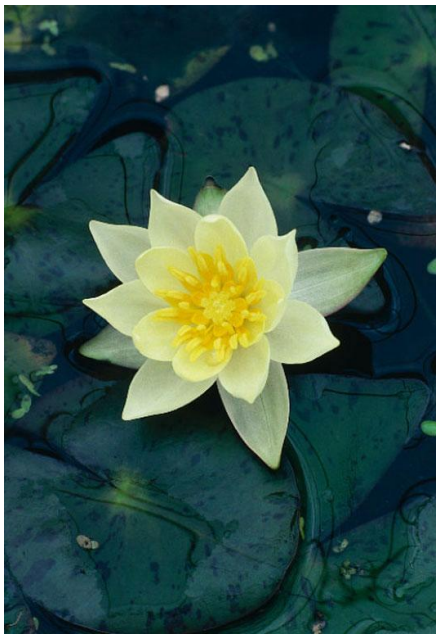
Plant Propagation Protocol for *[Nymphaea tetragona]*
ESRM 412 – Native Plant Production



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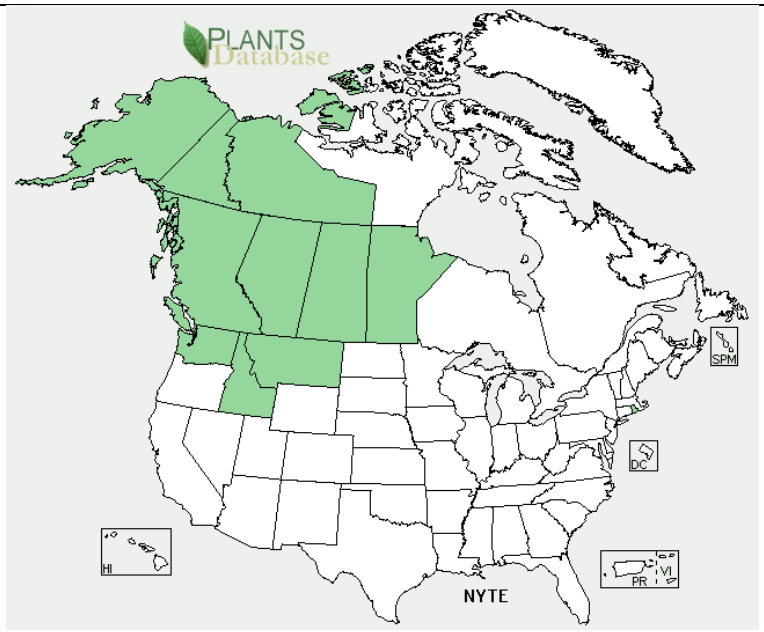
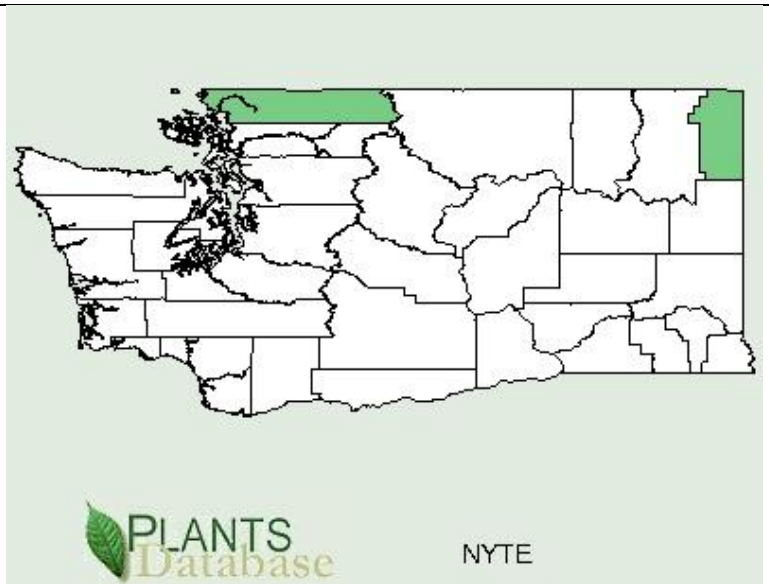
(DaXingAnLing Snow Lotus Herb Bio-technology Co., Ltd)

TAXONOMY	
Family Names	
Family Scientific Name:	Nymphaeaceae (“Plant Profile: *Nymphaea tetragona* Georgi pygmy waterlily”)
Family Common Name:	Water-lily family (“Plant Profile: *Nymphaea tetragona* Georgi pygmy waterlily”)
Scientific Names	
Genus:	*Nymphaea* L. (“Plant Profile: *Nymphaea tetragona* Georgi pygmy waterlily”)
Species:	*Nymphaea tetragona* Georgi (“Plant Profile: *Nymphaea tetragona* Georgi pygmy waterlily”)

Species Authority:	*Nymphaea tetragona* Georgi pygmy water-lily ("Plant Profile: *Nymphaea tetragona* Georgi pygmy waterlily")
Variety:	
Sub-species:	
Cultivar:	
Authority for Variety/Sub-species:	
Common Synonym(s) (include full scientific names (e.g., *Elymus glaucus* Buckley), including variety or subspecies information)	*Castalia crassifolia* Hand.-Mazz. *Castalia tetragona* (Georgi) G. Lawson *Leuconymphaea tetragona* (Georgi) Kuntze. *Nymphaea crassifolia* (Hand.-Mazz.) Nakai *Nymphaea fennica* Mela *Nymphaea tetragona* var. *crassifolia* (Hand.-Mazz.) Y. C. Chu *Nymphaea tetragona* var. *himalayense* F. Henkel et al. *Nymphaea tetragona* subvar. *indica* Casp. *Nymphaea tetragona* var. *indica* (Casp.) F. Henkel et al. *Nymphaea tetragona* var. *lata* Casp. *Nymphaea tetragona* var. *wenzelii* (Maack) F. Henkel et al. *Nymphaea wenzelii* Maack
Common Name(s):	Pygmy water-lily ("Plant Profile: *Nymphaea tetragona* Georgi pygmy waterlily") Pygmy water-lily, small white water-lily, Zwerg-Seerose
Species Code (as per USDA Plants database):	NYTE ("Plant Profile: *Nymphaea tetragona* Georgi pygmy waterlily")
GENERAL INFORMATION	
Geographical range (distribution maps for North America and Washington state)	 (USDA)

	 (USDA) Common from north Michigan, east through Manitoba, Canada, and north to Alaska and Eurasia. There are some occurrences in Montana, British Columbia, Saskatchewan, Manitoba, and Alberta, Canada. *Nymphaea tetragona* is very rare in Washington and possibly extirpated. It was historically found around 1930 in Whatcom and Pend Oreille counties (Hitchcock)
Ecological distribution (ecosystems it occurs in, etc):	
Climate and elevation range	Grows best at an elevation of 0 to 4000 feet (Hitchcock)
Local habitat and abundance; may include commonly associated species	*Nymphaea tetragona* is found in ponds, swamps, lakes, and quiet streams in the lowland and montane zones (Hitchcock)
Plant strategy type / successional stage (stress-tolerator, competitor, weedy/colonizer, seral, late successional)	A species of interest in aquatic and vernal pools (Lavelle)
Plant characteristics (life form (shrub, grass, forb), longevity, key characteristics, etc)	*Nymphaea tetragona* is a perennial aquatic herb with leaves arising from unbranched, erect rhizomes and a slender stem. The floating leaf blades are elliptic-oval and hairless. The leaves are green and sometimes mottled red-brown to purple above (young leaves) and green to dull purple beneath, and they are 1-5 in. (3-13 cm) long by 3⁄4 to 4 1⁄4 (2-11 cm) wide, with 7-13 palm-like veins. The white to pinkish, yellow-centered, non-odorous flowers open in

	the afternoon and close in the evening. The floating inflorescence is 1 to 3 in. (3-7.5 cm) in diameter. There are 7-15 petals that are equal in size to the green, leafy bracts and are 3⁄4 to 1 in. (2-3 cm) long. The base of the flower is square where it attaches to the pedicel. The flowers of *N. tetragona* open in the afternoon and close in the evening. The fruits are berry-like, leathery, many-seeded, capsules that rupture to release a jelly-like seed mass. The seeds are ovoid and less than 1/8 in. (3 mm) by 1/16 in. (2 mm) (Hitchcock).
PROPAGATION DETAILS	
Ecotype (this is meant primarily for experimentally derived protocols, and is a description of where the seed that was tested came from):	*Nymphaea tetragona* is a part of a restoration project that is designed to restore forest conditions on approximately 965 acres of Forest Service lands within the Auggie, Seeley, and Mountain Creek drainages. The vegetation treatments are designed to develop a diverse mix of vegetative composition and structure, reduce the risk of bark beetle infestations, and reduce the threat of sustained high intensity wildfire in the wildland-urban interface (Lavelle).
Propagation Goal (Options: Plants, Cuttings, Seeds, Bulbs, Somatic Embryos, and/or Other Propagules):	Seeds (Germplasm Resources Information).
Propagation Method (Options: Seed or Vegetative):	Seed ("Plant Profile: *Nymphaea tetragona* Georgi pygmy waterlily"). A water plant requiring a rich soil and a sunny position in still. Prefers a pH between 6 and 7. Best grown in 15 - 30cm of water (GardenBed) The division of hardy waterlilies is best undertaken during the spring, although they can also be divided in early summer as well. With most cultivars the lifted plant will consist of a main rootstock from which several eyes will have grown to form sizeable branches. The side branches that should be retained for replanting. ("Propagating Hardy Waterlilies Division and Eyes").
Product Type (options: Container (plug), Bareroot (field grown), Plug + (container-field grown hybrids, and/or Propagules (seeds, cuttings, poles, etc.))	Wrapping the developing seed head in a muslin bag to avoid the seed being lost collects the seed. Harvest it 10 days after it sinks below the soil surface or as soon as it reappears. Divide in May. Each portion must have at least one eye. Submerge in pots in shallow water until established (GardenBed).
Stock Type:	
Time to Grow (from seeding until plants are ready to be outplanted):	

Target Specifications (size or characteristics of target plants to be produced):	Flower small, 2.5 to 5 cm. across, white, with a small number of floral parts; receptacle distinctly tetragonal. Leaves ovate, small (2.5 to 12 cm. long), green above with brown blotches when young, under surface dull red; sinus open, lobes acute. Petiole with 2 main air-canals. Rhizome erect, covered with projecting leaf-scars (Conrad).
Propagule Collection (how, when, etc):	
Propagule Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc):	Seed germination of waterlilies requires light and the presence of ethylene whose production is stimulated when seeds are crowded together. Germination is enhanced by cold stratification for several months. However, a large number of seeds germinate after the removal of adult plants and light breaks dormancy and stimulates germination (DiTomaso, 442)
Pre-Planting Propagule Treatments (cleaning, dormancy treatments, etc):	
Growing Area Preparation / Annual Practices for Perennial Crops (growing media, type and size of containers, etc):	Sow seeds as soon as it is ripe in a greenhouse in pots submerged under 25mm of water. Prick out into individual pots as soon as the first true leaf appears and grow them on in water in a greenhouse for at least two years before planting them out in late spring (GardenBed). Plant each eye in a small pot using an aquatic planting compost, and place in a shallow bowl of water. Stand these in a partially shaded cold frame. As they grow the water level must be raised. Re-pot until the stage at when they can be moved on to a small planting basket and then introduce them to a shallow tank or the margins of the pond until they are large enough to be transferred to a full-sized basket. After five to six weeks the plants will start to develop and become recognizable as young waterlilies (“Propagating Hardy Waterlilies Division and Eyes”)
Establishment Phase (from seeding to germination):	
Length of Establishment Phase:	Four to five years after germination (Kunii, 95)
Active Growth Phase (from germination until plants are no longer actively growing):	
Length of Active Growth Phase:	
Hardening Phase (from end of active	

growth phase to end of growing season; primarily related to the development of cold-hardiness and preparation for winter):	
Length of Hardening Phase:	
Harvesting, Storage and Shipping (of seedlings):	Aquatic seeds like *Nymphaea tetragona* cannot tolerate drying. The seeds are best germinated immediately or refrigerated for short periods of time between sheets of moist toweling or filter paper (Holloway).
Length of Storage (of seedlings, between nursery and outplanting):	
Guidelines for Outplanting / Performance on Typical Sites (eg, percent survival, height or diameter growth, elapsed time before flowering):	Cut the side branches from the main rootstock and then discard the older central part of the plant. Although large and apparently healthy it is unlikely to produce a plant that can compare in quality with those resulting from the side branches. These pieces are planted directly into planting baskets, as would be the case for any freshly purchased waterlily. Propagating waterlilies by division is a natural consequence of good pond management. After three or four years most cultivars become overgrown, their foliage climbing out of the water and flower quality diminishing ("Propagating Hardy Waterlilies Division and Eyes"). Nymphaea tetragona can maintain an equilibrium rhizome volume by annual turnover of 20%-30% of its mass (Kunii, 94).
Other Comments (including collection restrictions or guidelines, if available):	*Nymphaea tetragona* blooms from June through August (Hickman). The primary threat to *Nymphaea tetragona* is a change in the water quality of its habitats. Changes in water quality may be due to nearby logging, siltation, nutrient loading, and eutrophication. Competition with exotic species may also be a factor (Hitchcock)
INFORMATION SOURCES	
References (full citations):	Conrad, Henry S. "Waterlilies of Washington". A Monograph of the Genus Nymphaea. The Carnegie Institution of Washington 1905. DiTomaso, J.M. and E.A. Healy. 2003. Aquatic and Riparian Weeds of the West. California: University of California, Agriculture and Natural Resources; 442 p. Douglas, G.W., G.B. Straley, D. Meidinger, and J. Pojar. 1999. *Illustrated Flora of British Columbia* vol. 3: *Dicotyledons (Diapensiaceae Through Onagraceae)*. Ministry of Environment, Lands and Parks, Victoria, British Columbia. 423 pp. GardenBed. *Nymphaea tetragona* Propagation Notes <http://plant.gardenbed.com/gardening.how/species/4339/plant/home>.

	Hickman, J.C. 1993. *The Jepson Manual: Higher Plants of California.* University of California Press, Berkeley. 1400 pp. Hitchcock, C.L., A. Cronquist, M. Ownbey, J.W. Thompson. 1964. *Vascular Plants of the Pacific Northwest* Part 2: *Salicaceae to Saxifragaceae.* University of Washington Press, Seattle, WA. 597 pp. Holloway, Dr. Patricia S. "Tips on Collecting, Processing and storing seeds of Alaska Native Plants". April 1994. Georgeson Botanical No. 18. Georgeson Botanical Garden. University of Alaska Fairbanks Agricultural and Forestry Experiment Station. Kunii, Hidenobu. Rhizome Longevity in Two Floating-leaved Aquatic Macrophytes, *Nymphaea tetragona* and *Brasenia schreberi*. 1993. 94-98 pp. Lavelle, Darlene. Auggie Creek Restoration/Fuels Project Threatened, Endangered, and Sensitive Plant Report. December 17, 2008. < http://www.fs.fed.us/r1/lolo/projects/auggie-creek-fuels/auggie_specialist_reports/tes_plants_report.pdf>. "Plant Profile: *Nymphaea tetragona* Georgi pygmy waterlily". United States Department Agriculture: Natural Resources Conservation Services. 21 May 2009 <http://plants.usda.gov/java/profile?symbol=NYTE>. "Propagating Hardy Waterlilies Division and Eyes". International Water Gardener. 22 May 2009. <http://pondmessenger.com/content.asp?Category=263&index=5>. USDA, ARS, National Genetic Resources Program. *Germplasm Resources Information Network - (GRIN)* [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. <http://www.ars-grin.gov/cgi-bin/npgs/html/tax_search.pl?Nymphaea%20tetragona>.
Other Sources Consulted (but that contained no pertinent information) (full citations):	
Protocol Author (First and last name):	Anna Cleveland
Date Protocol Created or Updated (MM/DD/YY):	05/27/09

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