

Plant Propagation Protocol for *Cistanthe tweedyi* (Tweedy's pussypaws)

ESRM 412 – Native Plant Production

Protocol URL: <https://courses.washington.edu/esrm412/protocols/CITW2.pdf>



Figure 1: *C. tweedyi* at Blewett Pass, Chelan County, Washington. Photo by Stephen Munro.

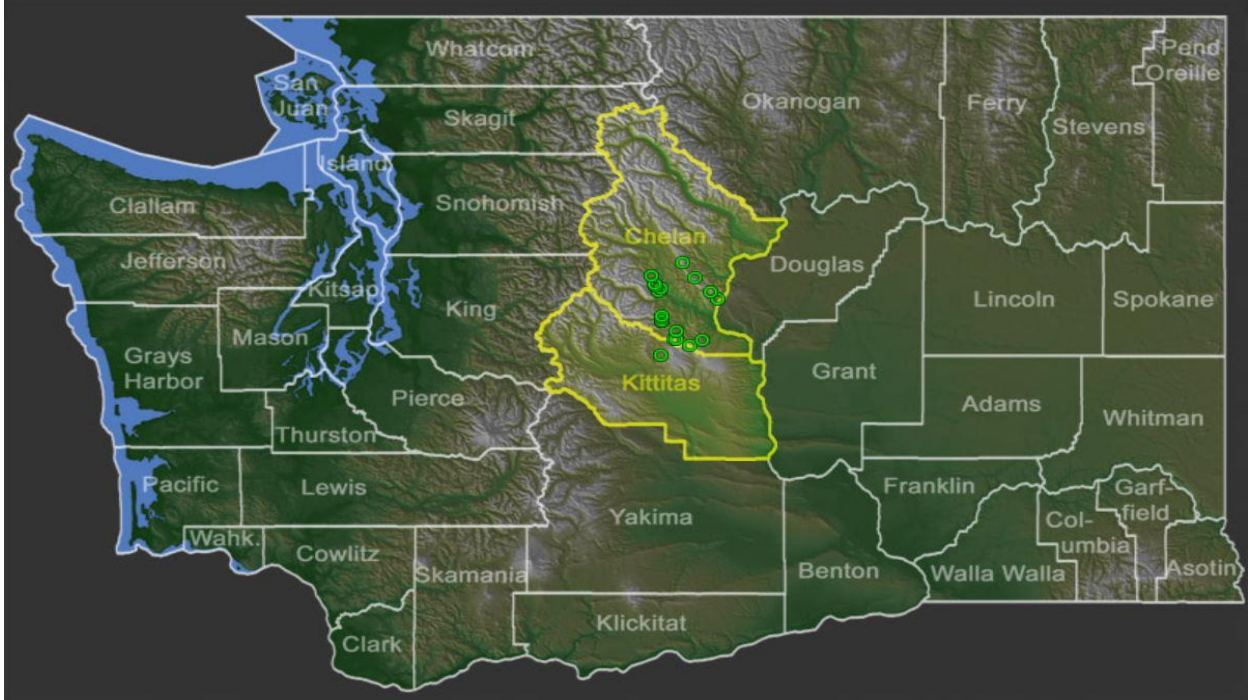


Figure 2: Reported occurrence of *C. tweedyi* in Washington State. Possible Okanogan County and extant British Columbian population(s) in E.C. Manning Provincial Park not captured here. Burke Museum [1].



Figure 3: USDA, 2018 [2].

TAXONOMY	
Plant Family	
Scientific Name	Portulacaceae (Montiaceae is the new monophyletic family for this species) [3]
Common Name	Purslane family (Montia family) [3]
Species Scientific Name	
Scientific Name	<i>Cistanthe tweedyi</i> (A. Gray) Hershkovitz (not currently accepted) [3].
Varieties	None
Sub-species	None
Cultivar	‘Alba’, ‘Inshriach Strain’, ‘Rosea’[4], ‘Elliot’s Variety’ [5]
Common Synonym(s)	<i>Calandrinia tweedyi</i> A. Gray <i>Lewisia aurantica</i> A. Nels LETW <i>Lewisia tweedyi</i> (A. Gray) B.L. Rob.

	<i>Lewisiopsis tweedyi</i> (A.Gray) Govaerts (this most recently accepted designation placing the plant in a monotypic genus within family Montiaceae) [3] <i>Oreobroma tweedyi</i> Howell
Common Name(s)	Tweedy's lewisia, Tweedy's bitterroot, mountain rose
Species Code (as per USDA Plants database)	CITW2
GENERAL INFORMATION	
Geographical range	See Figure 2 for Washington State occurrences. In the United States <i>C. tweedyi</i> is known from the Wenatchee Mountains of Washington State chiefly in Chelan County and also occurring in northern portions of Kittitas County. The recorded occurrences of the species range from South Navarre Peak in north, south to near the town of Liberty, west to Ladies Pass and east to Twenty-Five Mile Creek [6]. It reportedly grows in the Methow Valley of Okanogan County, Washington yet, current reports neglect to record any Okanogan populations [1]. A Canadian population is found in British Columbia's E.C. Manning Provincial Park not far from the international border [7].
Ecological distribution	In Washington State <i>C. tweedyi</i> grows in the Wenatchee Mountains. These mountains are complex geologically and differ from the rest of the Cascade Mountain range in origin and composition. Significantly these mountains escaped glaciation during the last Ice Age. Thus these mountains represent a pre-glacial refugia and this plant is a distinctive survivor of this previous epoch [5]. In the United States and British Columbia, Canada it is found on soils derived from basalt and granite primarily [7]. C.L. Hitchcock also observed the plant growing on sandstone in Washington State [1]. These soils are formed by the frost shattering of the parent material and are unstructured screes. Wind blows the finest soil particles away. These screes are thus porous and breathing with a substantial addition of humus contributed by adjacent conifers and grasses [5].
Climate and elevation range	Climate in the vicinity of <i>C. tweedyi</i> is a semi-arid climate with cold winters, and hot dry summers or Köppen <i>BSk</i> designation[8]. Temperatures in the range of the plant vary between -25 to 100 °C. Despite the extreme conditions it is probable that the plant thrives because of rather than in spite of these temperature conditions. Moisture is available in large part as melting snow and varies from 20 to 50cm [5]. Known

	<p>recorded elevations are from 570 to 2400 meters. Altitude itself does not seem to be a limiting factor for the plant's survival itself but is more contingent upon altitude and moisture in tandem. Moisture increases in this region. At higher altitudes where the plant is found snowfall accumulation also increases [6].</p>
<p>Local habitat and abundance</p>	<p>In the United States <i>C. tweedyi</i> is most commonly associated with the <i>Pinus ponderosa</i> forests of the Wenatchee Mountains [1]. Associated with these open forests is the regular occurrence of fire [5]. While the association with <i>Pinus ponderosa</i> is valid in the heart of its range the plant is associated with a number of other forest types. The associated forest cover for a population near Indian Creek Road at an elevation of 800 meters includes <i>Acer macrophyllum</i>, <i>Pseudotsuga menziesii</i>, and <i>Thuja plicata</i> with <i>Pinus ponderosa</i> noticeably missing. At Sugarloaf Mountain, elevation 1780 meters, <i>Abies lasiocarpa</i> and <i>Pinus albicaulis</i> are dominant. The associated shrubs, herbs, and grasses are as varied as the tree cover suggests [6]. In British Columbia a population grows in open coniferous forests and sites devoid of forest cover. Associated tree species may include <i>Pinus ponderosa</i> and <i>albicaulis</i>, <i>Abies lasiocarpa</i> and <i>Pseudotsuga menziesii</i> [7]. The plant can be found primarily in forest openings yet will persist even when shaded yet may not flower. If the shade is removed the plant will resume to flower profusely the following spring [5]. Plants are found with a north-west to south-east facing orientation corresponding to the direction the mountains run where the species is found (in the United States). Mostly the plants will be found in talus, rock crevices, or rock ledges. This micro-habitat is due to the plant's need for sharp drainage. A lack of competition in these areas from other plants could be a contributing factor as well [6]. The needed cooling effects provided by these rocks and talus must be considered especially when the plant is growing in full sun. The plant will still favor these rocky environs even when found in semi-shaded conditions [5].</p>
<p>Plant strategy type / successional stage</p>	<p>This species readily colonizes disturbed sites in its range including road cuts, washouts, and talus slides [6]. It also found in good numbers around abandoned gold mines that dot the Wenatchee Mountains [5].</p>
<p>Plant characteristics</p>	<p><i>C. tweedyi</i> is a clump-forming perennial herb arising from a thick, fleshy, reddish taproot up to almost 1</p>

meter. The taproot is topped by a branched crown that gives rise to a dense cluster of thick-stalked, evergreen, smooth, simple, succulent basal leaves, which are lance-shaped to egg-shaped, 10-20 cm long and 1-5 cm wide. It produces flowering stems 10-20 cm tall [6]. The flowering stems each bear 1-4 flowers on short (2-5 cm) branches accompanied by two lanceolate bracts. Bracts and sepals are entire-margined on the plant. Each flower has 2 sepals and 7-9 petals that are 2.5-4.0 cm long and salmon, yellowish-pink or white in color [9]. The pedicels of the plant are recurved in fruit, the ovary is triangular in cross-section with the fruit dehiscent apically. The fruits are small (25-40 mm long) egg-shaped, one-celled capsules which open by 3 valves. Each fruit contains on average 12-20 black, shiny seeds about 2 mm long [10]. There is wide variation in seed set and seeds per flower in the wild may range from 9-42 per flowers with an average of 26. Depending on the amount of seed set the flowering scape will reflex ever more closely to the mother plant if the seed set is high [6]. The capsule of the plant is dehiscent and dehisces apically. This would suggest seed would not move very far from the mother plant yet this does not take into account the peculiar fleshy appendage attached to the seed. The appendage called a strophiole [10]. Ants approach the hanging seed (which has opened from the apically, while hanging upside down) and carry it away up to five at a time. Apparently, the creatures devour the strophiole tissue and leave the seed behind to germinate [6]. The chromosome base number (n) for Tweedy's lewisia is 46 [10]. This condition suggests euploidy of the species. Bloom times range from April to July depending on elevation and exposure to sun or shade [6]. The population in E.C. Manning provincial park may bloom as late as August [7]. The flowers are visited by bees and syrphid flies yet it has not been determined exactly how these creatures aid in pollination [6]. The age of the plant is unknown yet massive specimens have been found, with a caudex 20 cm in diameter and a taproot 2.5 meters long suggesting a venerable age [5].

PROPAGATION DETAILS

Ecotype	Wild-collected or cultivated-collected seed does not measurably change the following requirements [5].
Propagation Goal	Plants

Propagation Method	Seed
Product Type	7 cm containers
Stock Type	N/A
Time to Grow	Plants
Target Specifications	Plants require 2-3 years until flowering and mature [12].
Propagule Collection Instructions	Seeds ripen at various times depending on elevation and exposure. Ripe seed will depend on the bloom time of the population targeted for seed collection [6]. Since the ripe seed capsules are reflexed on the flowering scape towards the mother plant collection is helped as the collector has an idea of where to find the capsule.
Propagule Processing/Propagule Characteristics	N/A seeds not collected by kilogram or pound.
Pre-Planting Propagule Treatments	<i>C. tweedyi</i> is erratic and difficult to raise from seed [4]. Germination of seed collected from cultivated plants has yielded germination rates of only 5% [13]. Light is required for germination of the seed. Sowing on the surface of the medium followed by eight weeks of cold stratification followed by exposure to warmth. Even then, germination may be sparse and it is advised to hold the seeds over for an additional year [14]. Germination improvement has been linked to the removal of the strophilar tissue, mimicking the consumption of this appendage and later seed dispersal by ants in nature [10]. It has been observed that after the seeds fall from the capsule an exposure to heat over the summer may aid germination rates. Seeds were exposed to summer heat in an unheated hoop-house and then planted in the autumn for germination the following spring. It was found that these seeds germinated at a far higher rate than other seed batches. This could be a helpful clue in improving germination rates of this species and this episode did mimic what seeds endure under natural conditions [12].
Growing Area Preparation / Annual Practices for Perennial Crops	Sharp drainage required, always. Builders sand is an economical and effective growing media [12].
Establishment Phase Details	Plants may grow at a steady pace the first and second years. Important to note that watering shall cease after plants stop putting on new growth [4], [12].
Length of Establishment Phase	2-3 years from seed to flower. Flowering a reliable measure of a mature species [4], [12].
Active Growth Phase	For seedlings and mature plants this time period should simulate the melting snows of spring by beginning watering in March, a dry rest during summer months,

	followed by additional watering in the autumn, followed by a dry rest over winter [4], [5], [6], [12].
Length of Active Growth Phase	Spring to mid-summer.
Hardening Phase	Hardening in this species should be understood to refer to implementing a strict watering regime. Plants should be watered beginning in March. After the plant has finished blooming watering should cease until autumn. Watering may resume until first frost. Then watering shall cease until spring. The intent is to mimic the natural watering times of the species as much as possible. This is crucial as the species is susceptible to crown rot if the soil is over saturated [4], [5], [12].
Length of Hardening Phase	N/A
Harvesting, Storage and Shipping	N/A
Length of Storage	N/A
Guidelines for Outplanting / Performance on Typical Sites	N/A no documented outplantings although plants cultivated in Wenatchee area gardens grow very well [5].
Other Comments	Wild collected seed should be collected judiciously. Please refer to the Washington State Department of Natural Resources for further information.
PROPAGATION DETAILS	
Ecotype	Cultivated or wild plants
Propagation Goal	Plants
Propagation Method	Vegetative
Product Type	7 cm containers
Stock Type	N/A
Time to Grow	Varies
Target Specifications	This method can be used for desired cultivars or reliable method for increasing this species as seed propagation is erratic [4], [12], [13], [14].
Propagule Collection Instructions	Cuttings may be taken after new flush of growth in spring or autumn from side growth shoots of the caudex. Rooting hormone is then applied and the cuttings struck into a sharply draining medium. If side shoots are non-existent the caudex can be scarred in the late winter or early spring to encourage side-shoot growth [4].
Propagule Processing/Propagule Characteristics	Side-growth from the caudex. Slicing a piece of the caudex with the shoot may be necessary for necessary root development [4].
Pre-Planting Propagule Treatments	N/A
Growing Area Preparation / Annual Practices for Perennial Crops	Builders sand, pumice, or other sharply draining mixes are the most practical media for cuttings [13].
Establishment Phase Details	Keep media moist during establishment [4].

Length of Establishment Phase	Four to five weeks [4].
Active Growth Phase	Spring until mid-summer [4].
Length of Active Growth Phase	Spring until mid-summer [4].
Hardening Phase	Same as for seed grown plants.
Length of Hardening Phase	Same as for seed grown plants.
Harvesting, Storage and Shipping	N/A
Length of Storage	N/A
Guidelines for Outplanting / Performance on Typical Sites	N/A no outplantings documented.
Other Comments	Cuttings taken of wild specimens should be judicious and sparing. Check for any required permit authorization(s).

INFORMATION SOURCES

References	<p>[1] "Collections Databases." Collections Databases Burke Museum. N.p., n.d. Web. 05 April 2018. http://biology.burke.washington.edu/</p> <p>[2] USDA NRCS National Plant Data Team. (2018). <i>Cistanthe tweedyi</i> (A.Gray) Hershkovitz: Tweedy's pussypaws. [Accessed April 08, 2018]. https://plants.usda.gov/core/profile?symbol=CITW2</p> <p>[3] Edwards, Erika J., Matthew Ogburn, R., & Edwards, Erika J. 2015. <i>Life history lability underlies rapid climate niche evolution in the angiosperm clade Montiaceae</i>. Molecular Phylogenetics and Evolution. 92: 181-192.</p> <p>[4] Nicholls, G. 2002. <i>Alpine Plants of North America: An encyclopedia of mountain flowers from the Rockies to Alaska</i>. Portland (OR): Timber Press.</p> <p>[5] Davidson, BL. 2000. <i>Lewisias</i>. Portland (OR): Timber Press.</p> <p>[6] Bubelis, W.F. 1968. <i>Contributions to an ecological life history of Lewisia tweedyi</i> (Gray) Robins. (Portulacaceae). Research report submitted in partial fulfillment of the requirements for the degree of Master of Science. University of Washington. 41 pp.</p> <p>[7] COSEWIC. 2013. <i>COSEWIC assessment and status report on the Tweedy's Lewisia <i>Lewisiopsis tweedyi</i> in Canada</i>. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 22 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm).</p> <p>[8] <i>Climatography of the United States NO.81</i>" (PDF). National Oceanic and Atmospheric Administration. May 2011. [Accessed April, 2018]. https://www.ncdc.noaa.gov/data-access/land-based-</p>
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Other Sources Consulted	Hershkovitz, H.A. 2006. <i>Ribosomal and chloroplast DNA evidence for diversification of western American Portulacaceae in the Andean region</i> . Gayana Bot. 63(1): 13-74, 2006.
Protocol Author	Stephen Munro
Date Protocol Created or Updated	05/16/18

Plant Data Sheet

Species

Tweedy's Lewisia,
Lewisia tweedyi



Range

L. Tweedyi is endemic to the Wenatchee Mountains of central Washington's Chelan and Kittitas Counties. Also, it can be found in the Methow valley in B.C.

Climate, elevation

Well drained mountain ecosystems with full sun.

Local occurrence

Wenatchee Mountains in Central Washington and the Methow Valley in B.C.

Habitat preferences

L. Tweedyi grows primarily in dry rocky banks and talus slopes with full sun where ponderosa pine is found.

Plant strategy type/successional stage

A perennial evergreen plant which specializes in living on dry rocky areas so it encounters little competition.

Associated species

L. Tweedyi Is commonly found with ponderosa pine. It is also related to a *Lewisia* found in more moist sandy soils near the Colombia.

May be collected as:

Can be collected as seeds or cuttings in mid June. (Gnps.org)

Collection restrictions or guidelines

The seeds have a sweet scent and come from a 10-20cm flower which is pink to yellow in color. (cwnp.org) Plants do not go to seed very well outside of the wild, so they are often propagated by stem cuttings which should be planted in early spring. (paghat.com)

Seed germination (needs dormancy breaking?)

Seeds should be stratified for the winter, or sewn during fall in a place with cold winters as to break dormancy.

Seed life (can be stored, short shelf-life, long shelf-life)

It is best to use the seeds the season they are collected. However, if needed they should be cleaned of the sweet skin, which may contain a germination inhibitor, dried in a paper bag and stored in a cool place.

Recommended seed storage conditions

In a paper bag in a cool place.

Propagation recommendations (plant seeds, vegetative parts, cuttings, etc.)

Seeds should be planted in early spring after sufficient cold stratification. (Susansgardenpatch.com) Cuttings should also be planted at this time.

Soil or medium requirements (inoculum necessary?)

“Well drained gritty soil in full sun” (Susansgardenpatch.com).

Installation form (form, potential for successful outcomes, cost)

After the plant has had sufficient time to establish it can be transplanted to the intended site.

Recommended planting density

Care requirements after installed (water weekly, water once etc.)

As *L. Tweedyi* is used to excessively well drained soils, watering should be done in small amounts. The pots can be kept on a layer of saturated sand so only the lower roots can access the water.

Normal rate of growth or spread; lifespan

Grows slowly and can live for many years, though not much is written about the lifespan. Populations spread very slowly as they rely on ants for seed distribution.

Sources cited

Pojar, Jim and Andrew MacKinnon. 1994. Plants of the Pacific Northwest Coast Washington, Oregon British Columbia & Alaska. BC Ministry of Forests and Lone Pine Publishing, Vancouver, British Columbia, Canada

<http://www.gnps.org> Georgia Native Plant Society

<http://www.cwnp.org/photopgs/ldoc/letweedyi.html> Central Washington Native Plants

<http://www.susansgardenpatch.com/rock15.htm> Susan’s Garden Patch

<http://www.paghat.com/lewisia7.html> The Garden of Paghat

http://www.em.ca/garden/per_lewisia_tweedyi1.html Perennial Gardening on the Prairies

Data compiled by (student name and date)