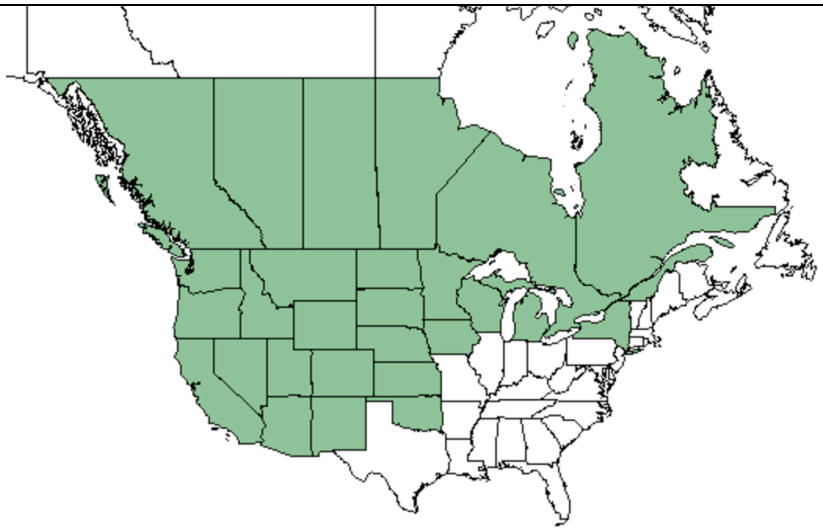
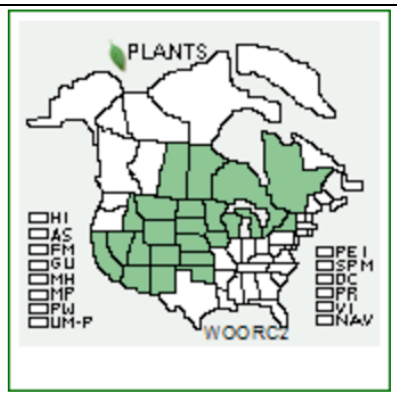
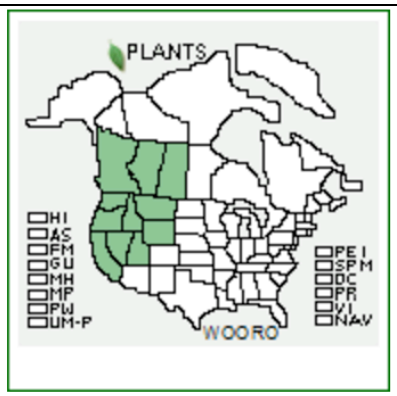
Plant Propagation Protocol for *Woodsia oregana*
ESRM 412 – Native Plant Production
Protocol URL: https://courses.washington.edu/esrm412/protocols/WOOR.pdf

TAXONOMY	
Plant Family	
Scientific Name	Woodsiaceae
Common Name	Wood Fern Family
Species Scientific Name	
Scientific Name	*Woodsia oregana* D.C. Eaton
Varieties	
Sub-species	*Woodsia oregana* ssp. *cathcartiana* *Woodisa oregana* ssp. *oregana*
Cultivar	
Common Synonym(s)	
Common Name(s)	Oregon cliff fern
Species Code (as per USDA Plants database)	WOOR
GENERAL INFORMATION	
Geographical range	 Distribution of both subspecies *Woodsia oregana* ssp. *cathcartiana* and *Woodisa oregana* ssp. *oregana*.[4]

	  *Woodsia oregana ssp. cathcartiana* Oregon cliff fern *Woodsia oregana ssp. oregana* Oregon cliff fern Distribution of each subspecies.[4]
Ecological distribution	Found from Alaska to California, and east through Idaho, Wyoming, Montana, Nevada, and Utah. Mostly found east of the Cascade summits in Washington and Oregon.[2,]
Climate and elevation range	Found between sea level and 11,000 ft elevation.[2]
Local habitat and abundance	Grows in crevices, rock bases, talus slopes on calcareous substrates.[1]
Plant strategy type / successional stage	Perennial[2]
Plant characteristics	This small fern grows erect to ascending with compact stems and few to many persistent petiole bases of unequal lengths.[3] The petiole is reddish-brown to dark purple proximally when mature.[3] Fronds are two to ten inches long, smooth, bright green, and glandular below.[5] Fronds are linear-lanceolate to narrowly ovate, pinnate-pinnatifid or 2-pinnate.[3] Pinnules dentate, often shallowly lobed. Spores are 45-50 µm; located o pinnule margins[3] Sporulating summer to fall[3]
PROPAGATION DETAILS	
Ecotype	
Propagation Goal	Plants
Propagation Method	Seed
Product Type	Container (plugs)
Stock Type	
Time to Grow	9 months[7]
Target Specifications	No information found.

Propagule Collection Instructions	Collect the entire frond when spores appear fully mature and place spore-bearing-side down on butcher paper or newspaper.[6] Store indoors in dry, warm conditions (68-77°F) for 7 to 10 days without air movement.[6] Spores will then appear on paper as fine dust.[6] Collect spores May through August.[7]
Propagule Processing/Propagule Characteristics	Spores can be stored up to 5 years in airtight containers.[6]
Pre-Planting Propagule Treatments	Once spores have been collected, they can be immediately sown or sored in sealed containers. Store at 32°F and 10% humidity in airtight containers for up to 5 years.[6]
Growing Area Preparation / Annual Practices for Perennial Crops	Germinate spores in any sterilized commercial soilless growing mix (for example, 6:1:1 milled sphagnum peat moss:perlite:vermiculite is an appropriate medium) in sterilized propagation flats with drainage holes. Moisten media thoroughly with distilled water. Evenly hand-sow spores directly on surface of moist media and cover tightly with clear plastic to maintain humidity and avoid fungal contamination.[6]
Establishment Phase Details	Keep flats with sown spores at room temperature (68 to 73°F) under soft incandescent lights (60 watts) on a timer for 12-hour photoperiod. Water periodically with a spray bottle of distilled water when media begins to dry slightly on the surface. Closely monitor for any fungal contamination.[6] Germ filament is thread-like and visible under a microscope.[6] After 20 days, the prothalli (gametophyte) will be visible as a "green haze"[7] across the media, and will continue to grow up to 10 weeks before reproductive structures (antheridia and archegonia) appear on the under-surface of the prothallus.[6] When the reproductive structures, visible under a microscope, appear, it is important to keep a thin film of water over the surface of the prothalli.[6] Heavily mist sealed flats with distilled water once or twice a day.[6] This is necessary for fertilization to occur, however unfertilized protahlli can live for years until the right moisture conditions exist for fertilization.[6] When antheridia have withered and disappeared (around 4 weeks after when they first appeared), remove clear plastic coverings. Transfer flats to greenhouse.[6]
Length of Establishment Phase	Spores germinate after 10 to 20 days[6] Proto-sporophytes develop after 8 weeks[7]
Active Growth Phase	At around 8 weeks after sowing spores, young fern plants (sporophytes) with true leaves and developing root system appear. Transplant plants that are 4 cm tall with at least 2 true leaves into 590ml or 800ml containers with Pro-Mix #1 medium (3:1 peat moss:perlite). Add Osmocote controlled

	release fertilizer (13N:13P2O5:13K2O; 8 to 9 mo release rate at 21 °C [70 °F]) and Micromax fertilizer (12% S, 0.1% B, 0.5% Cu, 12% Fe, 2.5% Mn, 0.05% Mo, 1% Zn) at the rate of 4 grams and 2 grams per 800ml container, respectively.[6]
Length of Active Growth Phase	3 months[7]
Hardening Phase	Move plants to an outdoor shadehouse (~50% shade[7]) after the last frost in spring.[6] Keep the soil moist and mist on a declining schedule for 2 weeks.[7] Lightly fertilize with Osmocote. Roots form a firm root plug in containers by the end of the first growing season.[6]
Length of Hardening Phase	4 months[7]
Harvesting, Storage and Shipping	No information found.
Length of Storage	No information found.
Guidelines for Outplanting / Performance on Typical Sites	Transplant between last frost and before mid-summer.[7]
Other Comments	It is best to collect fronds from at least three individual plants to promote fertilization options and genetic diversity.[7]

INFORMATION SOURCES

References

1. Stuart, Tom. "Woodsia oregana D.C. Eaton." *Hardy Fern Library*. N.p., n.d. Web. 12 May 2017. <http://hardyfernlibrary.com/ferns/listSpecies.cfm?Auto=134>.
2. "Woodsia oregana." *WTU Herbarium Image Collection - Burke Museum*. N.p., n.d. Web. 12 May 2017. <http://biology.burke.washington.edu/herbarium/imagecollection.php?SciName=Woodsia oregana>.
3. "Woodsia oregana." *Flora of North America*. E-Flora BC: An initiative of the Spatial Data Lab, Department of Geography UBC,, n.d. Web. 12 May 2017. <http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=200004233>.
4. "Map: Woodsia oregana subsp. oregana." *Flora of North America*. E-Flora BC: An initiative of the Spatial Data Lab, Department of Geography UBC,, n.d. Web. 12 May 2017. < https://plants.usda.gov/core/profile?symbol=WOOR
5. Tilton, A.M. George Henry. "A Fern Lover's Companion." *The Fern Lover's Companion*. N.p., n.d. Web. 12 May 2017. <http://www.basiccarpentrytechniques.com/Horticulture/The%20Fern%20Lover%27s%20Companion/11365-h.htm#wood>.
6. Luna, Tara. "Native fern propagation in Glacier National Park's

	Native Plant Nursery." *Native Plants Journal* 1.1 (2000): 5-9. 7. Goforth, Tom. "Native Fern Propagation from Spores stage and the." *Crow Dog Native Ferns*. Crow Dog Native Ferns, 2011. Web. 12 May 2017. <http://.crowdognativeferns .com%2ffernpropmtc.pdf&p=DevEx,5040.1>.
Other Sources Consulted	1. Rook, Earl J.S. "Woodsia oregana." Earl J.S. Rook, 26 Feb. 2004. Web. 12 May 2017. <http://www.rook.org/earl/bwca/nature/ferns/woodsiaor.html>. 2. "Woodsia oregana ." *Flora of Eastern Washington and Adjacent Idaho*. Robert L. Carr, n.d. Web. 12 May 2017. <http://web.ewu.edu/ewflora/Woodsiaceae/Woodsia%20scopulina.html>. 3. Dyer, Mary H. "Wood Fern Information – Learn About Wood Fern Growing Conditions." *Gardening Know How*. N.p., 03 May 2017. Web. 12 May 2017. <https://www.gardeningknowhow.com/ornamental/foliage/wood-ferns/wood-ferns-in-the-garden.htm>. 4. KROMER K., RAJ A., ¯O£NIERZ L., POTURA£A D. 2008. Propagation in vitro and ex situ cultivation of Woodsia alpina (Bolton) S.F. Gray. In: E. Szczêœniak, E. Gola (eds), Club mosses, horsetails and ferns in Poland resources and protection. Institute of Plant Biology, University of Wroc³aw, Wroc³aw, p. 1528. Pr 5. Thomas, Paul A., and Mel P. Garber. "Growing Ferns." *UGA Extension*(2015): 1-16. *CAES*. Web. 12 May 2017. <https://secure.caes.uga.edu/extension/publications/files/pdf/B%20737_4.PDF>. 6. Wagner, Florence S. "Evidence for the Origin of the Hybrid Cliff Fern, Woodsia x Abbeae (Aspleniaceae: Athyrioideae)." *Systematic Botany*, vol. 12, no. 1, 1987, pp. 116–124. *JSTOR*, www.jstor.org/stable/2419221. 7. Otto, Elizabeth. "Newsletter of the Colorado Native Plant Society." *Aquilegia*13.5 (1989): 2-7. Web. 12 May 2017. <http://epublications.regis.edu/cgi/viewcontent.cgi?article=1048&context=aquilegia>. 8. Aguraiuja, Ruth. "Reintroduction of the endangered fern species Woodsia ilvensis to Estonia: a long-term pilot study." *Biodiversity and Conservation*20.2 (2010): 391-400. Web. 12 May 2017. <https://link.springer.com/article/10.1007/s10531-010-9970-2>. 9. Pyner, Tim. "The Cliff Fern family, Woodsiaceae." *BPS Website*. BPS Website - http://ebps.org.uk, 26 Sept. 2015. Web. 24 May 2017. <http://ebps.org.uk/the-cliff-fern-family-woodsiaceae/>.
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