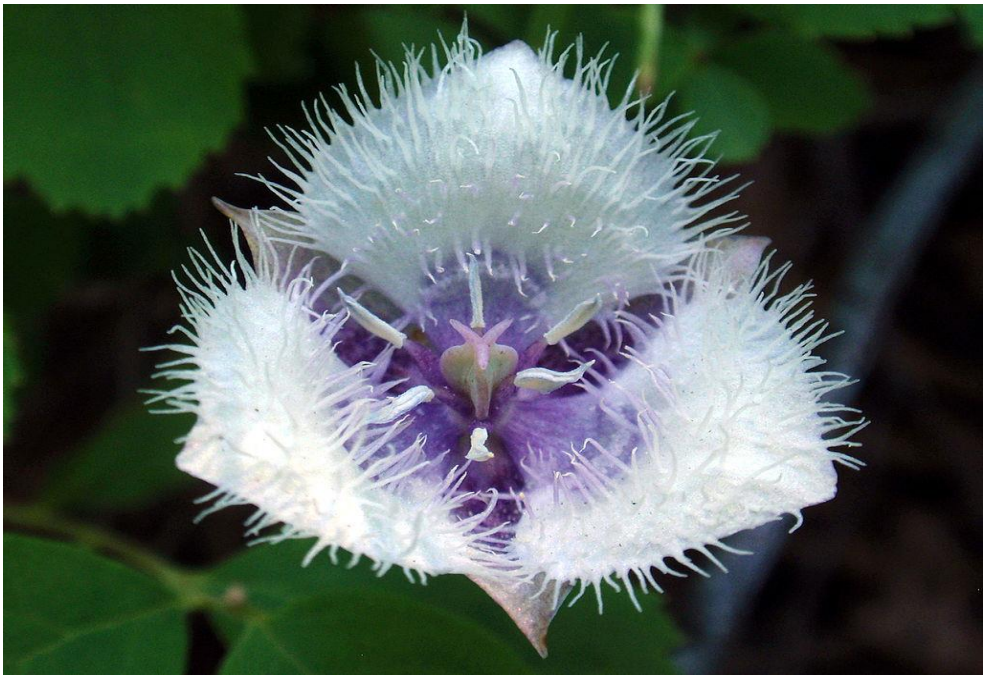
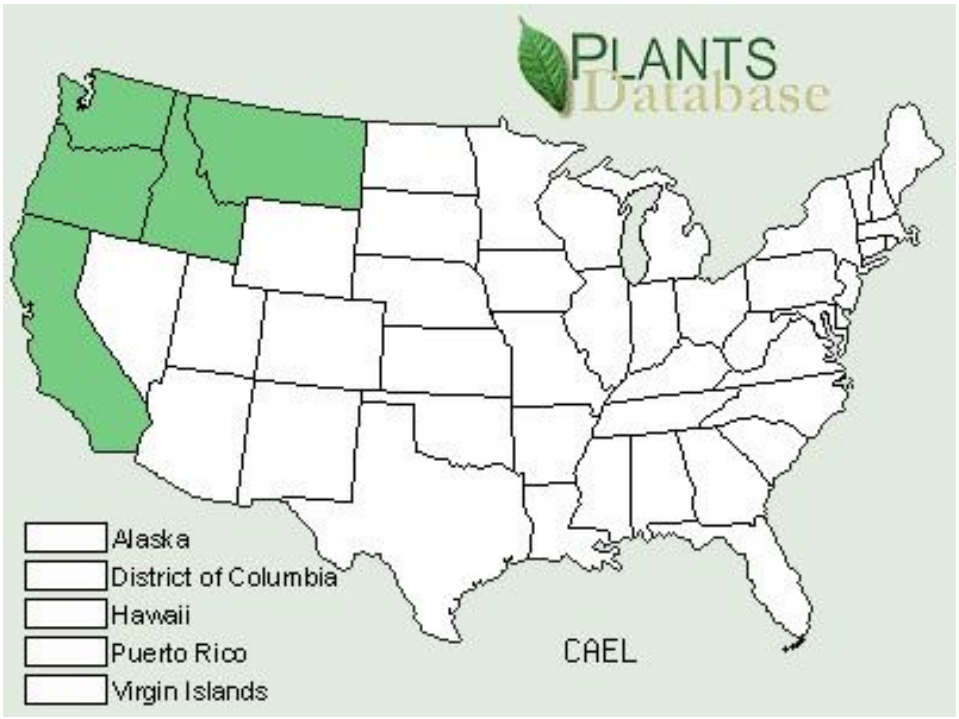
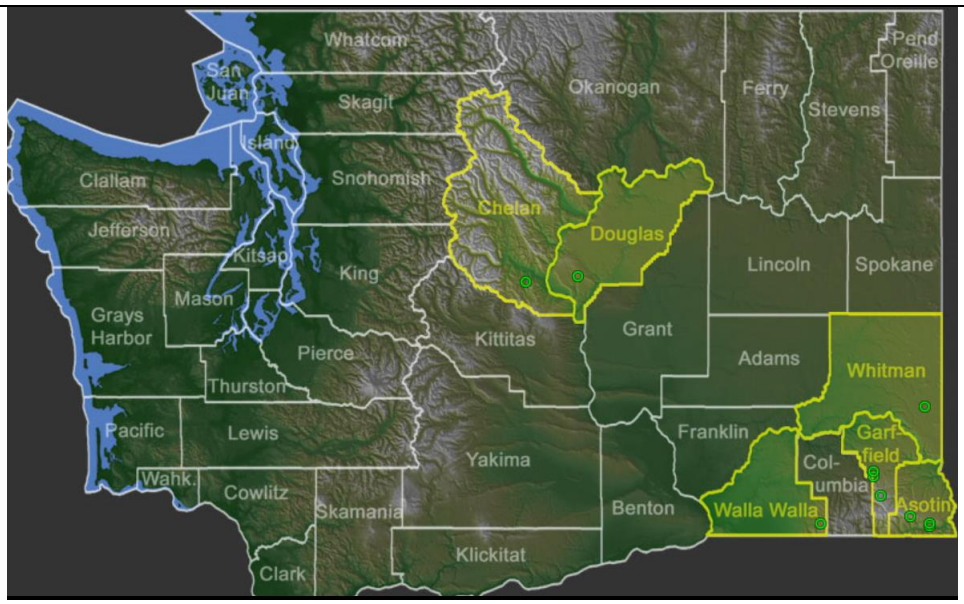
Plant Propagation Protocol for *Calochortus Elegans*
ESRM 412 – Native Plant Production
Protocol URL: https://courses.washington.edu/esrm412/protocols/CAEL.pdf



Source: Tom Hilton - Cats Ear 01Uploaded by Orchi, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=20640871

TAXONOMY	
Plant Family	
Scientific Name	*Liliaceae*
Common Name	Lily family
Species Scientific Name	
Scientific Name	*Calochortus elegans* Pursh
Varieties	*Calochortus elegans* var. *amoenus* hort. *Calochortus elegans* var. *elegans* Pursh *Calochortus elegans* var. *lobbii* Baker *Calochortus elegans* var. *major* Hook. *Calochortus elegans* var. *minor* Hook. *Calochortus elegans* var. *nanus* Alph.Wood

	Calochortus elegans var. *oreophilus* Ownbey *Calochortus elegans* var. *selwayensis* (H.St.John) Ownbey *Calochortus elegans* var. *subclavatus* Baker
Sub-species	
Cultivar	
Common Synonym(s)	
Common Name(s)	Elegant Mariposa Lily, Star Tulip, Elegant cat's ears ; Northwestern mariposa lily
Species Code (as per USDA Plants database)	CAEL
GENERAL INFORMATION	
Geographical ran**ge**	*Calochortus elegans* occurs only in Western North America. Its southernmost range is in Northern California and it extends northward to eastern Washington, and the border between eastern Idaho and Montana. [1]  United States Department of Agriculture Plants Database

	 Source: Washington Territorial University Herbarium
Ecological distribution	*Calochortus elegans* is a native perennial herb that is found on open rocky soils at the margins of coniferous forests and on grassy hills in open montane woodlands. [1, 2, 3] It grows best in either full or part shade and does not tolerate full sun. It also prefers well-drained soil such as loam and clay. [4, 5]
Climate and elevation range	Grows in mid-high elevation (250-2000 meters), prefers dry and cold environments, though can tolerate winter precipitation. Tends to grow in areas that fluctuate from 0-25 ℃ [11]
Local habitat and abundance	*Calochortus elegans* and its varieties are found in coniferous forest margins, grassy slopes in open woods and sometimes on prairies in well-drained soil. [1,3,12]
Plant strategy type / successional stage	Seeds germinate in early winter, often coinciding with the beginning of the rainy season in its local habitat. 4 It is abundant in its local regions, but globally rare. 1,3 Since it does not tolerate high heat or sunlight well, it goes dormant in early summer. 4 Adapted to dry, cold environments (hardiness zones 7b-9a). Bulbs easily rot when exposed to too much water. [1,5,6] Exhibits a bulb geophyte life history. [1]
Plant characteristics	Perennial herb, produces a slender unbranched stem (5- 20 cm long) with 1-2 basal leaves that are 10-20 cm long. Leaf remains green through flowering. The inflorescence has 2-6 erect flowers, usually only 1-3. Each flower has three sepals and three petals with purple crescent near the base.. The petals are heavily bearded above the purple crescent; hairs are long and straight , but pointed petals tips are hairless. The gland itself is naked but fringed above and below. The flower is bisexual, with six stamens and three fused carpels. The fruit is a 1-2cm long winged capsule. [1,2,3, 11, 12]
PROPAGATION DETAILS (SEED)	
Ecotype	

Propagation Goal	Plants
Propagation Method	Seed
Product Type	Propagules seeds, cuttings, poles, etc.) [9]
Stock Type	Field grown
Time to Grow	Growing from seed can take 5-7 years before the plant will flower, 3-4 years before the plants are ready to be out-planted. [4,7,8]
Target Specifications	First year bulb
Propagule Collection Instructions	Seed is collected when the winged capsules begin to split in early summer. Capsules are clipped from the plant and hand stripped to remove the large seed. For short-term storage or transportation, seeds should be kept in paper bags until it is cleaned. [7, 8, 9]
Propagule Processing/Propagule Characteristics	No seed density for *Calochortus elegans* could be found, though *Calochortus nitidus,* which has the same type of fruit, yielded a seed density of 190,000 seeds/lb [7] and *Calochortus macrocarpus* had a seed density of 603,360 seeds/lb. [9] Seed longevity is unknown. Tetrazolium viability tests for *C. macrocarpus* yielded 86% viability. [9]
Pre-Planting Propagule Treatments	To clean, the seed is held in the center of the capsule between the wings and broken; the wings must be crushed crossways to extract the seed. [7, 9] Capsules are crushed to release the seed, all material is separated from the seed by using a hand screen. For transport, seeds can be kept in paper bags at room temperature. Cold moist stratification (5 ℃) for a minimum of six weeks with 8 hours of light and 16 hours of darkness is needed. [4, 5, 7. 9] This species requires summer dormancy, which lasts around 6 months. The plant should be allowed to dry out completely during dormancy and then can be placed in dry storage between 15-21 ℃[4, 8, 10]
Growing Area Preparation / Annual Practices for Perennial Crops	Seed can be directly sown into 1.5'' deep flats. Success has been high with various *Calochortus* genera with the UC Davis general mix (1/2 sand, ½ milled sphagnum peat moss) , however other mixes have been used successfully such as loam or clay soil.[4] A light scattering of gravel or vermiculite will aid in keeping the seedlings from washing away or clumping up. Seedlings can then be transplanted into larger 1 gallon pots. Adequate drainage must be ensured. During the establishment and growing phase, this plant will not tolerate a heated greenhouse. The ideal planting depth is ¼'' (.6 cm)[4, 7, 8] Plants should be allowed to go dormant by early summer. Dormancy can be induced by allowing the plants to totally dry-down and then placing them into dry storage. [4, 7, 8, 9] Low-nitrogen bulb fertilizer may be used; Lilly miller "Bulb and Bloom" is recommended. [4]

Establishment Phase Details	Cold moist stratification (as described in the pre-planting propagule treatment) is required. This can be done in an artificial chamber set to 5℃ or, if local conditions allow, seed can be sown directly in the ground outdoors in early December. Cool spring temperatures also aid in survival. Seeds sown directly in the ground in early December began to emerge mid-April. Seeds should be covered to a depth of no more than 1/4 inch. Seeds should be watered weekly, though care should be taken not to overwater as this plant is sensitive to water stress. [4, 5, 7. 9]
Length of Establishment Phase	2-6 months, [7. 8, 9]
Active Growth Phase	Plants actively grow from late fall to the beginning of summer dormancy (six to eight months), when the plants senesce. The seedlings can be potted up after around two years and should be transplanted outdoors following 2 years of growth. [4, 10]
Length of Active Growth Phase	6 months [4, 5, 7, 8, 9, 10]
Hardening Phase	Plants naturally go dormant following a dry down in early summer. Dormancy is marked by a yellowing of the first-year leaf and then subsequent withering. As soon as the yellow leaf is noticed (near the beginning of summer) all watering should cease to allow plants to go into dormancy and to prevent rotting. The container should be allowed to thoroughly dry out before placing the plant in dry storage. Hardening is thus not required as the active growth phase starts with the onset of fall rains or watering and plants senesce around the end of spring or beginning of summer. [4, 10]
Length of Hardening Phase	Six to eight months (dormancy phase) [4, 7, 8, 9, 10]
Harvesting, Storage and Shipping	Dormant individuals can be placed in dry storage at 10-15 ℃ [8]
Length of Storage	3-6 months
Guidelines for Outplanting / Performance on Typical Sites	Seedlings take 5-7 years to flower. Seedlings are grown until their second year of growth and then should be transplanted. [4]
Other Comments	Deer will eat the flower buds and small rodents eat the leaf. Pocket gophers eat the entire plant. [4] *Calochortus* typically does not have high levels of pest damage.[4]
PROPAGATION DETAILS (BULB)	
Ecotype	

Propagation Goal	Plants
Propagation Method	Vegetative
Product Type	Propagules (seeds, cuttings, poles, etc.)
Stock type	
Time to grow	3-4 years
Target Specifications	Flowering plants Bulbils
Propagule Collection Instructions	Bulbs should not be collected from the wild as success rates are low and bulb collection kills the entire plant. [10] Bulbs should be planted from already established plants grown from seed. Most *Calochortus* species produce bulb offsets and can be separated with care and re-planted, though no specific information concerning *Calochortus elegans* is available. [5, 4, 10]
Propagule Processing/Propagule Characteristics	
Pre-Planting Propagule Treatments	No information found concerning whether scarring of the bulb is needed. For most *Calochortus* species, bulb offsets are harvested and re-planted. [4,5]
Growing Area Preparation/Annual Practices for Perennial Crops	Bulbs should be planted at a depth of 8-10 cm in 1 gallon containers Growing media should not be kept extremely moist to avoid rotting of the bulb. [4, 10] A one gallon pot should be used per three bulbs planted. Bulbs should be spaced around 7.5-10 cm apart. Success is also high in raised beds. The UC Davis general mix (1/2 sand, ½ milled sphagnum peat moss) or a very sandy soil and loam mix is recommended.. Pumice can be added to assist in drainage. [4] During dormancy, if the pots are outdoors and will receive rainfall, the bulbs should be dug up = stored in vermiculite or sand to avoid desiccation in dry storage at a temperature of around 20 ℃ [4]
Establishment phase details	Bulbs are known to divide very slowly. Germinants likely will not be seen for six months. Plants should be watered around once a week, but care must be taken not to over-water the plants. Plants should be kept in cool, not humid environments. [4]
Establishment phase length	Above ground growth will not be seen for at least six months post planting.
Active growth phase	During the first season post planting the active growth phase will be shorter than normal due to prolonged establishment. Plants should not be watered often and a few applications of low-strength bulb or orchid fertilizer can be applied. Once the leaves turn mostly yellow, the plant should be allowed to go dormant. [4, 10]

Active growth phase length	From post-dormancy to early summer (6-8 months, 4-5 during the first season)
Hardening phase details	Plants naturally go dormant following a dry down in early summer. Dormancy is marked by a yellowing of the first-year leaf and then subsequent withering. As soon as the yellow leaf is noticed (near the beginning of summer) all watering should cease to allow plants to go into dormancy and to prevent rotting. The container should be allowed to thoroughly dry out before placing the plant in dry storage. If the bulbs have been established outdoors, they should be dug up and stored in dry storage. Hardening is thus not required as the active growth phase starts with the onset of fall rains or watering and plants senesce around the end of spring or beginning of summer [4, 10]
Hardening phase length	6-8 months (dormancy)
Harvesting, storage and shipping	Dormant bulbs can be kept in cool, dry conditions inside of a paper bag or cardboard box at around 5℃[7]
Length of storage	
Guidelines for Outplanting/Performance on Typical Sites	Bulbs should be out-planted in early fall. [4, 5] Calochorti bulbs divide slowly and flowers will not be seen until 5-7 years post planting. Survival rate for bulb outplanting is low. [4]
Other comments	It is not recommended to try to propagate *Calochortus* by bulbs since survival is typically low and not all species are known to produce offsets. [4, 10] Do not collect bulbs from the wild as this will kill the entire plant. Bulbs should only be collected from plants already grown from seed. [10]
INFORMATION SOURCES	
References	[1]Plants Profile for *Calochortus elegans* (elegant mariposa lily). USDA NRCS National Plant Data Team, n.d. Web. 25 Apr. 2017. Web. <https://plants.usda.gov/core/profile?symbol=cael> [2] Hitchcock, Leo C., Arthur Cronquist, and Jeanne R. Janish. Flora of the Pacific Northwest an illustrated manual. Seattle: U of Washington Press, 1973. Print. [3] Turner, Mark, and Phyllis Gustafson. *Wildflowers of the Pacific Northwest*. Portland: Timber Press, 2006. Print. [4] Mcdonald, H. P. "How to Grow Calochortus." Mariposa 2 (Oct. 1990): 1-5. The Geoff Burleigh Information Archive. Web. 24 Apr. 2017. [5] Keator, Glenn, California plant specialist (2017, April 25). E-mail correspondence [6] "United States Department of Agriculture." USDA Plant Hardiness Zone Map. N.p., n.d. Web. 25 Apr. 2017. Web. <

	\<http://planthardiness.ars.usda.gov/PHZMWeb/> [7] Skinner, David M. 2007. Propagation protocol for production of *Calochortus nitidus* Dougl seeds (field grown); Pullman Plant Materials Center, Pullman, Washington. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 2 February 2007). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery. * [8] Leigh, Mark; Pushnik, James C.; Boul, Rachelle D.; Brown, Matthew R.; Hunt, John W.; Koenig, David A.. 2006. Propagation protocol for production of Container (plug) *Calochortus luteus* bulbs Potted nursery stock; University of California - Chico Chico,CA * [9] Barner, Jim. 2009. Propagation protocol for production of Propagules (seeds, cuttings, poles, etc.) *Calochortus macrocarpus* Dougl. seeds USDA FS - R6 Bend Seed Extractory Bend, Oregon. In: Native Plant Network. URL: http://NativePlantNetwork.org (accessed 2017/04/25). US Department of Agriculture, Forest Service, National Center for Reforestation, Nurseries, and Genetic Resources. * [10] Miller,M.T.;Antos, J.A.;Allen,G.A. 2004. Dormancy and flowering in two mariposa lilies (Calochortus) with contrasting distribution patterns. Canadian Journal of Botany. 82: 1790–1799 [11] "Calochorus elegans." Calflora. California Native Plant Society , n.d. Web. 24 Apr. 2017. < http://calscape.cnps.org/Calochortus-elegans-(Cat's-Ear)?srchcr=sc58f03fb2a0613> [12] Knoke, Don, and David Giblin. "*Calochortus elegans*." *WTU Herbarium Image Collection - Burke Museum*. N.p., n.d. Web. 26 Apr. 2017. < http://biology.burke.washington.edu/herbarium/imagecollection.php?SciName=Calochortus%20elegans> [13] Gerritsen, Mary E., and Ron Parsons. *Calochortus: Mariposa lilies & their relatives*. Portland: Timber Press, 2007. Print. **Propagation protocols cited were not prepared for Calochortus elegans but for other Calochortus spp.*
Other Sources Consulted	Levy-Boyd, Dylan. Fourth Corner Nurseries. (2017, April 25). E-mail correspondence.
Protocol Author	Jasna Hodzic
Date Protocol Created or Updated	06/05/2017