rate of 54% (USDA 1948).
Active Growth Phase	Partial shade may be used during first year, though not necessary when adequate overhead irrigation is used

	(Schopmeyer 1974). Straw mulch can be spread to an equal height of the seedling after its first growing season to protect from snow or drying out during winter (Schopmeyer 1974). Straw should be removed before second growing season.
Length of Active Growth Phase	Spring to Fall.
Hardening Phase	Most *Picea* sp. require a period of freezing temperatures to induce the next season's growth (Schopmeyer 1974).
Length of Hardening Phase	4 to 6 weeks after onset of winter dormancy (Schopmeyer 1974).
Harvesting, Storage and Shipping	Most *Picea sp.* can be grown multiple years in a single container (forestry cones, tree pots), though upsizing to a larger container is recommended as needed (Schopmeyer 1974).
Length of Storage	2 to 3 years (Schopmeyer 1974)
Guidelines for Outplanting / Performance on Typical Sites	One specimen grown in Britain took nearly 60 years to grow to 36 feet (Kruckeberg 1996). Time until cone-bearing age is 15+ years (Kruckeberg 1996).
Other Comments	Due to its rarity in the wild, seeds should sourced very carefully and ideally from trees already in cultivation (Kruckeberg 1996).
INFORMATION SOURCES	
References	Earle, Christopher J. (2019). Picea breweriana. The Gymnosperm Database. https://www.conifers.org/pi/Picea_breweriana.php Accessed April 29, 2019. Ledig, F.T., P.D. Hodgskiss, and D.R. Johnson. (2005) Genic diversity, genetic structure, and mating system of Brewer spruce (Pinaceae), a relict of the Arcto-Tertiary forest. *American Journal of Botany* 92:1975-1986. Hilton, Tom (2013) Photograph. Picea breweriana Canyon Creek Lakes 2. Little Jr., Elbert L. (1971) *Atlas of United States trees, Vol. 1, conifers and important hardwoods*: U.S. Department of Agriculture Miscellaneous Publication 1146, 9 p., 200 maps. Kruckeberg, A. R. (1996) *Gardening with native plants of the Pacific Northwes*t. Seattle: University of Washington Press.

	McVicar, Jekka. (2008). *Seeds: the ultimate guide to growing successfully from seed.* London: Kyle Cathie Limited. Morgenstern, E. K. Correspondence with Schopmeyer, C.S. March 1968, describing work of B. S. P. Wang. Petawawa Forest Exp. Stn., Chalk River, Ontario. Schopmeyer, C.S. (1974) *Seeds of woody plants in the United States*. Washington DC: Forest Service, U.S. Dept. of Agriculture. Taylor, Ronald J. 1993. Sections on Picea and Tsuga. Flora of North America Editorial Committee (eds.): *Flora of North America North of Mexico, Vol. 2.* Oxford University Press. United States Department of Agriculture. (2019). *Plants Profile for Picea breweriana (Brewer Spruce).* https://plants.usda.gov/core/profile?symbol=PIBR Accessed April 29, 2019. United States Department of Agriculture. (1948) *Woody-plant seed manual.* Misc. Publ. 654, 416 p.
Other Sources Consulted	Terence, M. (2008). Brewer spruce: Economically worthless, ecologically priceless. Arcata: Northcoast Environmental Center. Retrieved from Agricultural & Environmental Science Collection; Alt-PressWatch Retrieved from https://search.proquest.com/docview/212365055?accountid=14784 Wilkinson, K.M., T.D. Landis, D.L. Haase, B.F. Daley, and R.K. Dumroese. (2014). *Tropical nursery manual: a guide to starting and operating a nursery for native and traditional plants*. Agriculture Handbook 732. USDA Forest Service, Washington, DC. 376 p.
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