Plant Propagation Protocol for *Cryptogramma stelleri*
ESRM 412 – Native Plant Production
Protocol URL: https://courses.washington.edu/esrm412/protocols/CRST2.pdf

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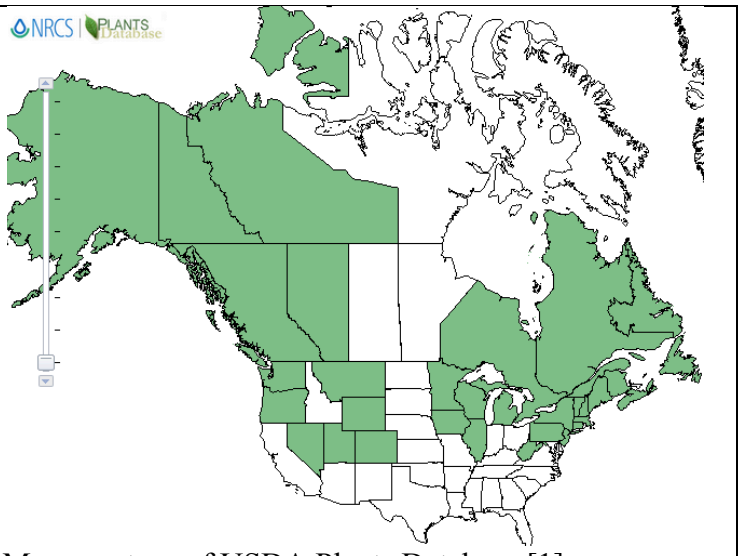
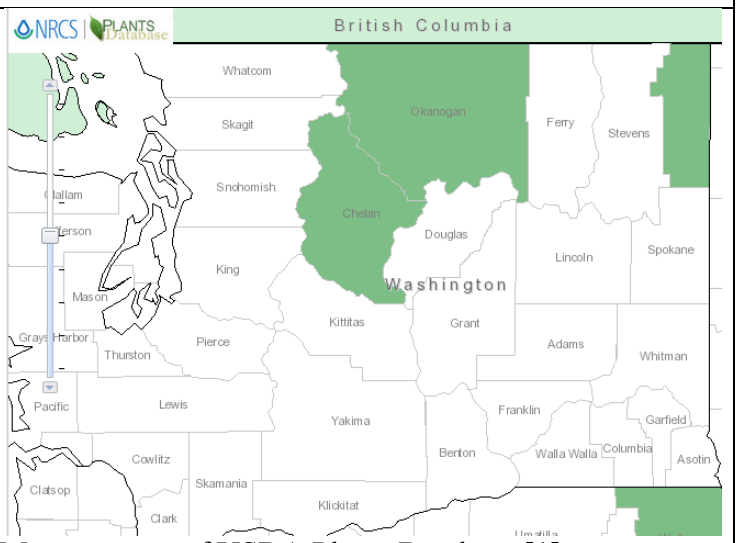
TAXONOMY	
Plant Family	
Scientific Name	Pteridaceae [1]
Common Name	Maidenhair Fern Family [1]
Species Scientific Name	
Scientific Name	*Cryptogramma stelleri* (S.G. Gmel.) Prantl [1]
Varieties	N/A
Sub-species	N/A
Cultivar	N/A
Common Synonym(s)	*Pteris stelleri* S. G. Gmel. [3,6] *Allosorus stelleri* Rupr. [3] *Pellaea stelleri* Watt. [3]
Common Name(s)	Fragile rockbrake [1] Steller's rockbrake [2] Slender rockbrake [7]
Species Code (as per USDA Plants database)	CRST2 [1]
GENERAL INFORMATION	

North American Distribution	 Map courtesy of USDA Plants Database [1]
Distribution in Washington State	 Map courtesy of USDA Plants Database [1]
Ecological distribution	*C. stelleri* is found on moist, shaded cliffs and ledges [3,5] in coniferous forests and other boreal habitats [6].
Climate and elevation range	Within the state of Washington it can be found at 2000-6000 ft. [2]. It is often found in the Wenatchee Mountains and in forested areas and ravines in Pend Oreille County [4].
Local habitat and abundance	*C. stelleri* typically grows on calcareous rocks and can form dense colonies on ledges and in crevices [6,7,8]. It is often found on limestone cliffs that are shaded and are associated with waterfalls or dripping water [10]. Associated species include *Acer glabrum, Thuja plicata, Saxifraga mertensiana,* and *Cystopteris fragilis* [2], and *Cryptogramma acrostichoides* [10].
Plant strategy type / successional stage	Information not found.

Plant characteristics	*C. stelleri* is a small, deciduous fern with sparse fronds that develop from a 1-1.5mm wide, creeping rhizome [7]. Rhizomes are typically very slender, scaly, and with a pilose texture [5]. Fronds appear in early spring and then die back in dry summer months [2,6,8,9]. Stipes are dark at the base and green above, and the blades are doubly-pinnate and rather thin. Leaves are dimorphic, with sterile and fertile fronds appearing separately [2,3]. Fertile fronds appear "pod-like" as the blade margins curl under and cover the sporangia, forming a false indusium [7]. Fertile fronds are erect and taller than sterile ones, typically 5-20cm, with sterile fronds being 3-15cm [2]. *C. stelleri* can be discerned from look-alikes by examining the number of fronds. *C. stelleri* has very few emerging from a slender rhizome, while *C. crispa* and *C. acrostichoides* have robust fronds crowded on short rhizomes [2,10]. Fronds of other *Cryptogramma* species are more persistent on plants than those of *C. stelleri* [2].
PROPAGATION DETAILS - SEED	
Ecotype	--
Propagation Goal	Plants
Propagation Method	Seed (spores)
Product Type	Container (plug)
Stock Type	--
Time to Grow	2 years from spores to outplanting [11]
Target Specifications	Plants that fill out a tall 5" x 3.5" container [11]
Propagule Collection Instructions	For ferns and *Cryptogramma* species generally, collect spores when sporangia are ripe (mid to late summer for *C. stelleri*) [2]. For non-green fern spores in general, mature sporangia will appear medium to dark brown, and ripeness can be ascertained with a hand lens. Sporangia with frayed edges or cracks have shed spores, while plump sporangia still contain their spores. Fertile fronds can be picked and placed in an envelope for transport [7].
Propagule Processing/Propagule Characteristics	Spores are very tiny and light [7]. Average weight for 1000 spores of related species *C. crispa* is 0.0097097 grams [12].
Pre-Planting Propagule Treatments	Information on storage of *C. stelleri* spores is unknown. Generally, for non-green fern spores, sowing as soon as possible after collection is recommended. If storage is necessary, store in cool conditions or in a refrigerator [7].

	Contamination by fungal spores and other fern spores can be a problem with fern propagation in general, and spores should be sterilized before planting. Place spores in a 5-10% bleach solution with a very small drop of a wetting agent. After soaking for one minute, drain and catch spores on filter paper and then rinse twice with distilled water [7].
Growing Area Preparation / Annual Practices for Perennial Crops	For fern propagation generally, a mixture of one to two parts finely textured peat moss and one part fine sand can be used and pH adjusted with lime or other basic additives. Both containers and media should be sterilized before sowing, and media should be moistened thoroughly using distilled water. *C. stelleri* requires media that is well-drained, consistently moist, and with a slightly basic pH [7].
Establishment Phase Details	Spores can be sown in flats and transplanted after germination. After sowing, cover flats with a glass plate or humidity dome to keep them sterile and maintain humidity. If necessary, water with a fine mist of distilled water to keep the top of the media moist until spores germinate [7]. After sowing, place flats in medium indirect or filtered sunlight. The optimal temperature range for germination is 68 - 86°F, and once germination is complete the temperature can be lowered [7].
Length of Establishment Phase	Roughly 2 months [7].
Active Growth Phase	After germination is complete and prothalli have formed, 6-12mm clumps can be lifted with tweezers and transplanted into trays with half fine peat and half sand and misted [7]. A second transplanting is typically done once sporelings appear, and small clumps with 1-3 sporelings are patched out into containers filled with sterilized media of one part fine peat to one part sand, firmed into place and misted. A glass plate should remain in place over containers to provide a consistent level of humidity and medium light should continue to be provided [7]. Culture of a related species *C. acrostichoides* has been successful using a screened bark mix with sand, vermiculite, and pumice as the media for transplanting sporelings. Pure lava rock has also been used with

	success. Once sporelings have been transplanted into containers, good drainage is critical. As in their natural habitat, *Cryptogramma* species like their roots to stay moist and cool, especially in summer heat, and tall containers can facilitate this [11].
Length of Active Growth Phase	Information not found.
Hardening Phase	For young ferns, hardening is achieved by slowly removing the glass plate over the course of three to six weeks during the first year in order to acclimatize the ferns to higher light levels and drier air [7]. *C. stelleri* is deciduous, and for mature plants, fronds will die back by late summer [2,7]. Less water is needed once plants enter this dormant phase [7].
Length of Hardening Phase	Information not found.
Harvesting, Storage and Shipping	Information not found.
Length of Storage	Information not found.
Guidelines for Outplanting / Performance on Typical Sites	During fall of the second year since sowing, plants should be ready for outplanting. Experience with a related species *C. acrostichoides* has shown that this species, and likely other plants in the genus, are highly sensitive, and site conditions must be matched well with their ideal habitat. High losses have been experienced with outplanting. Plants that successfully establish typically produce fertile fronds within 2-3 years total post germination [11].
Other Comments	This species can be very challenging to cultivate and does not fare well in areas with intense summer heat [9]. *C. stelleri* is listed as Sensitive in the state of Washington, with a ranking of G5 (Globally Secure) / S1S2 (Critically Imperiled to Imperiled in the state). Fewer than 10 known populations occur in Washington state [2]. This species is also listed as threatened or endangered in some Northeastern states [1]. Although it is not a federally listed species under the Endangered Species Act, the listing of *C. stelleri* as Sensitive in Washington state should discourage disruption of habitat and wild collection of this species.
INFORMATION SOURCES	
References	[1] USDA Plants Database https://plants.usda.gov/core/profile?symbol=CRST2 Last accessed 12 May 2018

	[2] Camp, P. & Gamon, J.G. (Eds). (2011). *Field Gide to the Rare Plants of Washington.* Seattle, WA: University of Washington Press. [3] Hitchcock, C. L., Cronquist, A., Ownbey M., & Thompson J. W. (1969). *Vascular Plants of the Pacific Northwest Vol. I: Vascular Cryptogams, Gymnosperms, and Monocotyledons.* Seattle, WA: University of Washington Press. [4] Frye, T.C. (1934). *Ferns of the Northwest.* Portland, OR: The Metropolitan Press. [5] Taylor, T.M.C. (1970). *Pacific Northwest Ferns and their Allies.* Toronto: University of Toronto Press. [6] Flora of North America Editorial Committee. (2002). *Flora of North America Vol. 2: Pteridophytes and Gymnosperms.* New York, NY: Oxford University Press. [7] Hoshizaki, B.J. & Moran, R.C. (2001). *Fern Grower's Manual* (2nd ed.). Portland, OR: Timber Press, Inc. [8] Foster, F.G. (1984). *Ferns to Know and Grow* (3rd ed). Portland, OR: Timber Press, Inc. [9] Olsen, S. (2007). *Encyclopedia of Garden Ferns.* Portland, OR: Timber Press, Inc. [10] Colorado Rare Plant Guide. *Cryptogramma stelleri.* http://www.cnhp.colostate.edu/rareplants/guide_print.asp?id=22152 Last accessed: 12 May 2018. [11] David Perasso – 4P Natives, personal communication, 15 May 2018. [12] Royal Botanic Gardens Kew. (2018). Seed Information Database. Version 7.1. *Cryptogramma crispa* Retrieved from: http://data.kew.org/sid/SidServlet?ID=58907&Num=Tzb

	Last Accessed: 15 May 2018. Dziuk, P.M. (2014). *Slender Cliff Brake – photo of sori.* [Photograph]. Retrieved from: https://www.minnesotawildflowers.info/fern/slender-cliff-brake Game, J. (2009). *Cryptogramma stelleri.* [Photograph]. Retrieved from: https://idfg.idaho.gov/species/taxa/58859
Other Sources Consulted	Jones, D.L. (1987). *Encyclopaedia of Ferns: An Introduction to Ferns, their Structure, Biology, Economic Importance, Cultivation and Propagation*. Portland, OR: Timber Press, Inc.
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