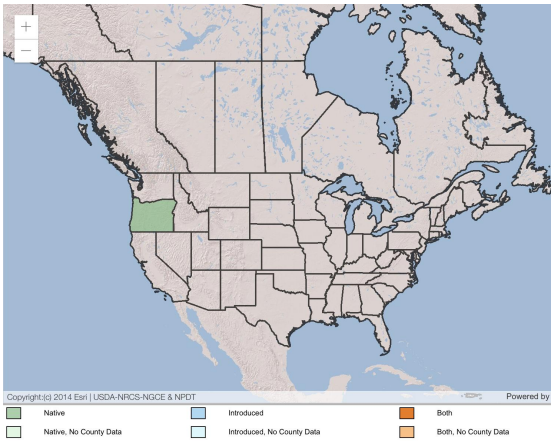
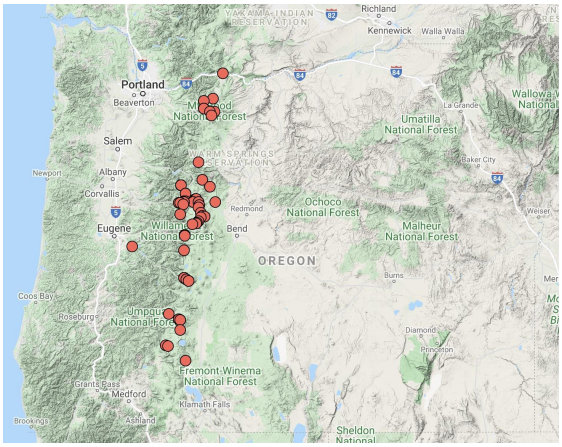
Plant Propagation Protocol for *Fragaria cascadensis*
ESRM 412 – Native Plant Production
URL: https://courses.washington.edu/esrm412/protocols/*2021/FRCA.pdf*

Photographer: Kim E. Hummer [4]

TAXONOMY	
Plant Family	
Scientific Name	Ranunculaceae
Common Name	Buttercup
Species Scientific Name	
Scientific Name	*Fragaria cascadensis* K.E. Hummer [1]
Varieties	N/A
Sub-species	N/A
Cultivar	N/A
Common Synonym(s)	N/A

Common Name(s)	Cascades strawberry [1]
Species Code (as per USDA Plants database)	FRCA
GENERAL INFORMATION	

Geographical range	North America Distribution  Source: USDA PLANT Database [1] Endemic to the western high Cascade Mountain Range in Oregon, United States. [3] Oregon Distribution  Source: OregonFlora, based at OSU Herbarium at Oregon State University [2] The strawberry's distribution in the Oregon Cascades stretches from the Columbia River in the north to the vicinity of Crater Lake in the south. [6]
Ecological distribution	*Fragaria cascadensis* is found in montane habitats. [5]

	Its known range is in the western Cascade Mountains from the Columbia River in the north, to the vicinity of Crater Lake in the south, at elevations of 1,000 to 3,800 m, in sandy-clay loams of volcanic origin, in forest clearings and open meadows. [3]
Climate and elevation range	Climate: The mean annual precipitation in the northern part of the decaploid distribution range is 200 to 250 cm, but it is 100 cm or lower in the southern area. The soils have udic moisture and frigid soil temperature regimes. [3] Elevation: 1,000 to 3,800 m [3]
Local habitat and abundance	Open alpine meadows, or on forest path edges, where direct sunlight breaks through the canopy; along stream banks or in roadside drainage ditches; growing in sandy-clay loam of volcanic origin. At these locations the dominant vegetation is usually Douglas fir [*Pseudotsuga menziesii* (Mirbel) Franco] or silver fir [*Abies amabilis* (Douglas ex Louden) Douglas ex Forbes]. Associated plants include: *Gaultheria humifusa* (Graham) Rydb., *Epilobium ciliatum* Raf., *Lupinus latifolius* J. Agardh., *Montia parvifolia* (Mociño ex de Candolle) Greene, *Vicia americana* Muhl. ex Willd., *Hieracium albiflorum* Hook., *Artemisia ludoviciana* Nutt., and *Agoseris grandiflora* (Nutt.) E. Greene. [3]
Plant strategy type / successional stage	Pioneering nature [4] Reproduce vegetatively by runners as well as by seed [4] Wild populations of strawberries consist of clonal colonies of plants with either imperfect (male or female) or perfect (hermaphrodite) flowers arising from runners. [4] Shallow rooted plant that spreads by competitive creeping
Plant characteristics	General: Perennial, herb, about 8 inches tall [7] Leaves: Green color with scattered white hairs (≈ 1mm) on upper sides of leaves [4]

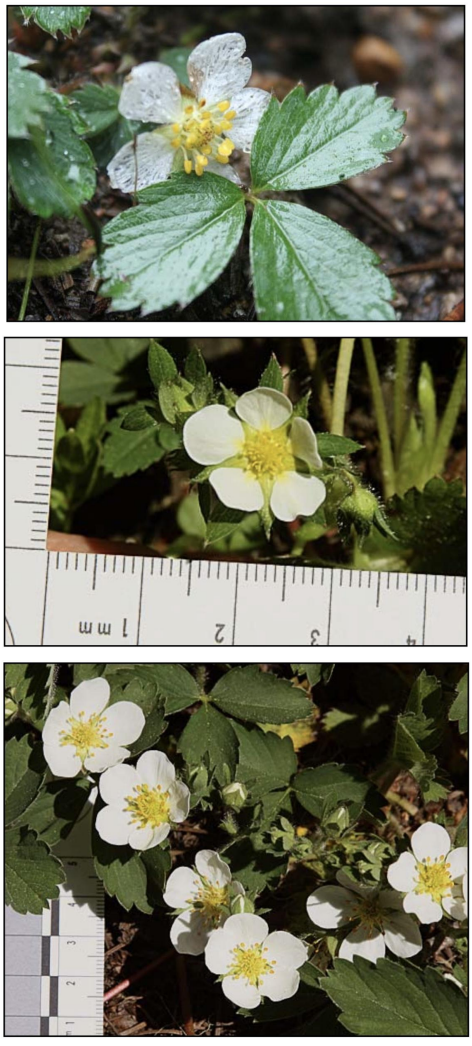
	Flowers: White flowers, typical of *Fragaria L.*7, Fragaria cascadensis begins growing after snowmelt in late May or early June, flowering in early July, about 2-3 weeks later than F. virginiana subsp. platypetala (Rydb.) Staudt at lower elevation below 1,000 m. Runner production begins after flowering. Fruit is ripe during August for about 2 weeks with plants at ≥ 1,500 m elevation ripening 1 to 2 weeks later than those at 1,000 m. [3]  Images top to bottom: Male, Female, and hermaphroditic flower Photographer: Kim E. Hummer [4] Fruits: Many achenes comma-shaped with concave edge, sometimes tear-drop shaped [4]

	 Image: F. cascadensis achenes Photographer: Dr. Sugae Wanda [4] Plants decaploid (2n=10x=70) [4]

PROPAGATION DETAILS

Protocol Information: Details adapted from Propagation Protocols for *Fragaria vesca* L. [8] and *Fragaria virginiana* [9] by Tara Luna of Glacier National Park, Montana

* I was unable to locate propagation protocols for *Fragaria cascadensis*, likely because it is a new species. Based on *F. cascadensis* familial and ecological associations with *F. vesca* and *F. virginiana* I believe protocols for these species provide an appropriate baseline from which to experiment with *F. cascadensis* propagation. All details will be a combination of these two sources unless otherwise indicated.

Ecotype	N/A
Propagation Goal	Plants
Propagation Method	Vegetative (Runners/Stolons)
Product Type	Container (plug)
Stock Type	Bareroot plants
Time to Grow	1 Year

Target Specifications	Height: 5 cm Root System: Bareroot transplant with well developed root system
Propagule Collection Instructions	Vegetative Propagation Method: Spring or Fall divisions Type of Cutting: Divisions. 30 to 50 plants with stolons are placed in a raised bed.
Pre-Planting Propagule Treatments	N/A
Growing Area Preparation / Annual Practices for Perennial Crops	Outdoor nursery in raised bed. Soil in raised bed is equal parts: well rotted cow manure, sand, and soil mix. Perform best on well drained, sandy loams at least 12 inches deep, but most loam soils provide good results if drainage is adequate. Shallow rooted, with most of the roots in the top 12 inches of soil. Soils with pH values between 5.5 and 7.0 provide the best growth. [10] Eliminate weeds, quackgrass, and other perennial weeds. Growing rotation or green manure crops and mechanically cultivating the soil before planting strawberries are standard weed control practices. Perennial weeds can also be killed before planting strawberries by applying a translocatable herbicide, such as glyphosate, which kills both weed tops and roots. [10]
Establishment Phase Details	Transplants establish in raised bed in 2 weeks
Length of Establishment Phase	2 weeks
Active Growth Phase	Outplanted as bareroot material or can be potted into containers.

Length of Active Growth Phase	N/A
Hardening Phase	None; plants are lifted from bed and planted as bareroot material. [9]
Length of Hardening Phase	N/A
Harvesting, Storage and Shipping	Total time to harvest: 1 year Harvest Date: Spring or Fall Plants are lifted from raised bed with shovel and outplanted as bareroot plants. [8] Storage Conditions: Plants overwinter in raised bed in outdoor nursery under snow cover.
Length of Storage	4 months
Guidelines for Outplanting / Performance on Typical Sites	As F. cascadensis possesses a restricted distribution, outplant in site that is characteristic of the specific climate and elevation associated with this species. It is important to track the progress of performance of these plants so as to identify issues to mitigate and gauge success of outplanting. [11]

PROPAGATION DETAILS	
Protocol Information: Details adapted from Propagation Protocol for *Fragaria vesca* by Lee E. Riley, Haley S. Smith, and Allison Klocke for USDA FS - Dorena Genetic Resource Center: In Native Plant Network [12] and "Strawberry Seeds" by Mr. Strawberry at strawberryplants.org. [13] ***** I was unable to locate propagation protocols for *Fragaria cascadensis*, likely because it is a new species. *F. vesca* is one of the 5 types of wild strawberries endemic to Oregon State and so I felt it was appropriate to utilize this protocol for a guideline to adapt to *F. cascadensis* while taking into account general strawberry seed propagation.	
Ecotype	N/A

Propagation Goal	Plants
Propagation Method	Seed
Product Type	Container (plug)
Stock Type	Container seedling, runners pruned [12]
Time to Grow	N/A
Target Specifications	Container seedling, runners pruned Root System: Firm plug in container [12]
Propagule Collection Instructions	Berries should be collected in early summer when ripe and stored in a plastic bag at ≈4 °C until extraction--within two weeks or so to prevent mold growth. Macerate berries thoroughly while still in plastic bag. Add water to bag to mix, and pour mixture in beaker. Add sufficient water. Water to berry mixture should be 3:1. Add pectinase (approximately 1 table spoon per liter) to volume and stir. Leave mixture at room temperature for 24 hours. Most seed should sink to bottom if filled and properly macerated initially. Pour off top layer of while gently mixing, or adding water from a faucet. Do not mix so violently that seed rises in the water column, but just enough that berry skin begins to float and pour off the non-seed debris. When seed is as clean as possible, pour wet seed onto paper towel and allow to dry. Pick out debris with tweezers. Dry to <38% RH. Store at 4 °C. [12]
Pre-Planting Propagule Treatments	Many strawberry seeds need to be cold treated to encourage germination. If your selected seeds require this, fear not. It is easy. Simply wrap your seeds, put them in an airtight container, and place them in a freezer. This simulates winter conditions, and the warming period

	lets the seed know it is time to come to life. After keeping the strawberry seeds below freezing for two to four weeks, remove the seeds from the freezer. Leave them in the jar or container as they gradually warm up to room temperature. [13] Due to small seed size, the easiest method is to sow seed into trays filled with stabilized medium plugs (Q-plugs). Trays are sealed inside plastic bags and placed into refrigeration at 1 to 3 °C for 30 days. Trays are checked weekly and kept moist throughout the stratification period. If mold is evident, trays should be treated with 1% hydrogen peroxide. [12]
Growing Area Preparation / Annual Practices for Perennial Crops	Greenhouse growing facility. Q-plugs are lightly covered with nursery grit. Seedlings are transplanted to target containers 3 to 4 weeks following removal from stratification. Growing medium used is 40:20:20:20 peat:composted fir bark:perlite:pumice with Nutricote controlled release fertilizer (18N:6P2O5:8K2O with minors; 180-d release rate at 21C) at the rate of 1.5 gram Nutricote per 262 ml container. [12] Annual practices include weed and pest management.
Establishment Phase Details	Germination is fairly uniform and is usually complete in 2 weeks. Following germination (while still in Q-plugs), plants are fertilized with soluble 12-2-14-6Ca-3Mg at 75 to 100 ppm for 2 weeks. [12]
Length of Establishment Phase	2 to 3 weeks [12]
Active Growth Phase	Care must be taken to prune runners throughout the growing season to avoid plant growth into neighboring containers and other crops grown in the vicinity. During the growing season, fertilization depends on weather. Soluble 20-9-20 NPK, 20-18-18 NPK, or 17-5-24 NPK at 100 ppm is applied weekly throughout the growing season. [12]
Length of Active Growth Phase	N/A

Hardening Phase	No dry-down is done to induce dormancy. Seedlings are moved to an outdoor growing area in early-September. [12]
Length of Hardening Phase	2 to 3 weeks [12]
Harvesting, Storage and Shipping	Harvest Date: Early October Storage Conditions: Seedlings are usually outplanted in fall. No storage except in outdoor growing area. Plants are well irrigated prior to shipping and shipped in containers. [12]
Length of Storage	N/A
Guidelines for Outplanting / Performance on Typical Sites	Plant the seedlings outdoors in the ground in the fall or winter after the rains have started. They should be planted in full sun in a light, loose soil, about ten inches apart. [12] As F. cascadensis possesses a restricted distribution, outplant in site that is characteristic of the specific climate and elevation associated with this species. It is important to track the progress of performance of these plants so as to identify issues to mitigate and gauge success of outplanting. [11]

Other Comments	*Fragaria cascadensis* is currently restricted to the Oregon Cascades. Morphologically similar plants from Washington, California and other mountain ranges in Oregon were shown to be octoploid. A plausible region for the origin of *F. cascadensis* is Beringia, where the octoploids most likely evolved. In this region, all necessary progenitors of *F. cascadensis* were presumably present, including the donor of the additional *F. iinumae*-like B subgenome. In this case, it is difficult to explain why *F. cascadensis* is restricted to the Oregon Cascades and has not been found in other parts of the Cascades or the Rocky Mountains that harbor suitable habitats for strawberries. Although these regions are suitable for closely related *Fragaria* taxa (*F. virginiana* subsp. *glauca* and subsp. *platypetala*), biotic differences

	might be strong enough to prevent *F. cascadensis* in these regions. [5] *Fragaria cascadensis* presents the possibility for developing and breeding a new class of cultivated strawberries. This wild Oregon strawberry, if crossed with the commercial strawberry, would likely result in hybrid offspring with lower fertility," says Hummer. "However, crossing this new species with other strawberries having the same number of chromosomes, such as the cultivated *F. vescana*or the wild Russian species *F. iturupensis,* should produce fertile offspring, which may reveal new flavors or genetic disease resistance. In the future, consumers could benefit from the knowledge gained and genes provided by this new wild strawberry." — Kim Hummer [6] Pests include: aphids, lygus bugs, spittlebugs, mites, nematodes, leaftiers, root weevils, slugs and snails, and birds. [10] Potential disease include: gray mold, leaf scorch, leaf spot, powdery mildew, red stele root rot, black root rot, verticillium wilt, and viruses. [10]

INFORMATION SOURCES	
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Protocol Author	Nicole Seiger
Date Protocol Created or Updated	5/27/21

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Note: This propagation protocol template was modified by J.D. Bakker from that available at: http://www.nativeplantnetwork.org/network/SampleBlankForm.asp