Plant Propagation Protocol for *Ranunculus aquatilis* L. *RAAQ*
ESRM 412 – Native Plant Production

TAXONOMY	
Family Names	
Family Scientific Name:	Ranunculaceae
Family Common Name:	Buttercup
Scientific Names	
Genus:	*Ranunculus*
Species:	*R. aquatilis* L.
Species Authority:	Linnaeus
Variety:	*Ranunculus aquatilis* L. var. *hispidulus* E. Drew *Ranunculus aquatilis* L. var. *typicus* L.D. Benson *Ranunculus trichophyllus* Chaix var. *hispidulus* (E. Drew) W. Drew (2). *Ranunculus aquatilis* L. var. *calvescens* (W.B.Drew) L.D.Benson *Ranunculus aquatilis* L. var. *capillaceus* (Thuill.) DC. *Ranunculus aquatilis* L. var. *harrisii* L.D.Benson *Ranunculus aquatilis* L. var. *lalondei* L.D.Benson *Ranunculus aquatilis* L. var. *longirostris* (Godr.) Lawson *Ranunculus aquatilis* L. var. *porteri* (Britton) L.D.Benson *Ranunculus aquatilis* L. var. *subrigidus* (W.B.Drew) Breitung *Ranunculus aquatilis* L. var. *trichophyllus* (Chaix) A.Gray (4)
Sub-species:	NA
Cultivar:	NA
Authority for Variety/Sub-species:	E. Drew, L.D. Benson, W. Drew, Dumort (2), Lawson, Breitung, A. Gray (4)
Common Synonym(s) (include full scientific names (e.g., *Elymus glaucus* Buckley), including variety or subspecies information)	BAAQ *Batrachium aquatile* (L.) Dumort RAAQH *Ranunculus aquatilis* L. var. *hispidulus* E. Drew RAAQT *Ranunculus aquatilis* L. var. *typicus* L.D. Benson RATRH *Ranunculus trichophyllus* Chaix var. *hispidulus* (E. Drew) W. Drew (2). *Ranunculus aquatilis* L. var. *calvescens* (W.B.Drew) L.D.Benson *Ranunculus aquatilis* L. var. *capillaceus* (Thuill.) DC. *Ranunculus aquatilis* L. var. *harrisii* L.D.Benson *Ranunculus aquatilis* L. var. *lalondei* L.D.Benson *Ranunculus aquatilis* L. var. *longirostris* (Godr.) Lawson *Ranunculus aquatilis* L. var. *porteri* (Britton) L.D.Benson *Ranunculus aquatilis* L. var. *subrigidus* (W.B.Drew) Breitung *Ranunculus aquatilis* L. var. *trichophyllus* (Chaix) A.Gray (4)
Common Name(s):	White water-buttercup, white water-crowfoot (1).
Species Code (as per USDA Plants database):	RAAQ
GENERAL INFORMATION	
Geographical range (distribution maps for North America and Washington state)	Throughout Pacific Northwest (1). N Alaska, and SW Alaska to British Columbia to S California. From east to west, range cover from SE Alaska to E Montana and Northwest

	Territories (2). Found in pools up to 3000 ft to 6000 ft elevation (6). For maps, see Appendix.
Ecological distribution (ecosystems it occurs in, etc):	RAAQ is an obligate wetland plant in Northeast, Southeast, North Central, North Plains, Southwest, Intermountain, Northwest regions of North America. It does not occur in Hawaii (2).
Climate and elevation range	Common at low to middle elevations (1).
Local habitat and abundance; may include commonly associated species	Ponds, sluggish streams, sloughs, water-filled ditches (1). Water less than 7' deep (4).
Plant strategy type / successional stage (stress-tolerator, competitor, weedy/colonizer, seral, late successional)	Aquatic, mostly perennial (1).
Plant characteristics (life form (shrub, grass, forb), longevity, key characteristics, etc)	Leaves: alternate, submerged leaves are finely divided, floating leaves broad, flat, 3-5 palmately lobed. Often aggregate into dense floating mats (15). Flowers: white, 10-20 mm wide; 5 sepals and petals; solitary and terminal on long stalks (1). Typically flowers from April to July (9). Five green sepals that are up to 1/8 inch long and free from each other. There are also five ¼ inch white petals that are independent of each other. Ten to 25 stamens and many superior and smooth pistils (9). Fruit: Achenes, asymmetrically egg-shaped, hairy to hairless, short beaked, cross-ridged, 10-20 in a round cluster (1). Each achene can be up to 1/16 inch long. They are consumed by water fowls (9). Stems submerged, weak, sparingly branched, leafy rooting at lower nodes, 1-2 mm thick, to 1 m long (1).

PROPAGATION DETAILS: Seeds	
Ecotype (this is meant primarily for experimentally derived protocols, and is a description of where the seed that was tested came from):	Seeds, no available location.
Propagation Goal (Options: Plants, Cuttings, Seeds, Bulbs, Somatic Embryos, and/or Other Propagules):	plants
Propagation Method	Seed

(Options: Seed or Vegetative):	
Product Type (options: Container (plug), Bareroot (field grown), Plug + (container-field grown hybrids, and/or Propagules (seeds, cuttings, poles, etc.))	Container plants
Stock Type:	NA
Time to Grow (from seeding until plants are ready to be outplanted):	NA
Target Specifications (size or characteristics of target plants to be produced):	NA
Propagule Collection (how, when, etc):	Seeds are collected when they are still green and have not fallen away in summer or autumn. Wrap and tie muslin around the faded flower deep enough to contain the ovules. Seeds can be collected in 2-3 weeks. Do not let the seeds dry out (5).
Propagule Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc):	NA
Pre-Planting Propagule Treatments (cleaning, dormancy treatments, etc):	NA
Growing Area Preparation / Annual Practices for Perennial Crops (growing media, type and size of containers, etc):	Prepare pots filled with aquatic soil mix or soil-based potting mix. After sowing the seeds evenly across the surface, spread thin layer of fine grit of about 5 mm thickness. The pots need to be set in a larger and deeper pot with enough water to barely cover the smaller pots. Pots should be then placed in bright areas (5).
Establishment Phase (from seeding to germination):	NA
Length of Establishment Phase:	NA
Active Growth Phase (from germination until plants are no longer actively growing):	NA
Length of Active Growth Phase:	NA
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):	NA
Length of Hardening Phase:	NA

Harvesting, Storage and Shipping (of seedlings):	NA
Length of Storage (of seedlings, between nursery and outplanting):	NA
Guidelines for Outplanting / Performance on Typical Sites (eg, percent survival, height or diameter growth, elapsed time before flowering):	Outplant the seedlings in the following Spring after the water has warmed up (5).
Other Comments (including collection restrictions or guidelines, if available):	Seeds only float for a few days (10). Germination from seeds are often unpredictable. Success rate can be improved by harvesting seeds when the fruit is still green. Do not fertilize because it encourages algal growth (5). Some Ranunculaceae have rudimentary embryos with a very small pro-embryo embedded in a large endosperm. The endosperm also contain germination-inhibiting chemicals that are activated in high temperatures. Such seeds can be exposed to cool temperature of 15 C (59 F) below to encouraging germination. Seeds can also be exposed to alternative temperatures or potassium nitrate or gibberellic acid. (9)

PROPAGATION DETAILS: Vegetative	
Ecotype (this is meant primarily for experimentally derived protocols, and is a description of where the seed that was tested came from):	NA
Propagation Goal (Options: Plants, Cuttings, Seeds, Bulbs, Somatic Embryos, and/or Other Propagules):	plants
Propagation Method (Options: Seed or Vegetative):	Vegetative
Product Type [options: Container (plug), Bareroot (field grown), Plug + (container-field grown hybrids, and/or Propagules (seeds, cuttings, poles, etc.)]	Container
Stock Type:	NA
Time to Grow (from seeding until plants are ready to be outplanted):	NA

Target Specifications (size or characteristics of target plants to be produced):	NA
Propagule Collection (how, when, etc):	Divisions are best in late Spring when growth is active and wounds heal quickly. Cuttings should be done in spring or summer after flowering (5).
Propagule Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc):	NA
Pre-Planting Propagule Treatments (cleaning, dormancy treatments, etc):	Thoroughly wash the stem, leaves, and roots to rid of algal weed. Divide the plant after flowing and separate each plant into single root crowns. Division can also occur in autumn. (5)
Growing Area Preparation / Annual Practices for Perennial Crops (growing media, type and size of containers, etc):	For cuttings and divisions, fill large pots with aquatic soil mix or heavy soil. Then partly bury the propagules into the soil with an additional thin layer of gravel. Place the pots into larger, deeper pots and add water until the smaller pots are barely covered in water. The pots should be located in brightly lit areas (5). Cuttings can also root in a jar of water. After the roots have sprouted, then transfer to potted soil or plant out (5).
Establishment Phase (from seeding to germination):	NA
Length of Establishment Phase:	Propagules from cuttings can be ready for planting in 2-3 weeks (5).
Active Growth Phase (from germination until plants are no longer actively growing):	NA
Length of Active Growth Phase:	NA
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):	NA
Length of Hardening Phase:	NA
Harvesting, Storage and Shipping (of seedlings):	NA
Length of Storage (of seedlings, between nursery and outplanting):	NA
Guidelines for Outplanting / Performance on Typical Sites (eg, percent survival, height or diameter growth,	NA

elapsed time before flowering):	
Other Comments (including collection restrictions or guidelines, if available):	If a plant is removed from water, the stem nodes will sprout roots (9). One experiment studied the interaction between flow velocity and growth medium's texture and the subsequent effects on RAAQ's growth rate. Boeger's study found that growth rate is the highest at all three flow velocities (22.6 cm/s, 11.0 cm/s, 2 cm/s) in mud substrate. The basic method is placing plant shoots in wood boxes submerged in a stream for 21 days (14).

INFORMATION SOURCES	
References (full citations):	See below.
Other Sources Consulted (but that contained no pertinent information) (full citations):	See below.
Protocol Author (First and last name):	Zhu Zhu Xiao
Date Protocol Created or Updated (MM/DD/YY):	04/28/09

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

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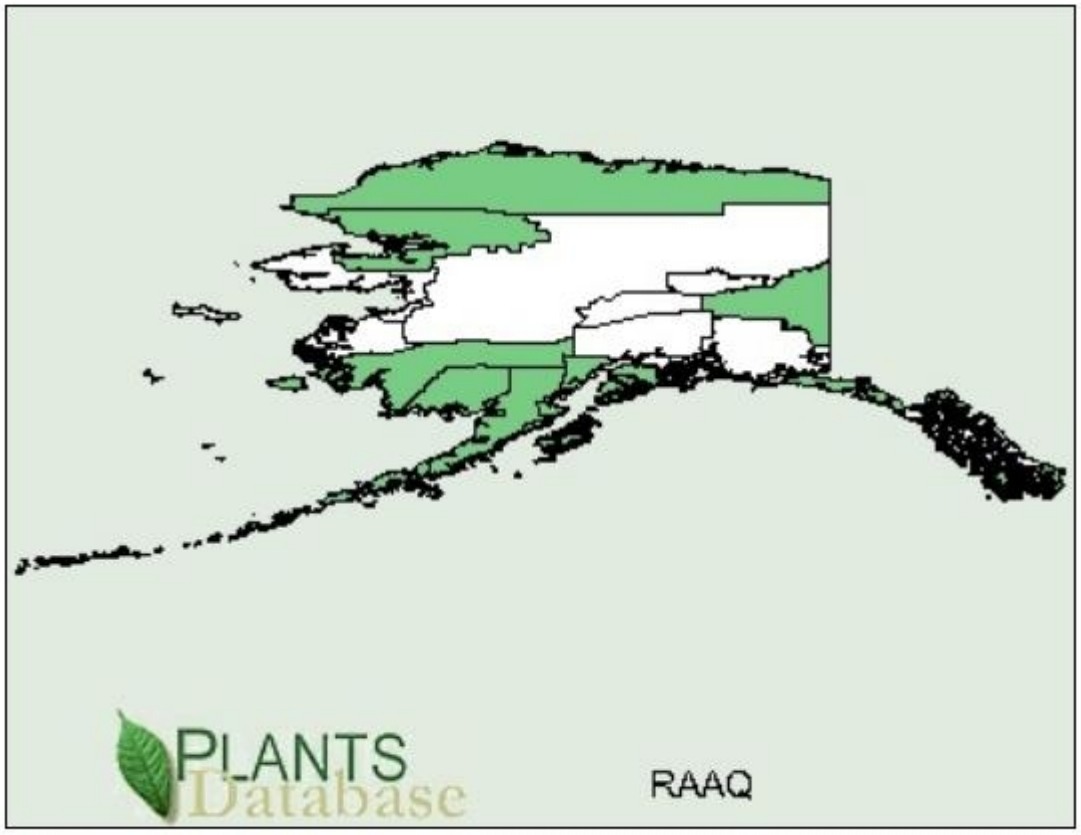
Appendix

Fig. 1 USDA Natural Resource Conservation Service. Plants Profile: *Ranunculus aquatilis*. [plants.usda.gov/java/profile?symbol=RAAQ] [Accessed April 13, 2009, 2:59 PM]

Ranunculus aquatilis L. - white water crowfoot
RAAQ
in the state of Alaska



Appendix continued

Fig. 2 USDA Natural Resource Conservation Service. Plants Profile: *Ranunculus aquatilis*. [plants.usda.gov/java/profile?symbol=RAAQ] [Accessed April 13, 2009, 2:58PM]

Distribution:
Ranunculus aquatilis L.

View Native Status

Present Absent