Taxon: Pistia stratiotes **Family:** Araceae

Common Name(s): Nile cabbage
tropical duckweed
water cabbage
water lettuce
water lily

Synonym(s): NA

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 6 Aug 2015

WRA Score: 18.0 **Designation:** H(HPWRA) **Rating:** High Risk

Keywords: Aquatic, Environmental Weed, Smothering, Spreads Vegetatively, Water-Dispersed

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)	y=1, n=0	n
204	Native or naturalized in regions with tropical or subtropical climates	y=1, n=0	y
205	Does the species have a history of repeated introductions outside its natural range?	y=-2, ?=-1, n=0	y
301	Naturalized beyond native range	y = 1*multiplier (see Appendix 2), n= question 205	y
302	Garden/amenity/disturbance weed	n=0, y = 1*multiplier (see Appendix 2)	n
303	Agricultural/forestry/horticultural weed	n=0, y = 2*multiplier (see Appendix 2)	y
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	y
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	n
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n
405	Toxic to animals	y=1, n=0	n
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	n

Qsn #	Question	Answer Option	Answer
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n
409	Is a shade tolerant plant at some stage of its life cycle		
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	n
411	Climbing or smothering growth habit	y=1, n=0	y
412	Forms dense thickets	y=1, n=0	n
501	Aquatic	y=5, n=0	y
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally	y=1, n=-1	n
604	Self-compatible or apomictic	y=1, n=-1	n
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	1
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	y
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant		
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)		
708	Propagules survive passage through the gut	y=1, n=-1	n
801	Prolific seed production (>1000/m2)	y=1, n=-1	y
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	y
803	Well controlled by herbicides	y=-1, n=1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire		
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	**Is the species highly domesticated?**	**n**
	Source(s)	**Notes**
	Parsons, W.T. & Cuthbertson, E.G. 2001. Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	No evidence

102	**Has the species become naturalized where grown?**	
	Source(s)	**Notes**
	WRA Specialist. 2015. Personal Communication	NA

103	**Does the species have weedy races?**	
	Source(s)	**Notes**
	WRA Specialist. 2015. Personal Communication	NA

201	**Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"**	**High**
	Source(s)	**Notes**
	Parsons, W.T. & Cuthbertson, E.G. 2001. Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	[Well-adapted to tropical climates] "The origin of water lettuce is not clear. Linnaeus gives its distribution as Asia, Africa and equatorial America. Currently it is found throughout Africa, southern Asia, the southern United States and the Caribbean, with scattered colonies in South America, India and the Netherlands, at heights between sea level and at least 1200 metres."

202	**Quality of climate match data**	**High**
	Source(s)	**Notes**
	Parsons, W.T. & Cuthbertson, E.G. 2001. Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	

Qsn #	Question	Answer
203	**Broad climate suitability (environmental versatility)**	**n**
	Source(s)	**Notes**
	Parsons, W.T. & Cuthbertson, E.G. 2001. Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"Water lettuce is sensitive to frost, and attempts to cultivate it in tanks at Griffith, New South Wale, failed because of frosting. Nevertheless, seeds can survive al least two months submergence in water at 4°C and a few weeks in ice at -5°C. In tropical areas, seeds require a short after-ripening period of about 20 days before germinating but, in the Netherlands, the after ripening period extends to more than six weeks. Seeds do not germinate in the dark or at temperatures below 20"C. but germinate readily in light at 25°C."
204	**Native or naturalized in regions with tropical or subtropical climates**	**y**
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Pantropical; in Hawai'i documented only from Kauai, Oahu, Molokai, and Maui,"
205	**Does the species have a history of repeated introductions outside its natural range?**	**y**
	Source(s)	**Notes**
	CABI, 2015. Pistia stratiotes. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"The widespread distribution in most countries with a tropical climate may be the result of its ancient use as medicine for humans, as well as its use as fodder for cattle and pigs (Sculthorpe, 1971)."
301	**Naturalized beyond native range**	**y**
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Pantropical; in Hawai'i documented only from Kaua'i, O'ahu, Moloka'i, and Maui, where it occurs in open ditches, ponds, and other watercourses, generally at low elevations. First collected on O'ahu in 1938 (Degener 11977, BISH). According to a letter attached to this specimen from Leora Dean, this species was brought from Los Angeles, California, in 1932 or possibly 1933"
302	**Garden/amenity/disturbance weed**	**n**
	Source(s)	**Notes**
	CABI, 2015. Pistia stratiotes. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[Agricultural and environmental weed] "P. stratiotes can seriously interfere with paddy crops (Holm et al., 1977; Waterhouse, 1993). Although no accurate measurement is available of the loss of water needed for agriculture through transpiration from beds of P. stratiotes, losses are believed to be considerable (Holm et al., 1977)." ... "P. stratiotes causes changes in both the physiochemical and biological characteristics of waterbodies it inhabits. "
303	**Agricultural/forestry/horticultural weed**	**y**

Qsn #	Question	Answer
	Source(s)	**Notes**
	Langeland, K.A. & Burks, K.C. (eds.). 2008. Identification and Biology of Non-Native Plants in Florida's Natural Areas. UF/IFAS Distribution, Gainesville, FL	"It can also be a serious competitor in rice paddies, taking root in the soil and competing for nutrients and space."

304	Environmental weed	y
	Source(s)	**Notes**
	Langeland, K.A. & Burks, K.C. (eds.). 2008. Identification and Biology of Non-Native Plants in Florida's Natural Areas. UF/IFAS Distribution, Gainesville, FL	"Capable of forming vast mats that disrupt submersed plant and animal communities and interfere with water movement and navigation ..." ... "A target of management research and control in Florida for at least 2 decades."
	CABI, 2015. Pistia stratiotes. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"P. stratiotes is a perennial monocotyledonous aquatic plant present, either naturally or through human introduction, in nearly all tropical and subtropical fresh waterways. It floats on the water surface, with roots hanging below floating leaves. Its growth habit can make it a weed in waterways, where it can kill native submerged plants and reduce biodiversity. It is a common aquatic weed in the USA, and may clog waterways in warmer states such as Florida. It is listed as a noxious weed or invasive aquatic plant in some states of the USA (USDA-NRCS, 2012)."
	Parsons, W.T. & Cuthbertson, E.G. 2001. Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"Water lettuce is, potentially, a very serious weed in some Australian waterways. Once established it spreads quickly over the entire surface of freshwater lakes, rivers and canals, impeding traffic and interfering with water now and recreational activities. The dense plant mass reduces light penetration, oxygen concentration and pH level In the water, thus destroying the habitat of fish and waterfowl." ... "It may also be a shelter for, and a breeding site of, disease-carrying mosquitoes, especially the malaria-carrying Anopheles spp., and the filiariasis-carrying Mansonia spp. The larvae of the latter species obtain their oxygen direct from the roots of water lettuce and do not need to surface to breathe."

305	Congeneric weed	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"A pantropical monotypic genus."

401	Produces spines, thorns or burrs	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Free-floating, aquatic herbs, spreading by stolons. Leaves pale green, simple, rosulate, obovate to oblong-cuneate, 3-15 cm long, 1.5-8 cm wide, broadest at apex, with 5-7 conspicuous parallel nerves, villous, apex broadly rounded to truncate or often emarginate, base cuneate to attenuate, sessile."

402	Allelopathic	

Qsn #	Question	Answer
	Source(s)	**Notes**
	Bich, T. T. N., & Kato-Noguchi, H. (2012). Allelopathic potential of two aquatic plants, duckweed (Lemna minor L.) and water lettuce (Pistia stratiotes L.), on terrestrial plant species. Aquatic Botany, 103: 30-36	[Extracts possess allelopathic properties] "The allelopathic potential of two aquatic species, duckweed (Lemna minor L.) and water lettuce (Pistia stratiotes L.) was examined on the seedling growth of eight test terrestrial species, alfalfa (Medicago sativa L.), cress (garden cress, Lepidium sativum L.), lettuce (Lactuca sativa L.), barnyard grass (Echinochloa crus-galli (L). Beauv.), crab grass (Digitaria sanguinalis L.), junglerice (Echinochloa colonum (L.) Link.), rye grass (Lolium multiforum L.) and timothy (Phleum pratense L.), and on the germination of cress and barnyard grass. Aqueous methanol extracts of the two aquatic species inhibited root growth of all test species at ≥0.01 g dry weight equivalent extract mL−1 (g DW eq. extract mL−1) and shoot growth at ≥0.03 g DW eq. extract mL−1. Although the inhibitory effects of the two aqueous methanol extracts on test species varied and were non-selective, an irreversible dose-threshold (1 g DW eq. extract mL−1) was necessary to completely inhibit the seedling growth and germination of all test species. These results suggest that duckweed and water lettuce may contain allelochemicals which are inhibitory to the growth and germination of terrestrial plant species."

403	Parasitic	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Free-floating, aquatic herbs, spreading by stolons." [No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	**Notes**
	Parsons, W.T. & Cuthbertson, E.G. 2001. Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"The plant has some potential a stockfeed." ... "Fresh plant material is accepted by weaner and adult pigs but cattle reject the ration when 5% of the plant is present."

405	Toxic to animals	n
	Source(s)	**Notes**
	Quattrocchi, U.. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[No evidence] "young leaves cooked and used as vegetable, fodder for rabbits and pigs"
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Dray, F. A., Center, T. D., & Habeck, D. H. (1993). Phytophagous insects associated with Pistia stratiotes in Florida. Environmental Entomology, 22(5): 1146-1155	"During July 1985 to June 1986, we surveyed the arthropod fauna associated with Pistia stratiotes L., waterlettuce, in Florida. Plant samples were collected at 61 sites. Samples comprised a minimum of 20 waterlettuce rosettes. Invertebrates were removed from the plant sample using a submergence technique. Eighteen phytophagous species were recovered from P. stratiotes. Six of these species are known waterlettuce feeders. They include the moths Petrophila drumalis (Dyar), Synclita obliteralis (Walker), and Samea multiplicalis Guenee, the aphid Rhopalosiphum nymphaeae L., the leafhopper Draeculacephala inscripta Van Duzee, and the weevil Tanysphyrus lemnae (F.). Most of these insects are either stenophagous or polyphagous; none feed exclusively on waterlettuce. The paucity of specialists on waterlettuce in Florida contrasts sharply with the richness of oligophagous species in South America. This suggests that waterlettuce is not a native species, despite observations of its occurrence in Florida as early as the mid-1700s."
	CABI, 2015. Pistia stratiotes. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Neohydronomus spp. are specialist feeders on P. stratiotes throughout its natural distribution in Central and South America. Confusion over the identity of the Neohydronomus sp. introduced into Australia for biological control was clarified by O'Brien and Wibmer (1989) who recognized three species. Very promising results have been obtained with the weevil Neohydronomus affinis (Hustache) which originated in South America. DeLoach et al. (1976) reported its specificity, and in 1982 it was released in Australia and subsequently in Botswana, Zimbabwe, Benin, Senegal, South Africa, Papua New Guinea and USA (see Harley et al., 1990; ECOWAS, 1995). The insect is well established in these countries, producing relatively high levels of control. Spodoptera pectinicornis is reported to control P. stratiotes in Thailand and has been screened and recommended for introduction into Florida, USA (Habeck and Thompson, 1994). A three pronged attack using the related weevils Argentinorhynchus bruchi, Argentinorhynchus breyeri and Argentinorhynchus squamosus have been successful in controlling the weed's spread in lab tests in Argentina (Anonymous, 2001). Several species of fungus have also been evaluated; Ramularia spp. (Fernandes and Barreto, 2005) and Sclerotinia sclerotiorum (Waipara et al., 2006) have shown potential for controlling P. stratiotes populations. See Waterhouse (1994) and Dray and Center (2002) for further information on biocontrol of P. stratiotes."
	Muniappan, R., Reddy, G.V.P. & Raman, A. (eds.). 2009. Biological Control of Tropical Weeds Using Arthropods. Cambridge University Press, Cambridge, UK	"Pistia stratiotes may also harbor disease-carrying mosquitoes such as species of the malaria vector Anopheles and Mansonia. The larvae of Mansonia perforate leaves and roots of P. stratiotes to reach air chambers (Lounibos and Dewald, 1989)."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	**Notes**
	Quattrocchi, U.. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[No evidence] "young leaves cooked and used as vegetable, fodder for rabbits and pigs"

Qsn #	Question	Answer
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[No evidence] "Free-floating, aquatic herbs, spreading by stolons."

409	Is a shade tolerant plant at some stage of its life cycle	
	Source(s)	**Notes**
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"Full sun is fine during winter, but the intense summer sun causes the leaves to yellow; partial shade allows the plants to maintain better color.

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Free-floating, aquatic herbs"

411	Climbing or smothering growth habit	y
	Source(s)	**Notes**
	Weber, E. 2003. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"It multiplies rapidly by vegetative growth and forms a compact continuous cover on the water surface, impeding water flow, displacing native water plants and lowering the oxygen content of the water. Dense mats may be colonized by emergent macrophytes."

412	Forms dense thickets	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Forms dense, smothering mats] "Free-floating, aquatic herbs, spreading by stolons."

501	Aquatic	y
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Free-floating, aquatic herbs, spreading by stolons." ... "...occurs in open ditches, ponds, and other watercourses, generally at low elevations."

502	Grass	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	USDA, ARS, National Genetic Resources Program. 2015. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/. [Accessed 3 Aug 2015]	"Family: Araceae subfamily: Aroideae tribe: Pistieae"

503	Nitrogen fixing woody plant	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Free-floating, aquatic herbs, spreading by stolons." [Araceae. No evidence]

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	**Notes**
	Parsons, W.T. & Cuthbertson, E.G. 2001. Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"ROOT Several; unbranched, 2 to 7 mm diameter and to 80 cm long; secondary roots to 4 cm long, each with a conspicuous root-cap, form a dense covering to the main root."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	**Notes**
	CABI, 2015. Pistia stratiotes. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[No evidence of reproductive failure] "According to Holm et al. (1977), Pistia is one of the most widely distributed hydrophytes. It has a cosmopolitan distribution throughout tropical and sub-tropical regions. In South and Central America, Africa and South-East Asia it is considered an endogenous species."

602	Produces viable seed	y
	Source(s)	**Notes**
	Parsons, W.T. & Cuthbertson, E.G. 2001. Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"SEED Green at first, brown when mature, oblong with. thick wrinkled seedcoat, 4 to 15 per fruit, each 2 mm long, flattened at the apex and containing an air chamber." ... "Water lettuce reproduces both by seed and vegetatively. The seeds, when shed, float on the water surface for a period before sinking and may be carried some distance by water flow."

603	Hybridizes naturally	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[No evidence] "A pantropical monotypic genus."

604	Self-compatible or apomictic	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Parsons, W.T. & Cuthbertson, E.G. 2001. Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	[Self-pollination prevented] "Inconspicuous, on a small bilaterally symmetrical inflorescence consisting of a surrounding white spathe (bract), 7 to 12 mm long, 5 mm wide, subtending a central column or spadix which carries the separate male and female flowers; a cup-shaped membrane, separating the male and female flowers, prevents self-pollination by exposing the female flower before the male flower."

605	Requires specialist pollinators	n
	Source(s)	**Notes**
	Parsons, W.T. & Cuthbertson, E.G. 2001. Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"Flowers are wind pollinated and seeds mature about 30 days after fertilisation."

606	Reproduction by vegetative fragmentation	y
	Source(s)	**Notes**
	Parsons, W.T. & Cuthbertson, E.G. 2001. Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"Water lettuce reproduces both by seed and vegetatively. The seeds, when shed, float on the water surface for a period before sinking and may be carried some distance by water flow. The buoyant seedling, too, move with the water, spreading the infestation over a wide area. The primary colony increases its size and density by the development of daughter plants on stolons. Further spread occurs when stolons break, freeing the daughter plant from the parent mass."

607	Minimum generative time (years)	1
	Source(s)	**Notes**
	Osmond, R. & Johnson, S. 2006. Water lettuce. Primefact 251. NSW Department of Primary Industries. www.dpi.nsw.gov.au	"Flowering and reproduction can occur as early as the four- to five-leaf stage of development. When conditions for growth are good, the plant can quickly reproduce and cover an entire body of water with a thick mat of connected rosettes."
	Gundlach, A. 2007. Invasive Species Guidebook for Department of Defense Installations in the Chesapeake Bay Watershed: Identification, Control, and Restoration. Wildlife Habitat Council. Silver Spring, Maryland. Prepared for the Department of Defense Legacy Resource Management Program, Project 06-328	"In warm climates it grows as a perennial, but in temperate regions it grows as an annual, regenerating from seed each spring. It grows as floating rosettes of grayish-green leaves, which occur individually or connected by stolons."

Qsn #	Question	Answer
701	**Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)**	**y**
	Source(s)	**Notes**
	Osmond, R. & Johnson, S. 2006. Water lettuce. Primefact 251. NSW Department of Primary Industries. www.dpi.nsw.gov.au	"This weed is thought to have spread through dumping of water lettuce from aquariums or fish ponds into creeks, rivers and wetlands, or of deliberate cultivation." ... "Pieces of water lettuce can be spread by boats or fishing equipment moving it from an infested to a clean water body."

702	**Propagules dispersed intentionally by people**	**y**
	Source(s)	**Notes**
	Parsons, W.T. & Cuthbertson, E.G. 2001. Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"The plant is also spread through the aquarium trade."
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"Water-lettuce is grown as an aquatic ornamental in water gardens and lily pools and has escaped cultivation to become a weed of fresh waters in Hawaii."

703	**Propagules likely to disperse as a produce contaminant**	
	Source(s)	**Notes**
	Caton BP, Mortimer M, Hill JE. 2004. A Practical Field Guide to Weeds of Rice in Asia. Los Baños (Philippines). International Rice Research Institute, Los Baños, Laguna, Philippines	"Pistia stratiotes ... Seed contaminant: unlikely"

704	**Propagules adapted to wind dispersal**	**n**
	Source(s)	**Notes**
	Parsons, W.T. & Cuthbertson, E.G. 2001. Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	[No evidence] "The seeds, when shed, float on the water surface for a period before sinking and may be carried some distance by water flow. The buoyant seedling, too, move with the water, spreading the infestation over a wide area. The primary colony increases its size and density by the development of daughter plants on stolons. Further spread occurs when stolons break, freeing the daughter plant from the parent mass."

Qsn #	Question	Answer
705	**Propagules water dispersed**	**y**
	Source(s)	**Notes**
	Parsons, W.T. & Cuthbertson, E.G. 2001. Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"Water lettuce reproduces both by seed and vegetatively. The seeds, when shed, float on the water surface for a period before sinking and may be carried some distance by water flow. The buoyant seedling, too, move with the water, spreading the infestation over a wide area. The primary colony increases its size and density by the development of daughter plants on stolons. Further spread occurs when stolons break, freeing the daughter plant from the parent mass."

706	Propagules bird dispersed	n
	Source(s)	**Notes**
	Muniappan, R., Reddy, G.V.P. & Raman, A. (eds.). 2009. Biological Control of Tropical Weeds Using Arthropods. Cambridge University Press, Cambridge, UK	"Pistia stratiotes is easily spread to new areas. Plants may attach to boats or fishing equipment and become transferred to distant locations. Silt including P. stratiotes seeds could move by flow or other mechanical means, and even potentially attached to animals. Moreover, as an ornamental for outdoor ponds and open aquaria (it does not grow well in covered aquaria) it is a favored organism in international trade, where it is sold by aquarium supply dealers and even over the Internet."

707	Propagules dispersed by other animals (externally)	
	Source(s)	**Notes**
	Muniappan, R., Reddy, G.V.P. & Raman, A. (eds.). 2009. Biological Control of Tropical Weeds Using Arthropods. Cambridge University Press, Cambridge, UK	[Potentially] "Silt including P. stratiotes seeds could move by flow or other mechanical means, and even potentially attached to animals."

708	Propagules survive passage through the gut	n
	Source(s)	**Notes**
	Muniappan, R., Reddy, G.V.P. & Raman, A. (eds.). 2009. Biological Control of Tropical Weeds Using Arthropods. Cambridge University Press, Cambridge, UK	[No evidence] "Pistia stratiotes is easily spread to new areas. Plants may attach to boats or fishing equipment and become transferred to distant locations. Silt including P. stratiotes seeds could move by flow or other mechanical means, and even potentially attached to animals."

801	Prolific seed production (>1000/m2)	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	Dray, F. A., & Center, T. D. (1989). Seed production by Pistia stratiotes L.(water lettuce) in the United States. Aquatic Botany, 3 (1): 155-160	"Pistia stratiotes L. (water lettuce) reportedly does not produce fruits and seeds in the United States. However, we discovered water lettuce fruits and seedlings at Loxahatchee National Wildlife Refuge, Palm Beach County, Florida. In April 1987, 95% of this population consisted of seeds. Forty percent of the 267 ramets m−2 of mat held fruits and the mat averaged 726 seeds m−2. Sediments held 4196 seeds m−2. Germination experiments showed that over 80% of the seeds were viable, a much greater proportion than reported in Brazil. Since the initial discovery, we have found seeds at many sites throughout south Florida. We have concluded seed germination is an important factor in the dynamics of some waterlettuce populations in the United States."

802	Evidence that a persistent propagule bank is formed (>1 yr)	y
	Source(s)	**Notes**
	Muniappan, R., Reddy, G.V.P. & Raman, A. (eds.). 2009. Biological Control of Tropical Weeds Using Arthropods. Cambridge University Press, Cambridge, UK	"Seeds sink to the bottom of the water body, where they form a persistent seed bank (densities of up to 4000 seeds/m2) (Dray and Center, 1989). Seeds germinate readily in warm (>20 □C), shallow water under high-light intensities (Pieterse et al., 1981). They remain dormant for long periods in dry sediments when water levels recede in dry seasons, and readily germinate when rehydrated during rains."

803	Well controlled by herbicides	y
	Source(s)	**Notes**
	Parsons, W.T. & Cuthbertson, E.G. 2001. Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"Chemical control is usually less expensive and more practical under Australian conditions. Spraying with diquat or the diuron based AFIOI* is recommended in New South Wales, using a wetting agent with the diquat. Where larger colonies occur, applications of diquat by helicopter, preferably in autumn, have given useful control; spring applications, however, usually result in substantial regrowth. In experiments, glyphosate and granular application of the butoxyethanol ester of 2,4-D have also given good control."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	
	Source(s)	**Notes**

Qsn #	Question	Answer
	CABI, 2015. Pistia stratiotes. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[Mechanical control may be effective, but missed plant fragments could re-establish] "Physical removal of the plants can be done manually or by means of machines. Depending on the size and type of the infested waterbody different machines can be used. Weeds may be removed from irrigation and drainage canals using standard equipment such as mowing buckets attached to a tractor or a hydraulic excavator, as well as mowing launches. In general Pistia plants will grow in a mixed vegetation with rooted plants and by using these machines the total aquatic vegetation will be removed (see Wade, 1990). Special floating harvesters, which first collect the material and subsequently dump it on the shore, may be used in lakes and rivers. However, it should be taken into consideration that, in general, re-colonization of Pistia will occur. This implies that control measures should be part of a long-term maintenance programme. Cost effectiveness of the control measures will depend on the losses brought about by Pistia infestation. This will be connected with the economic importance of the waterbody as well as the indirect effect on health of the local population via water-borne diseases."

Qsn #	Question	Answer
805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	
	Source(s)	**Notes**
	CABI, 2015. Pistia stratiotes. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Biological Control: Neohydronomus spp. are specialist feeders on P. stratiotes throughout its natural distribution in Central and South America. Confusion over the identity of the Neohydronomus sp. introduced into Australia for biological control was clarified by O'Brien and Wibmer (1989) who recognized three species. Very promising results have been obtained with the weevil Neohydronomus affinis (Hustache) which originated in South America. DeLoach et al. (1976) reported its specificity, and in 1982 it was released in Australia and subsequently in Botswana, Zimbabwe, Benin, Senegal, South Africa, Papua New Guinea and USA (see Harley et al., 1990; ECOWAS, 1995). The insect is well established in these countries, producing relatively high levels of control. Spodoptera pectinicornis is reported to control P. stratiotes in Thailand and has been screened and recommended for introduction into Florida, USA (Habeck and Thompson, 1994). A three pronged attack using the related weevils Argentinorhynchus bruchi, Argentinorhynchus breyeri and Argentinorhynchus squamosus have been successful in controlling the weed's spread in lab tests in Argentina (Anonymous, 2001). Several species of fungus have also been evaluated; Ramularia spp. (Fernandes and Barreto, 2005) and Sclerotinia sclerotiorum (Waipara et al., 2006) have shown potential for controlling P. stratiotes populations. See Waterhouse (1994) and Dray and Center (2002) for further information on biocontrol of P. stratiotes."
	Winston, R.L., Schwarzländer, M., Hinz, H.L., Day, M.D.,Cock, M.J.W., Julien, M.H. (eds.). 2014. Biological Control of Weeds: A World Catalogue of Agents and Their Target Weeds, 5th edition. USDA Forest Service, Forest Health Technology Enterprise Team, Morgantown, West Virginia	[Presence in Hawaiian Islands not documented] "Neohydronomus affinis ... Weed eliminated from three of four original release sites in FL within 18-30 months of release, but establishment and control not universal. Disperses well naturally"

Summary of Risk Traits:

High Risk / Undesirable Traits
• Grows in tropical climates
• Pantropical, & widely naturalized, including Kauai, Oahu, Molokai, and Maui
• Agricultural & environmental weed
• Forms dense cover in water bodies
• Reproduces by seeds & vegetatively
• Able to reproduce within first growing season
• Seeds & vegetative fragments spread by water, attached to boats or other water craft, & possibly externally by animals
• Prolific seed production
• Seeds may persist in the soil

Low Risk Traits
• Unarmed (no spines, thorns or burrs)
• Palatable to animals (possible food source)
• Non-toxic
• Ornamental
• Self-incompatible
• Herbicides may provide effective control