Plant Propagation Protocol for *Potamogegeton natans*
ESRM 412 – Native Plant Production
URL: https://courses.washington.edu/esrm412/protocols/2024/PONA4.pdf

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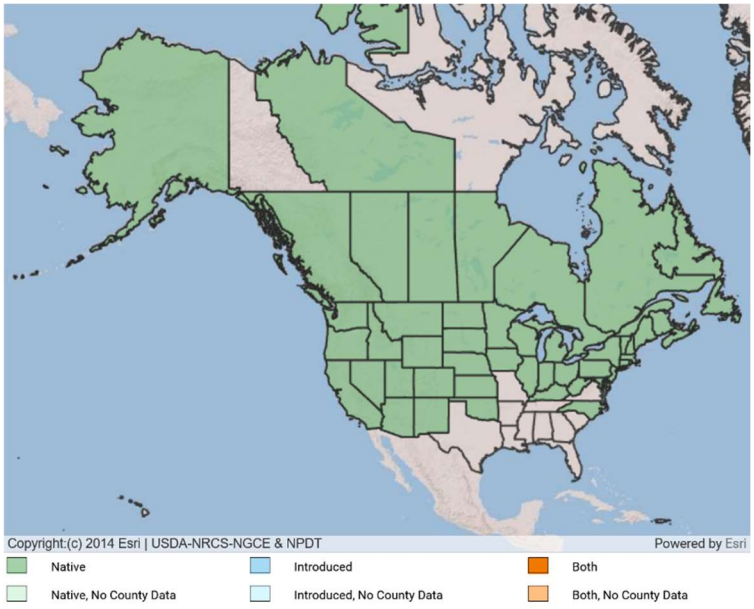
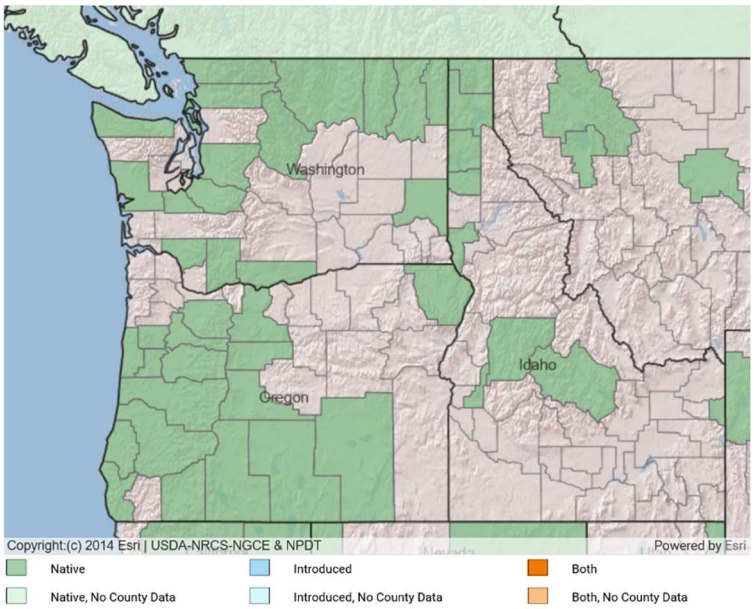
TAXONOMY	
Plant Family	
Scientific Name	*Potamogetonaceae* Bercht. & J. Presl[2]
Common Name	Pondweed Family[2]
Species Scientific Name	
Scientific Name	*Potamogeton natans* L.[2]
Varieties	No varieties recognized[2]
Sub-species	No sub-species recognized[2] *Note*: Known to hybridize with other *Potamogeton spp*. producing sterile offspring[3,4]
Cultivar	No cultivars recognized[2]
Common Synonym(s)	None recognized[2]

Common Name(s)	Floating pondweed,[2] floating-leaved pondweed,[5,6,7] broad-leaved pondweed[6]
Species Code (as per USDA Plants database)	PONA4
GENERAL INFORMATION	
Geographical range	Common and widespread in the Pacific Northwest and throughout much of northern North America.[6]   *Note:* Distribution maps adapted from USDA Plant Database[2]

Ecological distribution	*P. natans* is classified as an obligate wetland plant and occurs in permanently flooded areas and calm, shallow water roughly 1-3m deep. This includes lakes, ponds, sloughs, sheltered bays, and slow streams.[5,6,7,8] Water may be fresh or brackish.[5,7]
Climate and elevation range	Permanently flooded, full sun locations from sea level and low elevations to mid-elevations.[5,8]
Local habitat and abundance	*P. natans* grows in organic and mineral soils.[7,8] It is a common species present in *Ranunculus aquatilis, Potamogeton gramineus, Nuphar polysepdum, Typha latifolia, Polygonum amphibium, and Potamogeton natans* plant associations/community types. [9,10,11]
Plant strategy type / successional stage	*Potamogeton spp.* are known to be weedy and occasionally become nuisances in small, shallow waterbodies, or controlled aquatic systems such as drainage canals and irrigation ditches.[8,12,13,14] *P. natans* is tolerant of poor water quality. [7]
Plant characteristics	*Potamogeton natans* is a perennial aquatic forb that grows from slender rhizomes rooted into the substrate from its lower nodes. It has two distinct leaf types; thin, linear submerged leaves averaging 15 cm long, and broadly elliptical floating leaves averaging 6-8 cm of blade length with a long petiole. Long and firm stipules subtend each leaf.[5,7] Both leaf types are leathery in texture. The submerged leaves often decay before fruits fully mature.[5,15] In the winter, growth dies back to the rhizome and winter tubers.[7,8,16] Small, wind-pollinated, 4-parted flowers are produced on an erect inflorescence spike that emerges above the water and bloom May-August.[7,] Fruits are small, tan achenes that float and are dispersed by water or are ingested and/or dispersed by wildlife.[5,13] *Potamogeton spp.* stabilize shorelines and are an important food source and habitat for many aquatic animals.[17] They make up a large percentage of the annual food consumption by ducks.[18,19]

	Asexual reproduction is common from broken-off pieces of stem and rhizome.[16]
PROPAGATION DETAILS: FROM SEED	
Ecotype	Seed harvested from *P. natans* of ponds and lakes around New York.[20]
Propagation Goal	Plants
Propagation Method	Seed
Product Type	Bareroot
Stock Type	No information available
Time to Grow	No information available
Target Specifications	Germinants[20]
Propagule Collection Instructions	In late summer (20 August – 12 September experimental), whole inflorescences should be collected with fruit attached. Fruits should always be kept wet with a damp cloth or by placing them in clean water.[20]
Propagule Processing/Propagule Characteristics	In experimental trials, *P. natans* remained viable and germinated for 4 years after planting in water and wet mud. Seeds can survive drying for a period, but after many months will become unviable (Guppy 1897, as cited by Muenscher 1936).[20] Seeds that survive ingestion by birds such as ducks germinate readily.[13] The seed density of related species, *P. perfoliatus,* can range from 3,839 seeds to 11,088 seeds per pound.[21]
Pre-Planting Propagule Treatments	Seeds may require a brief after-ripening period as they naturally finish the ripening process underwater.[22] Leaves, immature seeds, and other detritus should be removed from the good seed. Seeds should be rinsed several times and stored in water at 1-3 °C for a period of cold stratification. Germination rates increase with time stratified up to a year.[20]

	Ideal stratification periods may need to be determined experimentally. Seeds should be sterilized before exposure to germination conditions.[22]
Growing Area Preparation / Annual Practices for Perennial Crops	After stratification seeds can be placed in glass jars or other small vessels and covered with 20-30 cm of fresh water.[20]
Establishment Phase Details	Germinating seeds should be kept in indirect light in a controlled environment such as a greenhouse. Water levels should be maintained at 20-30 cm above the seeds and distilled or conditioned water should be used to avoid damaging the plants with high concentrations of chemicals or dissolved ions. Water must remain aerobic through water changes or an aquarium bubbler.[20,23]
Length of Establishment Phase	If seeds are removed from all fleshy material and their seed coats are broken, germination can be observed in as little as one day when maintained at 29 °C.[22]
Active Growth Phase	No information is available for *P. natans* propagated by seed. Some general aquatic plant guidelines: Root media should be fine textured, and non-compacting to ensure root health of submerged aquatic vegetation. Media can be purchased premade or mixed from sand, topsoil, and similar components. Large stock tanks can be used for growth similar to field conditions, or smaller stock tanks may be used for lower cost and greater flexibility. Planting containers should be without holes to prevent loss of substrate, or plants should be planted directly into substrate within the larger growth container. Water quality should be monitored for plant health and chlorine should be avoided. Slow-release fertilizer may be used to replace nutrients as they are consumed. Water should be aerated to provide circulation and prevent hypoxic environments. Pests can be treated with insecticides or small populations of insect-eating fish.[23] When planting into media, gently insert roots into a hole in the substrate and spread media overtop to secure. Place containers into tanks immediately to avoid plant desiccation.[23]

Length of Active Growth Phase	No information available
Hardening Phase	No information available
Length of Hardening Phase	No information available
Harvesting, Storage and Shipping	Being aquatic, *Potamogeton spp.* lack cuticles and must always be kept wet to avoid desiccation.[23]
Length of Storage	Storage of plants should be avoided to avoid the risk of desiccation.
Guidelines for Outplanting / Performance on Typical Sites	No information available
Other Comments	Seed can be immediately dispersed in new locations if lacking the capacity for germination and growth in a nursery environment.[21] A permit is likely required for the collection of seeds or other vegetative material from wild populations on public land. Those wishing to gather propagation materials should check with the appropriate agencies before collection.

PROPAGATION DETAILS: VEGETATIVE

Note: No information is available for *P. natans.* As such, a protocol is provided based on general *Potamogeton* propagation and the species *P. perfoliatus* of the same genus (*Potamogeton* L.) that has similar habitat, and growth characteristics to *P. natans. P perfoliatus* is not native to the Pacific Northwest but does overlap in the eastern range of *P. natans* as well as north in BC.[17]

Ecotype	No specific ecotype discussed
Propagation Goal	Plants
Propagation Method	Vegetative – Rhizome or Stem Cuttings[24]
Product Type	Bareroot, Container (Propagules if directly outplanting to a site)[17,23,24]
Stock Type	No information available
Time to Grow	About 14 weeks for *P. perfoliatus*[24]

Target Specifications	Fully rooted plants established enough to survive stormy and winter weather conditions. If producing cuttings for immediately outplanting to the site, aim for lengths at least 3 cm long with several nodes.[24]
Propagule Collection Instructions	Whole plants of *Potamogeton* can be collected with a rake during the growing season.[8] Cuttings can be made of any part of the stem and rhizome and multiple cuttings may be made from the same stem. Longer cuttings about 7.5 cm in length were found to form new roots and shoots quicker than shorter 2.5 cuttings.[24] Try to select plants with healthy growth points for best success. Mother plants of a similar size will produce more uniform daughters.[23] Plant materials must be kept in water or wet paper towels to avoid desiccation between the collection and processing sites.[20,23] *Note:* Cuttings can be taken and planted immediately if propagating from the same site or if better suited to production goals.[17]
Propagule Processing/Propagule Characteristics	Cuttings can be maintained in clear containers of tap water at room temperature and in ambient light for over a month.[24]
Pre-Planting Propagule Treatments	Cuttings should be inspected to avoid introducing weeds or pests to the propagation environment. If cuttings need to be stored for a period they may be kept in water as described above.[24]
Growing Area Preparation / Annual Practices for Perennial Crops	Sediments may be removed from a pondweed bed in the field to provide media or media can be made from components or purchased premixed.[23] A combination of peat and oyster shell has shown to be effective for *P perfoliatus.* Ideal media mixes will be low in organic materials but still provide some nutrients to the plant.[17] Plants may be grown in movable containers filled with media or as bareroot stock in one large tank with a media bottom.[17,23]

	Water tanks can be either large or small depending on the number of plants needed and how much space and resources are available. Tanks should be large enough to cover plants with at least 45 cm of water.[23,24] Either a source of water low in dissolved ions and free of chlorine or a way to treat the water is recommended, as both can be damaging to aquatic plants.[23]
Establishment Phase Details	Insert cuttings roughly 5 cm into the substrate and backfill around each cutting to hold it in place. Be sure that the cutting is in the correct orientation with growth points facing up. A thin layer of sand over the media can help hold the cutting in place and limit nutrient loss to the water.[23] Cuttings may also be rooted in water without any media.[24] Water temperatures should be maintained around 20-25 °C while cuttings are established.[24] Water should be kept clean using nets, filters, or herbivore cleaning crews to limit algae growth.[17] Aeration may be necessary to maintain proper gas exchange in the tank and supplemental lighting may be required depending on the season.[23,24]
Length of Establishment Phase	*P. perfoliatus* will root within 2-3 weeks of taking cuttings.[24]
Active Growth Phase	Cultural practices are maintained similar to those of the establishment phase. Slow-release fertilizer should be used to supplement plant growth. Start with low concentrations and adjust rates for optimal growth.[23] *Potamogeton* propagated in natural areas or restoration sites may need temporary enclosures to protect from damage by animals. Tanks should be monitored for weed species to limit their spread and keep competition low.[17]
Length of Active Growth Phase	About 12 weeks between rooted *P. perfoliatus* cuttings and transplant-ready plants.[24]
Hardening Phase	Planting cuttings directly may save time and produce more resilient plants as shoots are likely to die back while roots and underground shoots develop. This saves energy from being used on shoot development until the following growth season when there is a vigorous underground system to support new growth.[17]

Length of Hardening Phase	No information available
Harvesting, Storage and Shipping	*Potamogeton spp.* must be kept wet to avoid desiccation.[23]
Length of Storage	Storage should be avoided due to the danger of desiccation and target plants should be outplanted as soon as possible once leaving the nursery.
Guidelines for Outplanting / Performance on Typical Sites	Outplanting of *P. perfoliatus* is done in a grid formation with 5-10 plants recommended per square foot.[17]
Other Comments	When starting new populations, using cuttings is often the least time-consuming propagation method compared to seed propagation.[17] A permit is likely required for the collection of seeds or other vegetative material from wild populations on public land. Those wishing to gather propagation materials should check with the appropriate agencies before collection.
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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