Taxon: Nymphaea caerulea

Family: Nymphaeaceae

Common Name(s): Blue Egyptian lotus
Blue lotus
Blue water-lily
Egyptian lotus

Synonym(s): Castalia caerulea (Savigny) Tratt.
Leuconymphaea caerulea (Savigny)
Nymphaea calliantha Conard
Nymphaea cyclophylla R. E. Fr.

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 17 Dec 2015

WRA Score: 11.0 **Designation:** H(HPWRA) **Rating:** High Risk

Keywords: Aquatic Herb, Naturalized, Ornamental, Self-Pollinated, 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)	n
304	Environmental weed		
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	y
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		
405	Toxic to animals	y=1, n=0	n
406	Host for recognized pests and pathogens	y=1, n=0	n
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	n
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n

Qsn #	Question	Answer Option	Answer
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		
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		
604	Self-compatible or apomictic	y=1, n=-1	y
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation		
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	3
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)		
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
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		
801	Prolific seed production (>1000/m2)		
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides		
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**
	Hanelt, P. (ed.). 2001. Mansfeld's Encyclopedia of Agricultural and Horticultural Crops (except Ornamentals), Volume 1. Springer-Verlag, Berlin, Heidelberg, New York	No evidence
	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	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**
	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	"Native to northern and tropical Africa..."

202	**Quality of climate match data**	**High**
	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	"Native to northern and tropical Africa..."

Qsn #	Question	Answer
203	**Broad climate suitability (environmental versatility)**	**n**
	Source(s)	**Notes**
	Dave's Garden. 2015. Blue Lotus of the Nile Lily - Nymphaea caerulea. http://davesgarden.com/guides/pf/go/37041/. [Accessed 17 Dec 2015]	"Hardiness: USDA Zone 10b: to 1.7 °C (35 °F) USDA Zone 11: above 4.5 °C (40 °F)"
	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	"Native to northern and tropical Africa"
	Missouri Botanical Garden. (2015). Nymphaea caerulea. http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=d255. [Accessed 17 Dec 2015]	"Zone: 10 to 12"

204	**Native or naturalized in regions with tropical or subtropical climates**	**y**
	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	[Native or naturalized in regions with tropical or subtropical climates? Yes] "Native to northern and tropical Africa.."

205	**Does the species have a history of repeated introductions outside its natural range?**	**y**
	Source(s)	**Notes**
	Erickson, T.A. & Puttock, C.F. 2006. Hawai'i Wetland Field Guide: An Ecological And Identification Guide to Wetlands And Wetland Plants of the Hawaiian Islands. Bess Press Books, Honolulu, HI	"Eqyptian blue water lily is native to northern and tropical Africa, now cultivated worldwide"

301	**Naturalized beyond native range**	**y**
	Source(s)	**Notes**
	Erickson, T.A. & Puttock, C.F. 2006. Hawai'i Wetland Field Guide: An Ecological And Identification Guide to Wetlands And Wetland Plants of the Hawaiian Islands. Bess Press Books, Honolulu, HI	"in the Hawaiian Islands it is found in a stock pond near Kehena Reservoir on Parker Ranch, now in wetlands from 700 to 800 m elevation. Introduced, aggressive-invasive"
	USDA, ARS, Germplasm Resources Information Network, 2015. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 16 Dec 2015]	"Naturalized: Southern America Brazil: Brazil - Sao Paulo Southern South America: Argentina - Misiones"
	Wagner, W.L. & Herbst, D.R. Supplement to the Manual of the flowering plants of Hawaii. Smithsonian Institution, Washington, D.C.	[Naturalized beyond native range? Yes] "newly naturalized (Hawai`i)"

302	**Garden/amenity/disturbance weed**	**n**

Qsn #	Question	Answer
	Source(s)	**Notes**
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence

303	Agricultural/forestry/horticultural weed	n
	Source(s)	**Notes**
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence

304	Environmental weed	
	Source(s)	**Notes**
	Erickson, T.A. & Puttock, C.F. 2006. Hawai'i Wetland Field Guide: An Ecological And Identification Guide to Wetlands And Wetland Plants of the Hawaiian Islands. Bess Press Books, Honolulu, HI	[Potentially. Listed as aggressive invasive] "in the Hawaiian Islands it is found in a stock pond near Kehena Reservoir on Parker Ranch, now in wetlands from 700 to 800 m elevation. Introduced, aggressive-invasive"
	Staples, G.W., Herbst, D.R & Imada, C.T. 2000. Survey of invasive or potentially invasive cultivated plants in Hawai'i. Bishop Museum Occasional Papers 65: 1-35	Potentially

305	Congeneric weed	y
	Source(s)	**Notes**
	Hegazy, A. K., Amer, W. M., & Khedr, A. A. (2001). Allelopathic effect of Nymphaea lotus L. on growth and yield of cultivated rice around Lake Manzala (Nile Delta). Hydrobiologia, 464(1): 133-142	"Lotus infestation of ricefields is a major cause of crop failure and decrease of grain yield in the newly reclaimed cut-off areas around lake Manzala, Egypt. This study provides insights in the allelopathic effect of Nymphaea lotus L. on rice (Oryza sativa cavr. Giza-177). Lotus rhizome extracts were inhibitory to seed germination and seedling growth of rice. The degree of inhibition was dependent on extract type and concentration. Ethanol and water extracts were more inhibitory than chloroform extracts. The phenolic fraction of ethanol extracts showed the highest inhibitory effects. In a target (rice) neighbor (lotus) pot experiment, rice dry mass and relative growth rate were dependent on its age and on lotus rhizome density, with decreased growth at increased lotus density. Field data on infested and non infested ricefields demonstrated a decreased leaf area index and yield in infested fields. Identification of the potential allelochemical compounds by gas chromatography/mass spectrometry revealed the presence of allelopathic phenolics in lotus rhizomes."
	Southern Tablelands & South Coast Noxious Plants Committee. 2001. Regional Weed Management Plan for Aquatic Noxious Weeds. Queanbeyan City Council, Queanbeyan, Australia	"Other serious aquatic weeds include Elodea canadensis (Canadian Pondweed), Egeria densa (Dense Waterweed), Ludwigia peruviana, Nymphaea capensis (Cape Waterlily), Myriophyllum spp (Watermilfoils), Hydrilla verticillata (Water Thyme), and Certophyllum demersum (Hornwort)."

401	Produces spines, thorns or burrs	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Erickson, T.A. & Puttock, C.F. 2006. Hawai'i Wetland Field Guide: An Ecological And Identification Guide to Wetlands And Wetland Plants of the Hawaiian Islands. Bess Press Books, Honolulu, HI	[No evidence] "Aquatic perennial herb, glabrous; rhizome unbranched, erect. Leaves basal, whorled; stipules absent; petioles reaching the water surface; leaf-blades dark green above, pale green with purple dots below, 30-40 cm diam., circular with entire or undulate margins."

402	Allelopathic	
	Source(s)	**Notes**
	Hegazy, A. K., Amer, W. M., & Khedr, A. A. (2001). Allelopathic effect of Nymphaea lotus L. on growth and yield of cultivated rice around Lake Manzala (Nile Delta). Hydrobiologia, 464(1): 133-142	[Unknown. Other Nymphaea species may possess allelopathic properties] "Identification of the potential allelochemical compounds by gas chromatography/mass spectrometry revealed the presence of allelopathic phenolics in lotus rhizomes."

403	Parasitic	n
	Source(s)	**Notes**
	Erickson, T.A. & Puttock, C.F. 2006. Hawai'i Wetland Field Guide: An Ecological And Identification Guide to Wetlands And Wetland Plants of the Hawaiian Islands. Bess Press Books, Honolulu, HI	"Aquatic perennial herb, glabrous" [No evidence. Nymphaeaceae]

404	Unpalatable to grazing animals	
	Source(s)	**Notes**
	Irvine, F. R. (1953). Waterlilies as food. Kew Bulletin, 8(3): 363-370	[Possibly. Palatability of foliage unknown. Aquatic habitat would limit browsing pressure] "The starchy rhizomes of the blue diurnal flowered N. caerulea Savigny and N. lotus Linn. are collected in the dry season in West Africa, when they consist of almost solid starch, and are then boiled or roasted and eaten." ... "The fruits and seeds of N. caerulea Say. were also baked and made into a kind of bread by the ancient Egyptians (9)."

405	Toxic to animals	n
	Source(s)	**Notes**
	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	n
	Source(s)	**Notes**
	Missouri Botanical Garden. (2015). Nymphaea caerulea. http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=d255. [Accessed 16 Dec 2015]	"Problems: No serious insect or disease problems. Leaf mining midges and aphids can be troublesome in some areas."

Qsn #	Question	Answer
407	**Causes allergies or is otherwise toxic to humans**	**n**
	Source(s)	**Notes**
	Hanelt, P. (ed.). 2001. Mansfeld's Encyclopedia of Agricultural and Horticultural Crops (except Ornamentals), Volume 1. Springer-Verlag, Berlin, Heidelberg, New York	"In Kenya and Tanzania cultivated by native healers for medicinal purposes. In South Africa cultivated for the edible rhizomes. The seeds are eaten boiled or ground into flour. The flowers are used as vegetables." [No evidence]
	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**
	Erickson, T.A. & Puttock, C.F. 2006. Hawai'i Wetland Field Guide: An Ecological And Identification Guide to Wetlands And Wetland Plants of the Hawaiian Islands. Bess Press Books, Honolulu, HI	"Aquatic perennial herb" [No evidence]

409	**Is a shade tolerant plant at some stage of its life cycle**	
	Source(s)	**Notes**
	Missouri Botanical Garden. (2015). Nymphaea caerulea. http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=d255. [Accessed 16 Dec 2015]	"This tropical water lily is best grown in still water in full sun to part shade. Full sun is best, but plants will usually flower well in part shade."

410	**Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)**	**n**
	Source(s)	**Notes**
	Gordon, D. R., Mitterdorfer, B., Pheloung, P. C., Ansari, S., Buddenhagen, C., Chimera, C., ... & Williams, P. A. 2010). Guidance for addressing the Australian Weed Risk Assessment questions. Plant Protection Quarterly, 25(2): 56-74	"always answer 'no' for submerged or floating aquatic plants or air plants."

411	**Climbing or smothering growth habit**	
	Source(s)	**Notes**
	Erickson, T.A. & Puttock, C.F. 2006. Hawai'i Wetland Field Guide: An Ecological And Identification Guide to Wetlands And Wetland Plants of the Hawaiian Islands. Bess Press Books, Honolulu, HI	[Could potentially smother water surfaces] "Aquatic perennial herb, glabrous; rhizome unbranched, erect. Leaves basal, whorled; stipules absent; petioles reaching the water surface; leaf-blades dark green above, pale green with purple dots below, 30-40 cm diam., circular with entire or undulate margins." ... "in the Hawaiian Islands it is found in a stock pond near Kehena Reservoir on Parker Ranch, now in wetlands from 700 to 800 m elevation. Introduced, aggressive-invasive"

412	**Forms dense thickets**	**n**

Qsn #	Question	Answer
	Source(s)	**Notes**
	Gordon, D. R., Mitterdorfer, B., Pheloung, P. C., Ansari, S., Buddenhagen, C., Chimera, C., ... & Williams, P. A. 2010). Guidance for addressing the Australian Weed Risk Assessment questions. Plant Protection Quarterly, 25(2): 56-74	"The thickets produced should obstruct passage or access, or exclude other species. Woody perennials are the most likely candidates, but this question may include densely growing grasses." [Aquatic plant does not produce thickets]

501	Aquatic	y
	Source(s)	**Notes**
	Erickson, T.A. & Puttock, C.F. 2006. Hawai'i Wetland Field Guide: An Ecological And Identification Guide to Wetlands And Wetland Plants of the Hawaiian Islands. Bess Press Books, Honolulu, HI	"Aquatic perennial herb, glabrous"

502	Grass	n
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network, 2015. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 16 Dec 2015]	Nymphaeaceae

503	Nitrogen fixing woody plant	n
	Source(s)	**Notes**
	Erickson, T.A. & Puttock, C.F. 2006. Hawai'i Wetland Field Guide: An Ecological And Identification Guide to Wetlands And Wetland Plants of the Hawaiian Islands. Bess Press Books, Honolulu, HI	"Aquatic perennial herb, glabrous; rhizomes unbranched, erect." [Nymphaeaceae]

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	**Notes**
	Erickson, T.A. & Puttock, C.F. 2006. Hawai'i Wetland Field Guide: An Ecological And Identification Guide to Wetlands And Wetland Plants of the Hawaiian Islands. Bess Press Books, Honolulu, HI	"rhizomes unbranched, erect."
	Gordon, D. R., Mitterdorfer, B., Pheloung, P. C., Ansari, S., Buddenhagen, C., Chimera, C., ... & Williams, P. A. 2010). Guidance for addressing the Australian Weed Risk Assessment questions. Plant Protection Quarterly, 25(2): 56-74	"This question addresses taxa that have specialized organs and should not include plants with just rhizomes/ stolons (see 6.06). Answer 'yes' only for perennial taxa with tubers, corms, or bulbs. Answer 'no' for non-geophytes, including those with rhizomes or stolons only"

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	**Notes**

Qsn #	Question	Answer
	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	No evidence
	USDA, ARS, Germplasm Resources Information Network, 2015. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 17 Dec 2015]	Widespread distribution. No evidence

602	Produces viable seed	y
	Source(s)	**Notes**
	Sheat, B. & Schofield, G. 1995. Complete Gardening in Southern Africa. Struik Publishers, Cape Town, South Africa	"All water lilies may be propagated from ripe seeds, but as these often take as long as four years to mature, Nymphaea are best propagated by division of the tuberous rootstock."
	Conard, H.S. 1905. The Waterlilies: Taxonomy and Bibliography. The Carnegie Institution, Washington D.C.	"Seed ellipsoidal, acuminate at the hilum, 0.17 cm. long by 0.12 cm. in diameter, dull olive brown ; surface marked with about 14 interrupted longitudinal lines of minute hairs ; raphe evident, not prominent. Aril longer than the seed."

603	Hybridizes naturally	
	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	[Unknown if natural hybrids occur] "Nymphaea caerulea has been crossed with other species to produce numerous ornamental hybrids."

604	Self-compatible or apomictic	y
	Source(s)	**Notes**
	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 75(3): 795-804	"Autogamy has also been reported among other members of subg. Brachyceras, such as N. caerulea and N. stellata Willd."
	Conard, H.S. 1905. The Waterlilies: Taxonomy and Bibliography. The Carnegie Institution, Washington D.C.	"Self-fertilization occurs regularly in this species."

605	Requires specialist pollinators	n
	Source(s)	**Notes**
	Thien, L. B., Bernhardt, P., Devall, M. S., Chen, Z. D., Luo, Y. B., Fan, J. H., Yuan, L. C. & Williams, J. H. (2009). Pollination biology of basal angiosperms (ANITA grade). American Journal of Botany, 96(1), 166-182	"Table 3. Pollination systems in the ANITA grade plants." [Nymphaea - Pollinators - Coleoptera, Hymenoptera (bees), Diptera (flies)] ... "In diurnal species of water lilies, bees and fl ies are attracted to the fl owers by the brilliant color and fl oral odors. The nocturnal tropical species attract beetles and have carpel appendages with starch that function as food bodies (Meeuse and Schneider, 1979/1980; Schneider and Williamson, 1993)."

606	Reproduction by vegetative fragmentation	
	Source(s)	**Notes**

Qsn #	Question	Answer
	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-lilies are propagated by several methods. The rhizome or corm may be divided; small offsets can be removed from around the base of a mature plant; or, in viviparous species - which produce small plantlets on the leaves - the plantlets can be removed, potted up, and grown to full size." [Vegetative fragments may possibly spread if detached from parent plants, but N. caerulea leaves are not viviparous]

607	Minimum generative time (years)	3
	Source(s)	**Notes**
	South African National Biodiversity Institute. 2002. PlantzAfrica.com - Nymphaea nouchali Burm. f. var. caerulea (Sav.) Verdc. http://www.plantzafrica.com/plantnop/nymphnouch.htm. [Accessed 17 Dec 2015]	"The blue water lily may be grown from seed, but this requires patience, for the plants take 3 to 4 years to flower." [Nymphaea nouchali var. caerulea (Savigny) Verdc. = synonym of N. caerulea]

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	
	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	"Nymphaea capensis ... On Kauai, garden escapes or discards of this water-lily have naturalized in some ponds and low-lying wet areas." [No evidence, but Nymphaea caerulea could be dispersed in a similar manner]

702	Propagules dispersed intentionally by people	y
	Source(s)	**Notes**
	Erickson, T.A. & Puttock, C.F. 2006. Hawai'i Wetland Field Guide: An Ecological And Identification Guide to Wetlands And Wetland Plants of the Hawaiian Islands. Bess Press Books, Honolulu, HI	"Eqyptian blue water lily is native to northern and tropical Africa, now cultivated worldwide"

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	**Notes**
	Erickson, T.A. & Puttock, C.F. 2006. Hawai'i Wetland Field Guide: An Ecological And Identification Guide to Wetlands And Wetland Plants of the Hawaiian Islands. Bess Press Books, Honolulu, HI	"in the Hawaiian Islands it is found in a stock pond near Kehena Reservoir on Parker Ranch, now in wetlands from 700 to 800 m elevation. Introduced, aggressive-invasive" [Inadvertent dispersal may be possible, but no evidence that this plant has become a contaminant of other crops]

Qsn #	Question	Answer
704	**Propagules adapted to wind dispersal**	**n**
	Source(s)	**Notes**
	Erickson, T.A. & Puttock, C.F. 2006. Hawai'i Wetland Field Guide: An Ecological And Identification Guide to Wetlands And Wetland Plants of the Hawaiian Islands. Bess Press Books, Honolulu, HI	"Fruit a berry 2.5-3.8 cm long, compressed-ovoid."

705	**Propagules water dispersed**	**y**
	Source(s)	**Notes**
	Singh, V. & Jain, D.K. 2012. Taxonomy of Angiosperms. 2nd Ed. (8th Reprint). Rastogi Publications, New Delhi	"The Nymphaeaceae are by large dispersed by water." ... "The fruit of Nymphaea is a spongy berry which dehisces by the swelling of mucilage surrounding the seeds. The seeds thus set free float as spongy aril entangles air bubbles. They settle down to the bottom of ponds as the aril decays."

706	**Propagules bird dispersed**	**n**
	Source(s)	**Notes**
	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 75(3): 795-804	"In cases involving overland dispersal, seeds are the probable dispersal units and waterbirds the likely agents." [N. caerulea has a berry, may be bird-dispersed]
	Singh, V. & Jain, D.K. 2012. Taxonomy of Angiosperms. 2nd Ed. (8th Reprint). Rastogi Publications, New Delhi	"The Nymphaeaceae are by large dispersed by water." ... "The fruit of Nymphaea is a spongy berry which dehisces by the swelling of mucilage surrounding the seeds. The seeds thus set free float as spongy aril entangles air bubbles. They settle down to the bottom of ponds as the aril decays."

707	**Propagules dispersed by other animals (externally)**	
	Source(s)	**Notes**
	South African National Biodiversity Institute. 2002. PlantzAfrica.com - Nymphaea nouchali Burm. f. var. caerulea (Sav.) Verdc. http://www.plantzafrica.com/plantnop/nymphnouch.htm. [Accessed 17 Dec 2015]	"It is difficult to collect the seed, because the seed pods burst without much warning and the seeds disperse and sink quite soon." [No evidence, although seeds could possibly adhere to birds or other animals in mud]

708	**Propagules survive passage through the gut**	
	Source(s)	**Notes**
	Pollux, B. J. A. (2011). The experimental study of seed dispersal by fish (ichthyochory). Freshwater Biology, 56(2): 197-212	"Table 1 Empirical evidence from feeding trials for ichthyochorous dispersal of seeds" [Nymphaea caerulea dispersed by Perca fluviatilis, the European perch]
	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 75(3): 795-804	[Unknown] "In cases involving overland dispersal, seeds are the probable dispersal units and waterbirds the likely agents."

801	**Prolific seed production (>1000/m2)**	

Qsn #	Question	Answer
	Source(s)	**Notes**
	Conard, H.S. 1905. The Waterlilies: Taxonomy and Bibliography. The Carnegie Institution, Washington D.C.	[Unknown] "Fruit large, round (4.5 to 6.4 cm. in diameter by 2.5 to 3.8 cm. high), truncate above, with deep radiating fissures between the carpels, flattened or even excavated beneath around the peduncle, of a pale green color, becoming translucent and brownish, crowned with the hard, slightly enlarged styles, and surrounded by the sepals and outer 4 petals, all of which are dark green and spotted as in the flower. The peduncle makes a large, rude spiral turn, holding the fruit still erect but with its base nearly or quite resting on the earth.—Seed ellipsoidal, acuminate at the hilum, 0.17 cm. long by 0.12 cm. in diameter, dull olive brown ; surface marked with about 14 interrupted longitudinal lines of minute hairs ; raphe evident, not prominent. Aril longer than the seed."

802	**Evidence that a persistent propagule bank is formed (>1 yr)**	
	Source(s)	**Notes**
	Royal Botanic Gardens Kew. (2015) Seed Information Database (SID). Version 7.1. Available from: http://data.kew.org/sid/. [Accessed 17 Dec 2015]	"Storage Behaviour: No data available for species. Of 4 known taxa of genus Nymphaea, 25.00% Orthodox(p/?), 25.00% Recalcitrant(?), 50.00% Uncertain" [Unknown if seeds can form a persistent seed bank in natural settings]

803	**Well controlled by herbicides**	
	Source(s)	**Notes**
	WRA Specialist. 2015. Personal Communication	Unknown. No information found on herbicide efficacy or chemical control of this species.

804	**Tolerates, or benefits from, mutilation, cultivation, or fire**	
	Source(s)	**Notes**
	WRA Specialist. 2015. Personal Communication	Unknown

805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	
	Source(s)	**Notes**
	WRA Specialist. 2015. Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits
• Thrives in tropical climates
• Naturalized on Hawaii Island, as well as in Brazil & Argentina
• Other Nymphaea are invasive
• Reproduces by seeds & possibly also vegetatively
• Self-compatible
• Seeds dispersed by water & intentionally by people

Low Risk Traits
• Negative impacts outside native range have not been documented
• Unarmed (no spines, thorns or burrs)
• Used as food by people
• Ornamental
• May be safe to cultivate in a contained pond or other water feature with minimal risk of natural dispersal