AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Azolla cristata*
Common name	-
Assessor	Mihaela Britvec
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Azolla cristata is of commercial importance in cultivation in southern and eastern Asia as a bio-fertilizer, valued for its nitrogen-fixing ability, which benefits crops such as rice when the fern is grown under it and reduces the need for artificial fertilizer addition. The thick mat of fronds also suppresses weed growth. Harvested fronds are also used as a food for fish and poultry. It is also often used as a floating plant in both coldwater and tropical aquaria, as well as in outdoor ponds. doi:	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Harvested fronds are also used as a food for fish and poultry.It is also often used as a floating plant in both coldwater and tropical aquaria, as well as in outdoor ponds.	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	It is closely related to Azolla filiculoides.	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	doi: 10.1111/j.1365-3180.2012.00926.x	High
5	2.02	What is the quality of the climate matching data?	High	doi: 10.1111/j.1365-3180.2012.00926.x	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	https://hirc.botanic.hr/fcd/	Low
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	soil, sand and gravel	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	doi: 10.1111/j.1365-3180.2012.00926.x	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	A. cristata is native to the America, but has been recorded as an invasive species in Kashmir, India, and South Africa.	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Azolla species have negatively impacts animal health (https://www.cabi.org/isc/datasheet/8119#toriskAndImpactFactors).	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	A. cristata reduce the light and oxygen levels in water bodies.	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	Azolla species are known to be able to damaged ecosystem services and lead to ecosystem change/ habitat alteration.	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	Social impacts of Azolla species have centred around the reduction of useful water surface area for recreation (fishing, swimming and water skiing) and water transport.	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	No physical threats to humans were found. https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Multiple peer-reviewed reports document competing with other plants. https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	no reference	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	A. cristata form thick mats.	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Multiple peer-reviewed reports document negative impacts of introduction including forming thick mats, competing with other plants, blocking navigation, and increasing difficulty and costs to commercial fishing. https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	no reference	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	no reference	Low

22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	no reference	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	This species inhabits in still or slow moving water of lakes, ponds, and streams. https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Multiple peer-reviewed reports document negative impacts of introduction including forming thick mats and competing with other plants. https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	ne reference	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	A. cristata is not carnivore.	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	competing with other plants: https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	Medium
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	no evedence	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	no reference	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	no reference	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	no reference	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	This fern is a nitrogen fixer.	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Has high reproductive potential.	Medium
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	2 days: The plants most usually reproduce asexually by fragmentation of the fronds as frequently as every two days. https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable habitats nearby)?	>1	Although waterfowl dispersal was regarded as a possible vector, the urban location of these occurrences [in Ottawa, Ontario and Gatineau, Quebec] suggested to those investigators that the 2003 occurrence most likely resulted from the dumping of home aquaria (Darbyshire and Thomson 2004) https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	through water flow between the organism's locations, cleaning of home aquaria	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no reference of actively attaching	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	In winter, Azolla survives as either sporocarps, which fall to the bottom of water bodies, or as sporophytes that float. https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	A. cristata is able to undergo rapid vegetative reproduction by the elongation and fragmentation of the small fronds.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	has not active dispersal mechanisms	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	fragments can be dispersed by animals between water bodies	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	A. cristata is able to undergo rapid vegetative reproduction throughout the year by the elongation and fragmentation.	Medium
43	7.09	Is dispersal of the taxon density dependent?	No	no reference	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	no reference	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Still or slow moving water of lakes, ponds, and streams.	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	data for taxonomically-related species A. fiiliculoides: https://www.cabi.org/isc/datasheet/8119#topreventionAndControl	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Seasonal flooding can also result in the spread of the organism locally. Still another possibility involves common use of Azolla as a freshwater aquarium plant; when aquarium water is released it may be transported into sewers and waterways (Whitley et al. 1999). https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	High

48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	no evidence	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	no evidence	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	professional judgement	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	professional judgement	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	professional judgement	Medium

Statistics	
Scores	
BRA	**32.0**
BRA Outcome	**High**
BRA+CCA	**44.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**23.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*18.0*
B. Biology/Ecology	**9.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*2.0*
6. Reproduction	*-2.0*
7. Dispersal mechanisms	*4.0*
8. Tolerance attributes	*0.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**20**
Environmental	**12**
Species or population nuisance traits	**16**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.52**
BRA	**0.51**
CCA	**0.63**

Date and Time
10/12/2021 12:04:24

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Azolla filiculoides*
Common name	Pacific mosquitofern
Assessor	Mihaela Britvec
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Members of the genus Azolla are utilized throughout the world for a wide variety of purposes besides its widespread uses as an ornamental in fish ponds and tanks (Lumpkin and Plucknett, 1980; 1982). A. filiculoides is used as a green manure in rice paddies, mainly in Asia, as an inhibitor of weed growth in rice cultivation in China and Vietnam (Kröck and Alkämper, 1991), and as an alternative high protein fodder for cattle, swine, poultry and fish, and possibly as an alternative food source for humans, again, mainly in Asia. It has also been used as a nitrate-rich compost which potentially increases soil organic nitrogen levels and cation exchange capacity. It is used for purification of water, removal of heavy metals (Sanyahumbi et al., 1998) and removal of nitrogen and phoshorous from wastewater (Forni et al., 2001). It has also been used variously as an ingredient in soap production, a cure for sore throats and as a control for mosquitoes in southern India as complete mats disrupt larval development (Rajendran and	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Members of the genus Azolla are utilized throughout the world for a wide variety of purposes besides its widespread uses as an ornamental in fish ponds and tanks (Lumpkin and Plucknett, 1980; 1982). A. filiculoides is used as a green manure in rice paddies, mainly in Asia, as an inhibitor of weed growth in rice cultivation in China and Vietnam (Kröck and Alkämper, 1991), and as an alternative high protein fodder for cattle, swine, poultry and fish, and possibly as an alternative food source for humans, again, mainly in Asia. It has also been used as a nitrate-rich compost which potentially increases soil organic nitrogen levels and cation exchange capacity. It is used for purification of water, removal of heavy metals (Sanyahumbi et al., 1998) and removal of nitrogen and phoshorous from wastewater (Forni et al., 2001). It has also been used variously as an ingredient in soap production, a cure for sore throats and as a control for mosquitoes in southern India as complete mats disrupt larval development (Rajendran and	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	It is closely related to Azolla cristata and other species within the genus Azolla (https://www.cabi.org/isc/datasheet/8119#tosimilaritiesToOtherSpeciesOrConditions).	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	A. filiculoides is a small fern native to the Americas which has spread widely throughout the world. Climatic requirements include suitably warm months for sporocarp development, adequate radiation and light intensity for vegetative growth, and adequate amounts of rainfall to prevent its aquatic habitat from drying up. This species of tropical origin is thought to have evolved a cold-tolerant strain since its introduction into Britain (Janes, 1998b) and South Africa (McConnachie, 2003). A. filiculoides may be able to survive temperatures as low as -10ºC before death occurs.	Medium
5	2.02	What is the quality of the climate matching data?	High	doi: 10.1016/j.limno.2014.05.003	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	doi: 10.1016/j.limno.2014.05.003	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	https://www.cabi.org/isc/datasheet/8119#topathwayVectors	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	doi: 10.1016/j.limno.2014.05.003	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	A. filiculoides is native to the Rocky Mountain states of the western USA and Canada, through Central America and to most of South America. It has been introduced to Europe, North and sub-Saharan Africa, China, Japan, New Zealand, Australia, the Caribbean and Hawaii.	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Negatively impacts animal health (https://www.cabi.org/isc/datasheet/8119#toriskAndImpactFactors).	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	It has commonly been utilised as an ornamental in fishponds and tanks and has spread from these foci, exhibiting a weedy phenology in nutrient enriched reservoirs and roadside canals (T. Center, Senior Researcher, Aquatic Weeds, United States Department of Agriculture, personal communication).	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	Damaged ecosystem services, ecosystem change/ habitat alteration	Very high

13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	Primarily, social impacts of A. filiculoides have centred around the reduction of useful water surface area for recreation (fishing, swimming and water skiing) and water transport.	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	Yes	Negatively impacts human health: A. filiculoides, coupled with the lack of light penetration, creates an anaerobic environment which can reduce the quality of drinking water and make survival for other organisms in the water impossible.	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	A. filiculoides, coupled with the lack of light penetration, creates an anaerobic environment which make survival for other organisms in the water impossible.	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	no reference	Medium
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Highly adaptable to different environments (https://www.cabi.org/isc/datasheet/8119#toriskAndImpactFactors).	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	In eutrophic water systems, A. filiculoides grows rapidly, easily outcompeting indigenous vegetation. Decaying root and leaf matter below a mat of A. filiculoides, and the lack of light penetration, creates an anaerobic environment.	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Primarily, social impacts of A. filiculoides have centred around the reduction of useful water surface area for recreation (fishing, swimming and water skiing) and water transport.	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	no reference	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	no reference	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	no reference	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	A. filiculoides in its native areas (South America and western North America) is a plant of slow flowing streams and rivers, ponds and lakes (Reed, 1962; Lumpkin and Plucknett, 1980;	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	In eutrophic water systems, A. filiculoides grows rapidly, easily outcompeting indigenous vegetation. Decaying root and leaf matter below a mat of A. filiculoides, coupled with the lack of light penetration, creates an anaerobic environment which can reduce the quality of drinking water and make survival for other organisms in the water impossible.	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Has propagules that can remain viable for more than one year.	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	Azolla filiculoides is not cornivore.	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	In eutrophic water systems, A. filiculoides grows rapidly, easily outcompeting indigenous vegetation.	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	no evedence	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	has propangules	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	no reference	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	no evidence	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	A. filiculoides grows in association with the heterocystous cyanobacterium (blue-green alga) Anabaena azollae (Nostocales: Nostocaceae), within the dorsal leaf lobe cavities (Ashton and Walmsley, 1984). The alga has the ability to fix atmospheric nitrogen and is able to fulfil the nitrogen requirements of the fern making it successful in nitrogen-deficient waters (Ashton, 1982).	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	has high reproductive potential, has propagules	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	1 months	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	https://www.cabi.org/isc/datasheet/8119#topathwayVectors	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	through water flow between the organism's locations	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no reference of actively attaching	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	has propangules	High

39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	A. filiculoides is able to undergo rapid vegetative reproduction throughout the year by the elongation and fragmentation of the small fronds.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	has not active dispersal mechanisms	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	fragments can be dispersed by animals between water bodies	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	A. filiculoides is able to undergo rapid vegetative reproduction throughout the year by the elongation and fragmentation of the small fronds.	High
43	7.09	Is dispersal of the taxon density dependent?	No	no reference	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	Tolerates fire.	Medium
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	A. filiculoides is a plant of slow flowing streams and rivers, ponds and lakes.	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	https://www.cabi.org/isc/datasheet/8119#topreventionAndControl	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Seasonal flooding can also result in the spread of the organism locally.	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	no evidence	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	No	Host records from around the globe show that the genus Azolla is attacked by generalist herbivores and that very few specialist insect species have evolved on these plants (Hill, 1997). However, four beetle species, the weevils Stenopelmus rufinasus and S. brunneus and the two flea beetles Pseudolampsis guttata and P. darwinii, appear to have specialized on the genus Azolla (Richerson and Grigarick, 1967; Habeck, 1979; Hill, 1999) and were identified as potential biological control agents for A. filiculoides in South Africa (Hill, 1997). Following host range testing, Stenopelmus rufinasus was released in 1997 as a biocontrol of A. filiculoides in South Africa (McConnachie et al.	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	https://doi.org/10.1016/j.sajb.2015.07.017	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	professional judgement	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	professional judgement	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	professional judgement	Medium

Statistics	
Scores	
BRA	**39.0**
BRA Outcome	**High**
BRA+CCA	**51.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**24.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*18.0*
B. Biology/Ecology	**15.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*2.0*
6. Reproduction	*0.0*
7. Dispersal mechanisms	*4.0*
8. Tolerance attributes	*2.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*

2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**21**
Environmental	**12**
Species or population nuisance traits	**23**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.67**
BRA	**0.67**
CCA	**0.63**

Date and Time
10/12/2021 11:22:25

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Cabomba caroliniana*
Common name	Carolina fanwort
Assessor	Tena Radočaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	C. caroliniana is a highly adaptable submersed aquatic macrophyte whose attractive flowers and finely dissected leaves have lead to widespread use and trade in the aquatic industry	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	C. caroliniana is a highly adaptable submersed aquatic macrophyte whose attractive flowers and finely dissected leaves have lead to widespread use and trade in the aquatic industry	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	no data available	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	The similarity of climatic conditions between native areas and the RA area is medium (Climatch)	Medium
5	2.02	What is the quality of the climate matching data?	Medium	I used climatch and distribution map of CABI	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	C. caroliniana is not present in the RA area.	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	Aircraft, Aquaculture stock, Machinery and equipment, Ship structures above the water line (CABI, 2020)	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	C. caroliniana is present in Hungary and Serbia (Király, G., Steták, D., & Bányász, Á. (2007). Spread of invasive macrophytes in Hungary. Neobiota, 7, 123-131.) Vukov, D., Jurca, T., Rućando, M., Igić, R., & Miljanović, B. (2013). Cabomba caroliniana A. Gray 1837: A new, alien and potentially invasive species in Serbia. Archives of Biological Sciences, 65(4), 1515-1520.	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	It is a popular aquarium plant native to South America (Brazil, Uruguay, Paraguay, and northeastern Argentina) and, according to some authors, to southeastern United States. It was introduced into the rest of the USA, Canada, Australia, Asia (China, Malaysia, India, Japan), and in many regions of its new range it is considered an invasive and noxious aquatic weed. In Europe, it was found in the United Kingdom (introduced to England), Belgium, the Netherlands, and Hungary. Newly recorded populations in Serbia are restricted to the canals in Bačka. Populations are established only on two localities (Mali Stapar and Odžaci). (Vukov, D., Jurca, T., Rućando, M., Igić, R., & Miljanović, B. (2013). Cabomba caroliniana A. Gray 1837: A new, alien and potentially invasive species in Serbia. Archives of Biological	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	It has a different ecological niche than most other aquatic plants, thus impacting native species (Zhang et al., 2003). C. caroliniana populations are often associated with areas with decreased species diversity (Cao et al., 2006). Hogsden et al. (2007) showed that while native macrophytes could be found in C. caroliniana beds, their abundance was both low and uneven (CABI, 2020)	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	no data available	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	In Queensland, C. caroliniana have been shown to negatively impact water quality. The winter dieback that occurs in harsher areas of its range can cause substantial nutrient release, especially manganese pulses. This sudden manganese release can impact the manganese cycle and impact water quality. Additionally dense stands can cause water loss through seepage and overflow, thus impacting hydrological regimes (Mackey,	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	In natural systems the plant can cause substantial nuisance to recreational users by impeding navigation, tangling fishing line and wrapping motor propellers. Thick vegetation can also decrease aesthetic value. This species can also reduce swimming access and potentially cause human health safety issues (CABI,	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	No (CABI, 2020)	Medium
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Smothers and outcompetes native species, and reduces the overall species diversity in aquatic systems (Weibert, C. (2015). Weed Risk Assessment for Cabomba caroliniana A. Gray (Cabombaceae)–Carolina fanwort.)	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	no data available	High

17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	The plant prefers warm sub-tropical climates with temperatures from 13-27 degrees C (ISSG, 2008), although it can tolerate below freezing temperatures. This species is able to adapt to a wide variety of climates, and can successfully overwinter in areas that are too cold for continuous growth. (Weibert, C. (2015). Weed Risk Assessment for Cabomba caroliniana A. Gray	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	C. caroliniana is an aggressive plant, and in many instances has seriously impacted biodiversity. C. caroliniana has a broader niche than, and may pose a threat to, native species (CABI, 2020)	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	This species can also reduce swimming access and potentially cause human health safety issues. In natural systems the plant can cause substantial nuisance to recreational users by impeding navigation, tangling fishing line and wrapping motor propellers	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	No	Matthews, J., van der Velde, G., Collas, F. P., de Hoop, L., Koopman, K. R., Hendriks, A. J., & Leuven, R. S. (2017). Inconsistencies in the risk classification of alien species and implications for risk assessment in the European Union.	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	Matthews, J., van der Velde, G., Collas, F. P., de Hoop, L., Koopman, K. R., Hendriks, A. J., & Leuven, R. S. (2017). Inconsistencies in the risk classification of alien species and implications for risk assessment in the European Union.	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=402	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	It grows rooted in the mud of stagnant to slow flowing water including streams, and smaller rivers (Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	In Queensland, C. caroliniana have been shown to negatively impact water quality. The winter dieback that occurs in harsher areas of its range can cause substantial nutrient release, especially manganese pulses. This sudden manganese release can impact the manganese cycle and impact water quality. Additionally dense stands can cause water loss through seepage and overflow, thus impacting hydrological regimes (Mackey,	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Király, G., Steták, D., & Bányász, Á. (2007). Spread of invasive macrophytes in Hungary. Neobiota, 7, 123-131.	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	Not applicable	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	Not applicable	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=402	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=402	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	Cabomba can spread locally via vegetative (asexual) or sexual reproduction (Weibert, C. (2015). Weed Risk Assessment for Cabomba caroliniana A. Gray (Cabombaceae)–Carolina fanwort).	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=402	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=402	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=402	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable habitats nearby)?	>1	Interconnected waterways, Humans are the main vectors of dispersal, probably introducing the plant by either intentional water garden plantings or through inappropriate disposal. Additionally, since the plant reproduces via fragmentation, boating activity facilitates the spread of the plant; fragments are frequently observed in lakes with heavy motorboat activit (CABI,	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Interconnected waterways (CABI, 2020)	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	Yes	The spread of the plant increases with boating activity; it has long, trailing stems that become wrapped around boat propellers and consequently is transported within and among water bodies (CABI, 2020)	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=402	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=402	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Not applicable	Very high

41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	No evidence, but The plant has been reported to be a source of food for water fowl. (CABI, 2020)	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	boating activity facilitates the spread of the plant (cabi, 2020)	Medium
43	7.09	Is dispersal of the taxon density dependent?	Yes	Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=402	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	No evidence	Medium
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	Yes	It can grow in water with pH from 5.7-9.2, is highly tolerant of anaerobic conditions and can survive in high alkalinity water (USDA-NRCS, 2008) and/or water with high turbidity. Growth is highest at medium turbidities, but the plant still thrives in high-turbidity water, and moderate-to-high turbidity water facilitates the production of adventitious roots (Mackey, 1996). The plant prefers warm sub-tropical climates with temperatures from 13-27 degrees C (ISSG, 2008), although it can tolerate below freezing temperatures (CABI, 2020)	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	In the north American region herbicide treatments have been used for cabomba control. Endothall provides excellent control but it is a contact herbicide only (Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=402)	Medium
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Flooding and other natural disasters (CABI, 2020)	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	No evidence	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	C. caroliniana does serve as a source of food for wildlife. (CABI, 2020)	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	The risks of entry into the RA area by the taxon are likely to no change. (Matthews, J., Beringen, R., Lamers, L. P. M., Odé, B., Pot, R., Velde, G., ... & Leuven, R. S. (2013). Risk analysis of the non-native Fanwort (Cabomba caroliniana) in the Netherlands.)	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	Potential future changes as a result of e.g. a rise in water temperature due to climate change, may i no change the suitability and area of C. caroliniana habitat and establishment (Matthews, J., Beringen, R., Lamers, L. P. M., Odé, B., Pot, R., Velde, G., ... & Leuven, R. S. (2013). Risk analysis of the non-native Fanwort (Cabomba caroliniana) in the Netherlands.)	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	Potential future changes as a result of e.g. a rise in water temperature due to climate change, may i no change the suitability and area of C. caroliniana habitat and establishment (Matthews, J., Beringen, R., Lamers, L. P. M., Odé, B., Pot, R., Velde, G., ... & Leuven, R. S. (2013). Risk analysis of the non-native Fanwort (Cabomba caroliniana) in the Netherlands.)	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	Matthews, J., Beringen, R., Lamers, L. P. M., Odé, B., Pot, R., Velde, G., ... & Leuven, R. S. (2013). Risk analysis of the non-native Fanwort (Cabomba caroliniana) in the Netherlands.)	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	Matthews, J., Beringen, R., Lamers, L. P. M., Odé, B., Pot, R., Velde, G., ... & Leuven, R. S. (2013). Risk analysis of the non-native Fanwort (Cabomba caroliniana) in the Netherlands.)	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	Matthews, J., Beringen, R., Lamers, L. P. M., Odé, B., Pot, R., Velde, G., ... & Leuven, R. S. (2013). Risk analysis of the non-native Fanwort (Cabomba caroliniana) in the Netherlands.)	Medium

Statistics	
Scores	
BRA	**29.5**
BRA Outcome	**High**
BRA+CCA	**39.5**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**13.5**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*10.5*
B. Biology/Ecology	**16.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*0.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*5.0*
8. Tolerance attributes	*0.0*
C. Climate change	**10.0**
9. Climate change	*10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*

B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**14**
Environmental	**11**
Species or population nuisance traits	**19**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.62**
BRA	**0.63**
CCA	**0.58**

Date and Time
06/12/2021 20:33:07

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Egeria densa*
Common name	Brazilian waterweed
Assessor	Mihaela Britvec
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	It is a well known and popular plant for use in aquaria and small ponds, not only for its attractiveness and resilience, but also for its oxygenating capacity which benefits the fish contained therein.	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	https://fau.digital.flvc.org/islandora/object/fau%3A33564/datastream/OBJ/view/Culture_of_the_Aquatic_Plant_Egeria_densa_in_a_Closed_System__Final_Report_for_Contract_No__021065__Submitted_to_the_Division_of_Aquaculture__Florida_Department_of_Agriculture_and_Consumer_Services.pdf	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	It is closely related to Elodea species.	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	https://doi.org/10.1016/j.limno.2005.01.001	Medium
5	2.02	What is the quality of the climate matching data?	High	https://doi.org/10.1016/j.limno.2005.01.001	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	doi: 10.3391/bir.2018.7.4.05	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	https://www.cabi.org/isc/datasheet/20491#topathwayVectors	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	doi: 10.3391/bir.2018.7.4.05	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	E. densa is native to parts of Argentina, Brazil and Uruguay. Being one of the most common plants for aquaria, it has been widely distributed around the world. In many regions it has escaped and has become an invasive aquatic weed. Most reports come from Central and North America, Europe and Australasia.	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	E. densa is an environmental weed not affecting cultivated crops to any extent, though may impact on agriculture by the blockage of irrigation channels.	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	Although there are positive economic impacts resulting in the trade in aquarium plants including E. densa, this is strongly countered by the costs of control as exercised in many areas where it has become a serious problem. Removal of E. densa from lakes and reservoirs in the USA costs some states several million	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	damaged ecosystem services, ecosystem change/ habitat alteration (https://www.cabi.org/isc/datasheet/20491#toriskAndImpactFacto	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	Dense mats of E. densa will deleteriously affect recreational activities such as fishing, swimming or boating.	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	no reference	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	E. densa can out-compete and displace native vegetation (https://www.cabi.org/isc/datasheet/20491#toimpactBiodiversity).	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	no reference	Medium
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	E. densa is native to parts of Argentina, Brazil and Uruguay. Being one of the most common plants for aquaria, it has been widely distributed around the world.	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	When dense mats of E. densa have formed, native species are displaced, oxygen may be depleted and the character of stream and lakes may be changed. The effects on the environment may be substantial, affecting the hydrology also.	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	negatively impacts tourism, reduced amenity values, reduced recreative options	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	no reference	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	no reference	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	E. densa formed dense mats.	Medium

23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Still water is prefered, or slow-running water, mild or warm. Cannot tolerate shaded water.	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	When dense mats of E. densa have formed, native species are displaced, oxygen may be depleted and the character of stream and lakes may be changed. The effects on the environment may be substantial, affecting the hydrology also.	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	no reference	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	Egeria densa is not carnovore species.	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	E. densa is a plant with a great capacity of photosynthesizing when illuminated and releases great quantities of oxygen. When dense mats of E. densa have formed, oxygen may be depleted and the character of stream and lakes may be changed.	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	no reference	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	no reference	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	no reference	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	no reference	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	specific habitat: E. densa cannot tolerate shaded water.	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Has high reproductive potential.	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	3 months	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	https://www.cabi.org/isc/datasheet/20491#toriskAndImpactFactors	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	through water flow between the organism’s locations	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no reference of actively attaching	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	Plants can reproduce by seeds.	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	The principal means of reproduction is vegetative, by fragmentation of stems.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Egeria densa has not active dispersal mechanisms.	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	Seeds and fragments can be dispersed by animals between water bodies.	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Has high reproductive potential, Highly mobile locally	High
43	7.09	Is dispersal of the taxon density dependent?	No	no reference	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	no refernce	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	cannot tolerate shaded water	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	Mechanical removal such as cutting, hand pulling or netting is feasible for small infestations, though the ability to propagate from small stem fragments means that repeat clearing will be required, or even that infestations may spread if removal is not adequate. Use of the herbicide diquat has been recommended, although using chemicals in water bodies leads to evident environmental risks. The stocking with certain fish such as grass carp has been suggested, as E. densa is highly palatable, but there are no reports as to the effectiveness of this method.	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Seasonal flooding can also result in the spread of the organism locally.	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	doi: 10.3391/bir.2018.7.4.05	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	no reference	Low
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	professional judgement (E. densa can out-compete and displace native vegetation)	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	professional judgement	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	professional judgement	Low

Statistics	
Scores	
BRA	**36.0**
BRA Outcome	**High**
BRA+CCA	**48.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**20.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*14.0*
B. Biology/Ecology	**16.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*2.0*
6. Reproduction	*-2.0*
7. Dispersal mechanisms	*4.0*
8. Tolerance attributes	*5.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**17**
Environmental	**12**
Species or population nuisance traits	**24**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.57**
BRA	**0.58**
CCA	**0.50**

Date and Time
08/12/2021 12:03:03

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Elodea canadensis*
Common name	Canadian waterweed
Assessor	Mihaela Britvec
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	https://www.cabi.org/isc/datasheet/20759#touses	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	https://www.cabi.org/isc/datasheet/20759#touses	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	It is closely related to Elodea nuttallii.	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	https://www.cabi.org/isc/datasheet/20759#toclimate	High
5	2.02	What is the quality of the climate matching data?	High	https://www.cabi.org/isc/datasheet/20759#toclimate	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Elodea canadensis originates from North America, concentrated around the St Lawrence Valley and the Great Lakes regions and the Pacific West Coast (Bowmer et al., 1995), but now occurs throughout the USA. The plant was introduced to the UK in the mid-1800s and has spread eastwards through Western Europe with the apparent exception, so far, of Iberia and northern Scandinavia. It is considered an invasive plant in Europe and has been reported as one of the most widespread invasive species in Russia (Vinogradova et al., 2018). E. canadensis is widespread and abundant in New Zealand (Bowmer et al., 1995) and is ranked as a medium risk with a weed potential score of 46 in New Zealand by the Aquatic Weed Risk Assessment Model (AWRM) (Champion et al., 2007). It has become naturalized in water bodies in the south-eastern parts of Australia, particularly in areas near major cities. It is most common in southern and eastern New South Wales, Victoria and Tasmania. It is also recorded from south-eastern South Australia and is sparingly naturalized in south-eastern Queensland (EWA, 2016). It has been recorded in	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	https://www.cabi.org/isc/datasheet/20759#topathwayVectors	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	Hussner, A. (2012). Alien aquatic plant species in European countries. Weed Research, 52 (4), 297-306.	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	https://www.cabi.org/isc/datasheet/20759#todistribution	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	https://www.cabi.org/isc/datasheet/20759#toimpactEconomic	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	https://doi.org/10.1046/j.1365-2427.1999.00390.x	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	https://www.cabi.org/isc/datasheet/20759#toimpactEnvironmental	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	https://www.cabi.org/isc/datasheet/20759#toimpactSocial	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	Yes	Species of Elodea are known to accumulate metals from the sediment and release them into the waterbody.	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	https://www.cabi.org/isc/datasheet/20759#toimpactEnvironmental	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	https://www.cabi.org/isc/datasheet/20759#tosummaryOfInvasiveness	Medium

17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Evidence shows that this plant is very adaptable and has can spread under a wide range of conditions and nutrient concentrations ranging from oligotrophic to eutrophic (Cook and Urmi-König 1985; Simpson, 1990). E. canadensis has a wide climatic tolerance (it is present from Alaska to Puerto Rico), though it may be less common at the extremes of its range, being predominant in temperate areas of North America and Europe. In studies of maximum depths at which a number of submerged aquatic plants were found, the maximum recorded for any species was 12-14 m for Elodea (Sheldon and Boylen, 1977; Pip and Simmons, 1986; Wells et al., 1997). Its average height is about 1.2 m, having a maximum height of 2.5 m (Wells et al., 1997). In Europe it can survive in water depths of up to 4 m (McGavigan, 2012) in slow moving water. This species can survive and even grow slowly under ice cover (Bowmer et al., 1995). In North America it has been recorded in neutral to slightly alkaline inland waters and in fresh to slightly brackish coastal waters (Holm et al., 1997). Riis et al. (2012), compared the effects of temperature and light availability on the growth and morphology of E. canadensis, Egeria densa and Lagarosiphon major and suggested that, in general, subject to variations due to timing of introductions, E. densa will dominate warmer, shallower waters, L. major will dominate in colder, clear-water lakes, whilst E. canadensis will continue its role as a pioneer species which is rapidly replaced by the two taller species after their arrival. Elodea canadensis prefers clean water with a current from 0 to 1 m/s. Optimum water temperatures range from 10 to 20°C, and silty water or water with organic sediment is preferred to a sandy substrate (Bowmer et al., 1995, Barrat-Segretain et al., 2002). The habitat preference of E. canadensis in lakes is towards large and deep lakes located at high altitudes, with long water-retention times and high water quality (Kolada and Kutyła 2016). E. canadensis exhibits positive growth under experimental conditions of high-salt concentrations (Stoler et al., 2018). Consequently,	Very high
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	https://doi.org/10.1899/03-097.1	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Elodea canadensis can form large and dense stands that interfere with boating, fishing and thereby adversely affect recreation activities (McGavigan, 2017). It makes it difficult for boats to travel through invaded waterways (Bowmer et. al., 1995) reduces recreational opportunities and diminishes aesthetics for the environment (Josefsson and Andersson, 2001).	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	doi: 10.1111/j.1600-0587.2013.00296.x	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	doi: 10.1111/j.1600-0587.2013.00296.x	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Elodea canadensis is dioecious and male plants are less common than female in its native range. Only female plants are currently found in Europe, and male plants have not been reported since 1903 (Cook and Urmi-König, 1985), so reproduction is only vegetative, involving vegetative fragments and turions (overwintering buds). Very small plant fragments are able to form roots from nodes and start growing (McGavigan, 2017). The main growing season is between mid-April and October. Plants die back in Autumn. Turions or short, densely-leaved resistant stems, develop then break off to float around the water body before they sink to the bottom over winter, where they rest until they re-grow in spring (Millane and Caffrey, 2014). Over-wintering buds and fragments of the brittle branches are easily detached by waves, currents, foraging animals and boat traffic. New roots develop quickly on the nodes of these fragments which are carried downstream to form new stands. This method of propagation gives E. canadensis a considerable advantage over annual species and resulted in its rapid spread throughout Europe following its	High
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Elodea canadensis prefers clean water with a current from 0 to 1 m/s.	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	https://www.cabi.org/isc/datasheet/20759#toriskAndImpactFactors	High

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Elodea canadensis is dioecious and male plants are less common than female in its native range. Only female plants are currently found in Europe, and male plants have not been reported since 1903 (Cook and Urmi-König, 1985), so reproduction is only vegetative, involving vegetative fragments and turions (overwintering buds). Very small plant fragments are able to form roots from nodes and start growing (McGavigan, 2017). The main growing season is between mid-April and October. Plants die back in Autumn. Turions or short, densely-leaved resistant stems, develop then break off to float around the water body before they sink to the bottom over winter, where they rest until they re-grow in spring (Millane and Caffrey, 2014). Over-wintering buds and fragments of the brittle branches are easily detached by waves, currents, foraging animals and boat traffic. New roots develop quickly on the nodes of these fragments which are carried downstream to form new stands. This method of propagation gives E. canadensis a considerable advantage over annual species and resulted in its rapid spread throughout Europe following its	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	E. canadensis is not carnivore species.	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	https://www.cabi.org/isc/datasheet/20759#toriskAndImpactFactors	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	no references	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	https://www.cabi.org/isc/datasheet/20759#toriskAndImpactFactors	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	no reference	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	no reference	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	no reference	Medium
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Elodea canadensis is dioecious and male plants are less common than female in its native range. Only female plants are currently found in Europe, and male plants have not been reported since 1903 (Cook and Urmi-König, 1985), so reproduction is only vegetative, involving vegetative fragments and turions (overwintering buds). Very small plant fragments are able to form roots from nodes and start growing (McGavigan, 2017). The main growing season is between mid-April and October. Plants die back in Autumn. Turions or short, densely-leaved resistant stems, develop then break off to float around the water body before they sink to the bottom over winter, where they rest until they re-grow in spring (Millane and Caffrey, 2014). Over-wintering buds and fragments of the brittle branches are easily detached by waves, currents, foraging animals and boat traffic. New roots develop quickly on the nodes of these fragments which are carried downstream to form new stands. This method of propagation gives E. canadensis a considerable advantage over annual species and resulted in its rapid spread throughout Europe following its	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	3 months	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	https://www.cabi.org/isc/datasheet/20759#topathwayVectors	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	https://doi.org/10.20302/NC.2018.27.25	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no reference of acitively attaching	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Elodea canadensis is dioecious and male plants are less common than female in its native range. Only female plants are currently found in Europe, and male plants have not been reported since 1903 (Cook and Urmi-König, 1985), so reproduction is only vegetative, involving vegetative fragments and turions	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Elodea canadensis is dioecious and male plants are less common than female in its native range. Only female plants are currently found in Europe, and male plants have not been reported since 1903 (Cook and Urmi-König, 1985), so reproduction is only vegetative, involving vegetative fragments and turions	Very high
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	E. canadensis has not active dispersal mechanisms.	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	Over-wintering buds and fragments of the brittle branches are easily detached by waves, currents, foraging animals and boat	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be rapid?	Yes	Over-wintering buds and fragments of the brittle branches are easily detached by waves, currents, foraging animals and boat traffic. New roots develop quickly on the nodes of these fragments which are carried downstream to form new stands. This method of propagation gives E. canadensis a considerable advantage over annual species and resulted in its rapid spread.	High
43	7.09	Is dispersal of the taxon density dependent?	No	no reference	Medium
8. Tolerance attributes					

44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	This species can survive and even grow slowly under ice cover (Bowmer et al., 1995).	Medium
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	https://www.cabi.org/isc/datasheet/20759#towaterTolerances	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	https://www.cabi.org/isc/datasheet/20759#topreventionAndControl	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Seasonal flooding can also result in the spread of the organism locally (Barrat-Segretain and Elger, 2004).	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	E. canadensis exhibits positive growth under experimental conditions of high-salt concentrations (Stoler et al., 2018). Consequently, salt marshes and brackish waters are likely to be invaded by this species if salt concentration is lower than to 3 g/l of salt (Thouvenot and Thiébaut, 2018).	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	Control by aquatic herbivores has been investigated in numerous countries (National Academy of Sciences, 1976). Species tested include Tilapia melanopleura, T. mossambica and the Chinese grass carp Ctenopharyngodon idella. Since the latter is an exotic species, introduction is only allowed when the species can be confined to a particular waterbody and, therefore, investment in fences is a prerequisite. Nevertheless, several successful examples of control are known from Western Europe and the USA (Stott et al. 1971; Willey et al., 1974; Mitzner, 1978; Fowler, 1984) and more recent experiments have found medium efficiency in the use of stocking grass carps (Bonar et al., 2002, Pípalová, 2006). There are some disadvantages in using grass carp, as these fish are generalist feeders and may also damage native plant species (see Vernon and Hamilton, 2011 for further	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	doi: 10.3897/neobiota.49.34318	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	doi: 10.3897/neobiota.49.34318	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	professional judgement	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	professional judgement	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	professional judgement	Medium

Statistics	
Scores	
BRA	**39.0**
BRA Outcome	**High**
BRA+CCA	**51.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**20.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*14.0*
B. Biology/Ecology	**19.0**
4. Undesirable (or persistence) traits	*9.0*
5. Resource exploitation	*2.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*5.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**

9. Climate change	*6*
Sectors affected	
Commercial	**17**
Environmental	**12**
Species or population nuisance traits	**27**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.68**
BRA	**0.69**
CCA	**0.63**

Date and Time
08/12/2021 08:26:12

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Elodea nuttallii*
Common name	western waterweed
Assessor	Mihaela Britvec
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	E. nuttallii is used in cool water aquariums. Elodea species are often a preferred food for waterfowl or crayfish (Lodge, 1991; van Donk and Otte, 1996), and can also be used as shelter for small fishes and aquatic invertebrates.	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Elodea species are often a preferred food for waterfowl or crayfish (Lodge, 1991; van Donk and Otte, 1996), and can also be used as shelter for small fishes and aquatic invertebrates. E. nuttallii is used in cool water aquariums.	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	It is closely related to Elodea canadensis and Egereia densa. https://www.cabi.org/isc/datasheet/20761#tosimilaritiesToOtherSpeciesOrConditions	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	https://www.cabi.org/isc/datasheet/20761#toclimate	High
5	2.02	What is the quality of the climate matching data?	Medium	https://www.cabi.org/isc/datasheet/20761#toclimate	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	https://doi.org/10.4462/annbotrm-10207	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	https://www.cabi.org/isc/datasheet/20761#topathwayCauses	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	https://doi.org/10.4462/annbotrm-10207	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	E. nuttallii is native to temperate North America common throughout most of the USA and south Canada and has a similar distribution to E. canadensis (eFloras, 2009; USDA-ARS, 2009; USDA-NRCS, 2009). In its non-native distribution, it is found in central and western Europe and Japan (Cook and Urmi-König,	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	no reference	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	negatively impacts aquaculture (https://www.cabi.org/isc/datasheet/20761#toriskAndImpactFactors)	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	damaged ecosystem services, ecosystem change (https://www.cabi.org/isc/datasheet/20761#toriskAndImpactFactors)	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	It is a submerged plant, and just like E. canadensis it forms large and dense stands that interfere with boating, fishing and adversely affect recreation activities.	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	Yes	Species of Elodea are known to accumulate metals from the sediment and release them into the waterbody.	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	It often forms dense, monospecific stands and displaces other aquatic plants from many localities (Simpson, 1984, 1990; Barrat-Segretain, 2005). Threat to/ loss of native species (https://www.cabi.org/isc/datasheet/20761#toriskAndImpactFactors).	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	no reference	Medium
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Waterweeds are competitive and well adapted to a broad array of environmental conditions (Cook and Urmi-König, 1985; Simpson, 1990).	Very high
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	The spread of E. nuttallii has resulted in displacement of E. canadensis (itself an invasive alien from N. America) from many localities where the latter had previously become well established in Europe (Simpson, 1990; Thiébaut et al., 1997; Barrat-Segretain, 2001; Larson, 2007). E. nuttallii is itself being replaced by Lagarosiphon major. Where it establishes it can form exceptionally dense monocultures, excluding native species	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	E. nuttallii have the potential to develop into dense submerged beds, which prevent the use of water for recreational and professional purposes (Larson, 2003), navigation and port infrastructure (CPS-SKEW, 2008). The plant can also clog and impede drainage waterways.	Very high

20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	doi: 10.1111/j.1600-0587.2013.00296.x	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	doi: 10.1111/j.1600-0587.2013.00296.x	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Introduced E. nuttallii exposed to environmental stresses show great phenotypic plasticity variations with increasing water nutrient enrichment and increases in leaf area with decreases in internode length, while the shorter broad-leaved phenotype typically occurs in shallow streams, whereas the longer spacer narrow-leaved phenotype occurs in lakes. Larger leaf width and higher number of lateral shoots - when nutrients are not limiting - may enhance plant performance (Simpson, 1988; Vanderpoorten	High
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	E. nuttallii has been found growing in a wide range of water bodies, in general in quiet water such as shorelines of lakes, reservoirs and ponds, along rivers and streams, and also in wetlands, canals and ditches (Hickman, 1993). In England, it has been recorded in lowland habitats only (Preston and Croft, 1997).	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Modification of nutrient regime (https://www.cabi.org/isc/datasheet/20761#toriskAndImpactFactors).	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Vegetative reproduction seems to be the dominant method of propagation - essentially by fragmentation and division of the stems and the production of winter buds from stem tips (Preston and Croft, 1997). It has been observed that, when introduced to a new habitat, the establishment of Elodea buds is rapid, since the propagules sink into the sediment and grow rapidly (Barrat-	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	E. nuttallii is not carnivore species.	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Iit can form exceptionally dense monocultures, excluding native species through competition.https://www.cabi.org/isc/datasheet/20761#tosummaryOfInvasiveness	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	no reference	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Vegetative reproduction seems to be the dominant method of propagation - essentially by fragmentation and division of the stems and the production of winter buds from stem tips (Preston and Croft, 1997).	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	no reference	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	no reference	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	no reference	Medium
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Vegetative reproduction seems to be the dominant method of propagation - essentially by fragmentation and division of the stems and the production of winter buds from stem tips (Preston and Croft, 1997). It has been observed that, when introduced to a new habitat, the establishment of Elodea buds is rapid, since the propagules sink into the sediment and grow rapidly (Barrat-	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	3 months	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	https://www.cabi.org/isc/datasheet/20761#topathwayCauses, https://www.cabi.org/isc/datasheet/20761#topathwayVectors	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	through water flow between the organism’s locations	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no reference of acitively attaching	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Vegetative reproduction seems to be the dominant method of propagation - essentially by fragmentation and division of the stems and the production of winter buds from stem tips.	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Vegetative reproduction seems to be the dominant method of propagation - essentially by fragmentation.	Very high
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	E. nuttallii has not active dispersal mechanisms.	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	Several traits of the species are typical of successful invaders: rapid growth, vegetative reproduction through fragments and easily dispersed by waterfowl.	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	fast growing, has high reproductive potential, reproduces asexually	High
43	7.09	Is dispersal of the taxon density dependent?	No	no reference	Medium
8. Tolerance attributes					

44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	Tolerates fire, for example.	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	Yes	Waterweeds are competitive and well adapted to a broad array of environmental conditions (Cook and Urmi-König, 1985; Simpson, 1990). E. nuttallii is able to grow in turbid, highly eutrophic waters (Cook and Urmi-König, 1985; Ozimek et al., 1993; Thiébaut and Muller, 1999), as well as in clear oligo-mesotrophic waters (Thiébaut et al., 1997; Barrat-Segretain, 2001; Nagasaka, 2004) with a certain degree of organic pollution (Best et al., 1996). Growth of E. nuttallii is stimulated by fertilization with nitrogen and benefits from an excess of ammonia (Dendène et al., 1993). It can occur to depths of 3 m (Simpson, 1990) and 5 m (Ikusima, 1984) where it develops into dense pure stands, but it is most frequently found in shallow water. Optimum pH has been found to be between 7 and 9 (Jones et al., 1993). It is tolerant of disturbance, oil pollution and is typically found in calcareous water, from fresh to slightly brackish coastal water (St John, 1965) up to 14 ppt salinity, and in fine sediment soil, where it is	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	https://www.cabi.org/isc/datasheet/20761#topreventionAndControl	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Seasonal flooding can also result in the spread of the organism locally.	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	highly adaptable to different environments, habitat generalist	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	no reference	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement (E. nuttallii is highly adaptable to different environments).	Very high
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	professional judgement	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	professional judgement (https://www.cabi.org/isc/datasheet/20761#toriskAndImpactFactors)	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	professional judgement (negatively impacts aquaculture/fisheries, negatively impacts tourism, reduced amenity values, reduced native biodiversity, damaged ecosystem services, ecosystem change/ habitat alteration, infrastructure damage, modification of	Medium

Statistics	
Scores	
BRA	**41.0**
BRA Outcome	**High**
BRA+CCA	**53.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**20.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*14.0*
B. Biology/Ecology	**21.0**
4. Undesirable (or persistence) traits	*9.0*
5. Resource exploitation	*2.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*7.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	

Commercial	**17**
Environmental	**12**
Species or population nuisance traits	**29**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.68**
BRA	**0.67**
CCA	**0.75**

Date and Time
08/12/2021 08:25:59

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Gymnocoronis spilanthoides*
Common name	Senegal tea plant
Assessor	Marina Piria
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	https://www.cabi.org/isc/datasheet/26246#topathwayCauses	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	No	https://www.cabi.org/isc/datasheet/26246#topathwayCauses	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	native to Peru, N Argentina, Bolivia, Paraguay, Uruguay and S Brazil. Climatch used and with the most of regions climatic conditions matches	High
5	2.02	What is the quality of the climate matching data?	High	Climatch	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	Escape, flooding, pet trade https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Hungary, Italy https://www.cabi.org/isc/datasheet/26246#toidentity	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	In Hungary from 1988; New Zealand from 1980s https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	Gymnocoronis spilanthoides forms large and dense populations but only in habitats modified by human activities, https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	Recreational activities, irrigation and navigation may also be affected. https://www.cabi.org/isc/datasheet/26246#toidentity	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	https://www.cabi.org/isc/datasheet/26246#toidentity	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	Yes	https://www.cabi.org/isc/datasheet/26246#toidentity	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	https://www.cabi.org/isc/datasheet/26246#toidentity	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	High
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	5.5-8 pH https://www.cabi.org/isc/datasheet/26246#toidentity	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	https://www.cabi.org/isc/datasheet/26246#toidentity	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	grow 15 cm per week up to 1.5m high https://www.cabi.org/isc/datasheet/26246#toidentity	High

23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	It can invade and degrade natural wetlands, competing strongly with slower growing native plants and affecting wetland birds and other animals depend upon them. Native species can also be submerged causing death.	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	can reproduce by seeds and vegetatively from stem fragments https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	https://www.cabi.org/isc/datasheet/26246#toidentity	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	water, flodding,pet trade https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Personal opinion	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	https://www.cabi.org/isc/datasheet/26246#toidentity	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	https://www.cabi.org/isc/datasheet/26246#toidentity	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
43	7.09	Is dispersal of the taxon density dependent?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	Low pH and persistant to chemicals https://www.cabi.org/isc/datasheet/26246#toidentity	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	G. spilanthoidesis very hard to kill and herbicides are effective only on the upper parts of the plant, as submerged parts are not killed and can regrow. Following repeated efforts, glyphosate has proven to be ineffective in south Queensland, and it shows some resistance to the most commonly approved aquatic herbicides https://www.cabi.org/isc/datasheet/26246#toidentity	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Gymnocoronis spilanthoides forms large and dense populations but only in habitats modified by human activities. https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	cannot tolerate saline or brackish water. https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	neotropical species https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	High

Statistics	
Scores	
BRA	**28.0**
BRA Outcome	**High**
BRA+CCA	**38.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**11.0**
1. Domestication/Cultivation	*0.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*10.0*
B. Biology/Ecology	**17.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*0.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*3.0*
8. Tolerance attributes	*4.0*
C. Climate change	**10.0**
9. Climate change	*10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**9**
Environmental	**11**
Species or population nuisance traits	**21**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.65**
BRA	**0.63**
CCA	**0.75**

Date and Time
23/11/2021 16:57:37

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Hygrophila polysperma*
Common name	Indian swampweed
Assessor	Marina Piria
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Aquarium plant https://www.cabi.org/isc/datasheet/28135	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	for aquarium purposes https://www.cabi.org/isc/datasheet/28135	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Eleven of the taxa characterised as high risk (Cyperus papyrus, C. sp., Hygrophila difformis, H. balsamica, H. corymbosa, H. sp., Microsorum pteropus, Spathiphyllum sp., Taxiphyllum barbieri, Teucrium scordium and Typha minima) should be restricted from use. If these taxa are not restricted, based on their establishment and dispersal characteristics, they have a high risk of becoming invasive. https://onlinelibrary.wiley.com/doi/full/10.1111/wre.12135?casa_token=7GBeRf6xub0AAAAA%3A2bED9v6GI1xdJqlX3U38rTvqRIcNOg	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Mediterranean climate matches with India, Bangladesh using climatch	High
5	2.02	What is the quality of the climate matching data?	High	climatch tolerate Cs - Warm temperate climate with dry summer - which is present in Adriatic basin	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	Not in RA area; H. polysperma has recently been reported in Europe for the first time, where plants were found in North Rhine-Westphalia, Germany and Hungary https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	biofouling, water, mail, debris https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	has recently been reported in Europe for the first time, where plants were found in North Rhine-Westphalia and Hungary	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Germany, USA https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	H. polysperma reduces biodiversity by competing with and displacing native vegetation, and is capable of changing the fauna and flora of an ecosystem. H. polysperma can form dense monocultures which exclude all native plants and do not provide habitat or food for wildlife. H. polysperma is an excellent competitor due to its low light compensation and saturation points, which allow it to start growing in low light conditions before other native plants do. H. polysperma is also able to rapidly change resource acquisition in response to changing environmental conditions, allowing it to outcompete many other species (Spencer and Bowes, 1985). Decomposing mats of H. polysperma also have the ability to cause fish kills by creating low	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	Negatively impacts aquaculture/fisheries, dense populations; H. polysperma has limited water flow in irrigations channels and flood-control systems (UFL-IFAS, 2005). H. polysperma is also reported as being a threat to rice fields (Krombholz, 1996). CABI	Very high
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	unsightly mats of vegetation decrease aesthetic values. These declines in recreational and aesthetic values can decrease tourism, which can be a major source of livelihood within the community.	Very high
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	H. polysperma can form dense mats that impede recreational activities such as boating, fishing, swimming, water skiing, canoeing, and kayaking. Herbicides typically used in controlling H. polysperma are estimated at costing between US$988 to US$1482 per hectare (US $400 to US $600 per acre), and total costs are even higher when labour and equipment are included (Cuda and Sutton, 2000). In an extreme case involving the use of fluridone in flowing water, control was achieved for a period of 20 months at a cost of US $34,580 per hectare (Sutton, 1996).	Very high
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	Very high

17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Low oxygen conditions https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	Very high
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	Not evidences https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No information https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	up to 3 m high https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	High
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	H. polysperma can grow submersed in water up to 3m (10 ft) deep and as an immersed plant along banks, preferring flowing waters, but also found growing in slow-moving systems such as lakes, marshes, canals, rivers, swamps, wetlands, and irrigation ditches (FNW Disseminules, 2007).	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	reduces level of oxygen	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	probably yes https://www.cabi.org/isc/datasheet/28135#tohabitat	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	https://www.cabi.org/isc/datasheet/28135#tohabitat	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	https://www.cabi.org/isc/datasheet/28135#tohabitat	Medium
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	https://www.cabi.org/isc/datasheet/28135#tohabitat	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	https://www.cabi.org/isc/datasheet/28135#tohabitat	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No data	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	asexual reproduction https://www.cabi.org/isc/datasheet/28135#tohabitat	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	https://www.cabi.org/isc/datasheet/28135#tohabitat	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	inFlorida high spore production https://www.cabi.org/isc/datasheet/28135#tohabitat	Medium
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	1 year https://www.cabi.org/isc/datasheet/28135#tohabitat	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	water, pet trade, biofouling https://www.cabi.org/isc/datasheet/28135#tohabitat	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	Not yet present	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	Yes	https://www.cabi.org/isc/datasheet/28135#tohabitat	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	https://www.cabi.org/isc/datasheet/109069	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	https://www.cabi.org/isc/datasheet/109069	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	it is not migratory species	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	H. polysperma can be transported with wildlife and carried to new locations (DCR, 2003).	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Has high reproductive potential, Has propagules that can remain viable for more than one year	Medium
43	7.09	Is dispersal of the taxon density dependent?	No	It is not density dependent	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	Has propagules that can remain viable for more than one year	High

45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	Yes	. polysperma is an excellent competitor due to its low light compensation and saturation points, which allow it to start growing in low light conditions before other native plants do. H. polysperma is also able to rapidly change resource acquisition in response to changing environmental conditions, allowing it to outcompete many other species (Spencer and Bowes, 1985). Decomposing mats of H. polysperma also have the ability to cause fish kills by creating low oxygen levels in the water (DCR, 2003).	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	Herbicides typically used in controlling H. polysperma are estimated at costing between US$988 to US$1482 per hectare (US $400 to US $600 per acre), and total costs are even higher when labour and equipment are included (Cuda and Sutton, 2000). In an extreme case involving the use of fluridone in flowing water, control was achieved for a period of 20 months at a cost of US $34,580 per hectare (Sutton, 1996).	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	https://www.cabi.org/isc/datasheet/28135#tohabitat	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	No data, but probably can't	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	Introduced grass carp can control it http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1059.7979&rep=rep1&type=pdf ; https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1095-8649.1981.tb02809.x	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Prefered climate is worm temperate climate and tropical wet and dry	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	The optimum temperature for H. polysperma is 22-28°C (71-82°F), with a minimum temperature of 4°C (39°F), and maximum temperature of 30°C (	Low
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	https://www.cabi.org/isc/datasheet/28135#tohabitat	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	H. polysperma reduces biodiversity by competing with and displacing native vegetation, and is capable of changing the fauna and flora of an ecosystem. H. polysperma can form dense monocultures which exclude all native plants and do not provide habitat or food for wildlife.;	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	The dense stands and mats of vegetation that are characteristic of this species when introduced outside of its native range can decrease the oxygen levels by limiting water circulation and increased decomposition of dead plants. Damaged ecosystem	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	CABI	Medium

Statistics	
Scores	
BRA	**40.0**
BRA Outcome	**High**
BRA+CCA	**44.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**23.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*18.0*
B. Biology/Ecology	**17.0**
4. Undesirable (or persistence) traits	*8.0*
5. Resource exploitation	*2.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*5.0*
8. Tolerance attributes	*-2.0*
C. Climate change	**4.0**
9. Climate change	*4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**18**
Environmental	**9**
Species or population nuisance traits	**20**

Thresholds	
BRA	24.75
BRA+CCA	24.75
Confidence	
BRA+CCA	0.69
BRA	0.70
CCA	0.58

Date and Time
23/11/2021 16:58:33

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Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Lemna aequinoctialis*
Common name	lesser duckweed
Assessor	Marina Piria
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Lemna aequinoctialis has been introduced to temperate areas in Europe, central North America, northern China and Japan through rice cultivation, as fish food and for ornamental purposes (Bengtsson et al., 1999; Ryman and Anderberg, 1999). I	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Lemna aequinoctialis has been introduced to temperate areas in Europe, central North America, northern China and Japan through rice cultivation, as fish food and for ornamental purposes (Bengtsson et al., 1999; Ryman and Anderberg, 1999). I	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Lemna minuta https://www.cabi.org/isc/datasheet/108968	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Preferred climate Cs - Warm temperate climate with dry summer similar as RA	High
5	2.02	What is the quality of the climate matching data?	High	Climatch	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	https://www.cabi.org/isc/datasheet/121132#tosimilaritiesToOtherSpeciesOrConditions	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	Aquaculture, debris, animals, https://www.cabi.org/isc/datasheet/121132#topathwayVectors	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Hungary aturalized https://www.cabi.org/isc/datasheet/121132#tointroductions	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Germany, Hungary https://www.cabi.org/isc/datasheet/121132#38a70df6-0555-43c1-9d8d-fd2304676293	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	L. aequinoctialis is one of the species that restricts the proper functioning of ponds, and contributes to eutrophication (Sengupta et al., 2010). Generally, invasive aquatic plants can affect microinvertebrate communities (Lukács et al., 2016).	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	L. aequinoctialis is one of the species that restricts the proper functioning of ponds, and contributes to eutrophication (Sengupta et al., 2010).	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	amenities https://www.cabi.org/isc/datasheet/121132#38a70df6-0555-43c1-9d8d-fd2304676293	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	can impact human activities such as boating, swimming and hydroelectric power plants (Hussner et al., 2010).	Very high
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	The species is useful as an indicator of phytotoxic contaminants in irrigation water in urbanized areas (Bengtsson et al., 1999). It is a good food source for humans and livestock due to its high protein content and high digestibility (Leng et al., 1995; Appenroth et al., 2017).	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Dense aggregations of duckweeds in eutrophic waters can reduce light penetration and pond aeration causing anoxia and fish death (Bengtsson et al., 1999)	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	https://www.cabi.org/isc/datasheet/121132#38a70df6-0555-43c1-9d8d-fd2304676293	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	It will tolerate temperatures from 6 to 33°C and pH from 3.2 to 9; optimal growth occurs at 20-28°C and pH 6.5-7.5. A minimum water depth of 0.30 m is desirable and levels of 60 mg/l of soluble nitrogen and 1 mg/l of phosphorus are required for normal growth (Gherardi, 2007). It grows abundantly at high phosphorus and chlorophyll a concentrations (Mukhopadhyay and Dewanji, 2005). Cs - Warm temperate climate with dry summer Preferred Warm average temp. > 10°C, Cold average temp. > 0°C, dry summers	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	the submerged vegetation is reduced when L. aequinoctialis cover is higher than 40% (Sengupta et al., 2010). Dense aggregations of duckweeds in eutrophic waters can reduce light penetration and pond aeration causing anoxia and fish death (Bengtsson et al., 1999). Generally, invasive aquatic plants can affect microinvertebrate communities (Lukács et al., 2016).	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	nvasive aquatic plants can impact human activities such as boating, swimming and hydroelectric power plants (Hussner et al.,	Very high
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	Nodata https://www.cabi.org/isc/datasheet/121132#38a70df6-0555-43c1-9d8d-fd2304676293	Low

21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No datahttps://www.cabi.org/isc/datasheet/121132#38a70df6-0555-43c1-9d8d-fd2304676293	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	a tiny free-floating aquatic plan	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	can be found in mesotrophic to eutrophic lentic waters of lakes, pools, ponds, rice fields and ditches and warm-temperate to tropical climates from sea level to 2800 m (Landolt, 1992; Beentje and Lansdown, 2018; Flora of China Editorial Committee, 2017).	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Dense aggregations of duckweeds in eutrophic waters can reduce light penetration and pond aeration causing anoxia and fish death (Bengtsson et al., 1999).	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	the species has a high reproductive capability that is advantageous in eutrophic lentic water (Appenroth et al., 2013).	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	https://www.cabi.org/isc/datasheet/121132#tohabitat	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	https://www.cabi.org/isc/datasheet/121132#tohabitat	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	https://www.cabi.org/isc/datasheet/121132#tohabitat	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	https://www.cabi.org/isc/datasheet/121132#tohabitat	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Vegetative reproduction occurs but natural hybridization is likely possible https://link.springer.com/article/10.1007/s00425-014-	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	reproduces vegetatively by plant buds	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	https://www.cabi.org/isc/datasheet/121132#tobiologyAndEcology	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	https://www.cabi.org/isc/datasheet/121132#tobiologyAndEcology	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	https://www.cabi.org/isc/datasheet/121132#tobiologyAndEcology	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	water, debris, birds and ducks, aquaculture https://www.cabi.org/isc/datasheet/121132#tobiologyAndEcology	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	It is not yet present in captivity of RA	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	it is floating plant	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	may be introduced to new water areas by slow-moving water along interconnected watercourses and by floods (Hicks, 1937).	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	may be introduced to new water areas by slow-moving water along interconnected watercourses and by floods (Hicks, 1937).	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	it is not migratory species	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	Lemna species can be distributed by birds, fish and mammals over short distances (Hicks, 1937; Flora of North America Editorial Committee, 2017).	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Duckweeds may be introduced to new water areas by slow-moving water along interconnected watercourses and by floods (Hicks, 1937).	High
43	7.09	Is dispersal of the taxon density dependent?	No	https://www.cabi.org/isc/datasheet/121132#tomeansOfMovementAndDispersal	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	seeds probably yes	Medium
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	can be found in mesotrophic to eutrophic lentic waters of lakes, pools, ponds, rice fields and ditches and warm-temperate to tropical climates from sea level to 2800 m	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	allowed pesticides; Physical/Mechanical Control -Lemna species can be removed mechanically from invaded waterways (Centre for Ecology & Hydrology, 2004).; Biological Control - Lemna species in general can be controlled by herbivorous fish such as grass carp (Centre for Ecology & Hydrology, 2004).Problem in mediterranean are endemic fish, pesticides not recommended and lack of herbivoreous fish.	Medium
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	In mediterranean region yes particularly after hydropover plant instalation in still water.	High

48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Can tolerate but not clear if can persist in brackish water https://link.springer.com/article/10.1007/s00425-015-2264-x	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Waterbodies in adriatic basin are not all connected, so introduced herbivoreouus are present only in limited numberof waterbodies.	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	Environmental requirements limit its spread into temperate areas (Crawford et al., 2001), but climate change could potentially expand the range of distribution.Vélez-Gavilán J, 2017. Lemna aequinoctialis (lesser duckweed). Invasive Species Compendium. Wallingford, UK: CABI. DOI:10.1079/ISC.121132.20203483098	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	Environmental requirements limit its spread into temperate areas (Crawford et al., 2001), but climate change could potentially expand the range of distribution. Establishment likely will increase but no evidence for RA	Low
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Environmental requirements limit its spread into temperate areas (Crawford et al., 2001), but climate change could potentially expand the range of distribution. Probably not change because waterbodies are not connected	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Environmental requirements limit its spread into temperate areas (Crawford et al., 2001), but climate change could potentially expand the range of distribution.	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	Environmental requirements limit its spread into temperate areas (Crawford et al., 2001), but climate change could potentially expand the range of distribution.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	Environmental requirements limit its spread into temperate areas (Crawford et al., 2001), but climate change could potentially expand the range of distribution.Preferred climate is Cs - Warm temperate climate with dry summer which already exist in Adriatic basin but risk can be higher if this climate expand its range by	Medium

Statistics	
Scores	
BRA	**40.0**
BRA Outcome	**High**
BRA+CCA	**48.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**23.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*18.0*
B. Biology/Ecology	**17.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*0.0*
6. Reproduction	*6.0*
7. Dispersal mechanisms	*3.0*
8. Tolerance attributes	*2.0*
C. Climate change	**8.0**
9. Climate change	*8.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**20**
Environmental	**9**
Species or population nuisance traits	**22**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.70**
BRA	**0.72**
CCA	**0.46**

Date and Time
23/11/2021 16:59:29

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Lemna minuta*
Common name	least duckweed
Assessor	Marina Piria
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	reared in garden ponds and escaped https://www.cabi.org/isc/datasheet/108968#todescription	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	for garden ponds https://www.cabi.org/isc/datasheet/108968#todescription	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Lemna aequinocitalis, L. turionifera https://www.tandfonline.com/doi/full/10.1080/11263504.2014.987846	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	This is cosmopilitan species native of temperate and subtropical areas of North and South America. From South America extending through to Central America and West Indies extended northward along the high mountains to Mexico and California (Flora of North America, 2008; Armstrong, 2009). Very common throughout the southeastern and southwestern United States (USDA-ARS, 2009) with some scarce distribution in the centre of the country (Flora of North America, 2008). Larson and Searcy (2007) reported its presence in Massachussetts recently (2005). The species has been introduced in western Europe and Japan (Landolt, 1986; Reveal, 1990) and may well be expected to be discovered elsewhere (Reveal, 1990) because it is almost certainly under-recorded, due its similarity with L. minor (Preston and Croft, 1997)	Very high
5	2.02	What is the quality of the climate matching data?	High	It occurs in temperate to subtropical regions with relatively mild winters (Flora of North America, 2008) and prefers a Mediterranean climate (Landolt, 1986) with high water	Very high
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	https://www.cabi.org/isc/datasheet/108968#todescription	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	water, wind, pet trade https://www.cabi.org/isc/datasheet/108968#todescription	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Hungary - Danube basin, Poland, Germany	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	https://www.cabi.org/isc/datasheet/108968#todescription	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	https://www.cabi.org/isc/datasheet/108968#todescription	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	https://www.cabi.org/isc/datasheet/108968#todescription	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	Reduced amenity values https://www.cabi.org/isc/datasheet/108968#todescription	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	Carpets (mats) can occasionally impede activities (navigation, bathing, fishing) and are sometimes perceived by the local residents as a symbol of contamination of waters; https://www.cabi.org/isc/datasheet/108968#todescription	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	https://www.cabi.org/isc/datasheet/108968#todescription	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	often grows with the other duckweeds (e.g., Spirodela, Landoltia, Wolffia, Wolffiella) and occupy a similar niche to Azolla filiculoides (Armstrong, 2009).	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	https://www.cabi.org/isc/datasheet/108968#todescription	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Prefer warm climates so Mediterrnean climate is tolerale	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	A blanketing growth over a large area leads to deoxygenation and fish-kills in hot weather, as well as a decrease in invertebrate diversity (Bramley et al., 1995). These thick, floating mats of vegetation could reduce submerged plant diversity by selecting a few tolerant species (Janes et al., 1996).	Very high
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	sports on the water, fishing	Very high
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	Not enough data on this topic https://www.cabi.org/isc/datasheet/108968#todescription	Medium

21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	Not enough data https://www.cabi.org/isc/datasheet/108968#todescription	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	small species	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	grows in slow-moving, calm, freshwater ponds and marshes (Armstrong, 2009), and stagnant freshwater habitats such as wetlands like in the Pantanal (Brazil) (Pott and Cervi, 1999). It occurs in temperate to subtropical regions with relatively mild winters (Flora of North America, 2008) and prefers a Mediterranean climate (Landolt, 1986) with high water temperature in summer. L. minuta is found in its introduced areas in sluggishly moving waters of ponds, pools, lakes, swamps, streams, drainage ditches, canals, and sloughs (Preston and Croft,	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	It affects the ecology of its habitat by forming mats on the water surface, reducing sunlight penetration and oxygen exchange. In Poland, it has been found in a nature reserve (Banaszek and Musial, 2009). Mats of free-floating plants such as L. minuta are well known to cause physico-chemical changes in the water beneath them (e.g. Pokorny and Rejmankova, 1983).	Very high
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Fast growing Has high reproductive potential Has propagules that can remain viable for more than one year Reproduces asexually	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	https://www.cabi.org/isc/datasheet/108968#tohabitat	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Modification of nutrient regime https://www.cabi.org/isc/datasheet/108968#tohabitat	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	https://www.cabi.org/isc/datasheet/108968#tohabitat	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Has propagules that can remain viable for more than one year	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Maybe possible, but not enough data https://link.springer.com/article/10.1007/s00425-014-2053-y	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	asexual	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	https://www.cabi.org/isc/datasheet/108968#tohabitat	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Fast growing Has high reproductive potential Has propagules that can remain viable for more than one year Reproduces asexually	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	https://www.cabi.org/isc/datasheet/108968#tohabitat	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	pet trade, by birds and mammals, fish restocking	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	not yet present	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no.	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	fragments, seeds	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Possibility of natural dispersal between basins is low,but could be possible by wind	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	not migratory species	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	yes by birds and mammals	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	https://www.cabi.org/isc/datasheet/108968#tohabitat	High
43	7.09	Is dispersal of the taxon density dependent?	No	https://www.cabi.org/isc/datasheet/108968#tohabitat	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	seeds	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	Highly adaptable to different environments Is a habitat generalist Tolerates, or benefits from, cultivation, browsing pressure, mutilation, fire etc Pioneering in disturbed areas Tolerant of shadeand, are strongly resistant to pollution	High

46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	Destroying the duckweed layer with herbicides does not solve the problem of excess nutrients in the water. Because of the exponential growth rate of Lemnaceae, herbicides must be used repeatedly (perhaps several times a year). Ideally, it is best to eliminate the inflow of nutrients, and the repetitive removal of the duckweed layer will greatly reduce the growth of duckweeds (Armstrong, 2009). Biological control using ducks, fish, turtles and crustaceans (water shrimp, crayfish, ostracods, freshwater prawns, daphnia, amphipods, etc.) may also help to control duckweed populations. There are a number of species of freshwater fish that eat duckweeds to supplement their diets, including grass carp (Ctenopharyngodon idella) for example. Duckweeds are also eaten by pacu (Colossoma bidens), a freshwater fish native to the Amazon River (Armstrong, 2009)	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Tolerates, or benefits from, cultivation, browsing pressure, mutilation, fire etc Pioneering in disturbed areas Tolerant of shade Highly mobile locally Benefits from human association (i.e. it is a	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	https://link.springer.com/article/10.1007/s00425-015-2264-x	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	Biological control using ducks, fish, turtles and crustaceans (water shrimp, crayfish, ostracods, freshwater prawns, daphnia, amphipods, etc.) may also help to control duckweed populations. There are a number of species of freshwater fish that eat duckweeds to supplement their diets, including grass carp (Ctenopharyngodon idella) for example.	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	https://www.cabi.org/isc/datasheet/108968#tohabitat	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	https://www.cabi.org/isc/datasheet/108968#tohabitat	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	https://www.cabi.org/isc/datasheet/108968#tohabitat	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	https://www.cabi.org/isc/datasheet/108968#tohabitat	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	https://www.cabi.org/isc/datasheet/108968#tohabitat	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	https://www.cabi.org/isc/datasheet/108968#tohabitat	Medium

Statistics	
Scores	
BRA	**33.0**
BRA Outcome	**High**
BRA+CCA	**33.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**16.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*10.0*
B. Biology/Ecology	**17.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*2.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*3.0*
8. Tolerance attributes	*2.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**11**
Environmental	**7**
Species or population nuisance traits	**19**

Thresholds	
BRA	24.75
BRA+CCA	24.75
Confidence	
BRA+CCA	0.75
BRA	0.78
CCA	0.50

Date and Time
23/11/2021 17:00:08

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Lemna turionifera*
Common name	turion duckweed
Assessor	Marina Piria
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Used in aquaculture, animal feed etc https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1749-7345.1981.tb00273.x	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1749-7345.1981.tb00273.x	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Lemna aequinocitalis, L. minuta etc. https://www.cabi.org/ISC/abstract/19992302892	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	native in North America and northern Asia. In North America it occurs from Mexico north to Alaska and through much of Canada and the United States east to Nova Scotia, it is largely absent from the southeastern United States. In Asia it occurs in a broad band from Turkey, north and east across Russia to Kamchatka and Sakhalin Island (Landolt 1986). In Eurasia, the western limits of its distribution have been obscured by apparently non-native populations (Muller 2004), where it has been recorded from Austria, Belgium (Hoste & Bruinsma 2007; van Landuyt 2007), the Czech Republic, France (Muller 2004), Germany (Landolt 1986, Wolff and Ortschiedt 1993), Poland (Muller 2004), the Netherlands (Wolff & Bruinsma 2005), Sweden and Norwayhttps://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1	Very high
5	2.02	What is the quality of the climate matching data?	High	https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.667.4194&rep=rep1&type=pdf Climatch confirmed	Very high
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	It is horizon species	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	by migrating birds https://www.researchgate.net/profile/Zofija-Sinkeviciene/publication/270506254_FIRST_RECORDS_OF_LEMNA_TURIONIFERA_IN_LITHUANIA/links/54abcd750cf2bce6aa1dba11/FIRST-RECORDS-OF-LEMNA-TURIONIFERA-IN-LITHUANIA.pdf	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Hungary, B. A. Lukács, A. Mesterházy, R. Vidéki & G. Király (2014): Alien aquatic vascular plants in Hungary (Pannonian ecoregion): Historical aspects, data set and trends, Plant Biosystems - An International Journal Dealing with all Aspects of Plant Biology: Official Journal of the Societa Botanica Italiana, DOI: 10.1080/11263504.2014.987846	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	https://www.researchgate.net/profile/Zofija-Sinkeviciene/publication/270506254_FIRST_RECORDS_OF_LEMNA_TURIONIFERA_IN_LITHUANIA/links/54abcd750cf2bce6aa1dba11/FIRST-RECORDS-OF-LEMNA-TURIONIFERA-IN-LITHUANIA.pdf	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	Probably similar as other Lemnacee	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	no data. https://www.fao.org/ag/againfo/resources/documents/DW/dw2.ht	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	Impact not recorded https://www.gbif.org/species/2867631	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Not recorded https://www.gbif.org/species/2867631	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	It is not poisonous and not pose risk to humans. Actually represents human food	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No data https://www.gbif.org/species/2867631	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	it is not parasite	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	it is cosmopolitan https://www.researchgate.net/profile/Zofija-Sinkeviciene/publication/270506254_FIRST_RECORDS_OF_LEMNA_TURIONIFERA_IN_LITHUANIA/links/54abcd750cf2bce6aa1dba11/FIRST-RECORDS-OF-LEMNA-TURIONIFERA-IN-LITHUANIA.pdf	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No evidences	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No evidences	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No data	Low

21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	Not known, usually used to remove pathogens and nutrients from polluted water https://link.springer.com/chapter/10.1007/978-1-4020-6027-4_10	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	small bodied species	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	typical for weetlands and tolerate up to 3 m/s	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	For other Lemna is known that reduce habitat quality but no evidence for this species.	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Its species name refers to the fact that it sometimes produces turions, vegetative plantlets that can disperse and go dormant for long periods.	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	No predation behaviour	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Yes would exploit nutrients https://link.springer.com/chapter/10.1007/978-1-4020-6027-4_10	Medium
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	.no.	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	https://gobotany.nativeplanttrust.org/species/lemna/turionifera/	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	with lemna minor https://d-nb.info/1236692624/34	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	Its species name refers to the fact that it sometimes produces turions, vegetative plantlets that can disperse and go dormant for long periods. https://gobotany.nativeplanttrust.org/species/lemna/turionifera/	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Its species name refers to the fact that it sometimes produces turions, vegetative plantlets that can disperse and go dormant for long periods. https://gobotany.nativeplanttrust.org/species/lemna/turionifera/	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	when appear adequate conditions	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable habitats nearby)?	>1	water, by migrating birds https://www.researchgate.net/profile/Zofija-Sinkeviciene/publication/270506254_FIRST_RECORDS_OF_LEMNA_TURIONIFERA_IN_LITHUANIA/links/54abcd750cf2bce6aa1dba11/	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	It is not yet in RA area	Very high
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	Probably not,not evidences	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	https://www.researchgate.net/profile/Zofija-Sinkeviciene/publication/270506254_FIRST_RECORDS_OF_LEMNA_TURIONIFERA_IN_LITHUANIA/links/54abcd750cf2bce6aa1dba11/FIRST-RECORDS-OF-LEMNA-TURIONIFERA-IN-LITHUANIA.pdf	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Probably with water currents as other Lemna	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	not migratory	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	by migratory birds https://www.researchgate.net/profile/Zofija-Sinkeviciene/publication/270506254_FIRST_RECORDS_OF_LEMNA_TURIONIFERA_IN_LITHUANIA/links/54abcd750cf2bce6aa1dba11/FIRST-RECORDS-OF-LEMNA-TURIONIFERA-IN-LITHUANIA.pdf	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	by birds https://www.researchgate.net/profile/Zofija-Sinkeviciene/publication/270506254_FIRST_RECORDS_OF_LEMNA_TURIONIFERA_IN_LITHUANIA/links/54abcd750cf2bce6aa1dba11/FIRST-RECORDS-OF-LEMNA-TURIONIFERA-IN-LITHUANIA.pdf	High
43	7.09	Is dispersal of the taxon density dependent?	No	https://en.wikipedia.org/wiki/Lemna_turionifera	Very high
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	capable of producing turions, which are starch-filled fronds that sink to the substrate and remain dormant until germinating when conditions are favorable	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	occurring at nutrient-rich sites more often than at average sites and only exceptionally at poor sites https://pladias.cz/en/taxon/data/Lemna%20turionifera#4	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	yes, probably by pesticides and biological control by herbivoruos fish	Medium
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	No data	Low

48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	survival and reproduction of L. turionifera fronds can be influenced by specific stresses, e.g., salinity https://www.proquest.com/docview/2174512883?pq-origsite=gscholar&fromopenview=true	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	No information related to this species but grasss carp probably will take this Laminacce species too https://www.fao.org/aq/againfo/resources/documents/DW/dw2.ht	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	https://pdf.sciencedirectassets.com/273182/1-s2.0-S1617138118X00053/1-s2.0-S1617138118300232/main.pdf?X-Amz-Security-Token=IQoJb3JpZ2luX2VjEGkaCXVzLWVhc3QtMSJHMEUCIQDc8m2PJnnbKZ42LpUSBfBoQegF7CSGzz8ITKl2PwKAqgIgZT7LRnEwkyfoC1pJqm5DnwhYUI1ZBZWnL5qJGNe%2Ftxwq%2BgMIMRAEGgwwNTkwMDM1NDY4NjUiDLCp1Blg4SPIedhM9SrXA5XmAGJcYVIfJYMG90O2uiMkSgrk%2BFoSkcpVCnGR24ao%2BhDtLBRANNmV7HpYQAZnrR2wF2Ql2O5TqJ2pr%2B72gP5djuFfbTTGDNTlOrXsU0Dh7w8V2hLQA%2FM4utaQXG3ih%2BGw2n%2FwacOWTME%2FexjUcqMq%2F5pxmyZzITOjdS0bzxc1J0DhxMrnL11cWi4mzqYxg3PhBFcnLKAyBVY2%2BW08qYaThKh4HfGKofH2sT4WJfLi7odtm9ZwJkJKzRuXou1s%2FweqAmG7JSBsBAzkd2txyLFAknM7ImVdKgqzf9kOl6QxiymEtpDe0R7Y9aurVqSwlSLsMhL7fQgVTZ0ixSzfgUIsdHQ144pwsacCtBzkg6gS3BLL%2FeeSXIkkKoSTIDsS2Dfzv7bBWYOvxYw854d2k6WIa4osE6FZMyO%2F4naDzSGmbWx%2FDnQwdAFFcuBwdLba1mbTSTdSJYXxCiSbFwQIh7WlxorP6vhJZLtdJkjYhtO4yi79XOC34%2BnwZOaiTCCS2sQGbBFvOZUWKUpC10yTxYTyQe%2B%2FSyDjfEXv1jDsW%2BpFoO5hDCLfPpiHIBOzT01IIHmaMWybLu0UGuIK4N%2BBdTCzifiJom0vzkK39yPl6etp0k%2BJdRwlrDDegu%2BMBjqlAUpMAYHFnuj4vujKO5BxGXN3kTs7V4TzLKFQh6dwGzxEQKsQZMk02dTOexVSNClOjwCYVxgfeAaPkyG%2FitN6mhrMtPxorL%2FdN9ZihI6dVkFQcQ2YJsCxBPuoNVRZ1Uw2mwttvfKc4HZf%2BqmeVN9UT%2FAHR5DOgC1aoxV9iRAipOSoyqEdWPBV9cW51cOLUtH0AgfHYtWC8AwShL2uND4wQGfM1aPGTw%3D%3D&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Date=20211122T162442Z&X-Amz-SignedHeaders=host&X-Amz-Expires=300&X-Amz-Credential=ASIAQ3PHCVTY2SYFFQ6V%2F20211122%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Signature=3860ad8e3b8989785bcc56eb131bfc4007f3485e12a5c4045371e5a28e9c93c2&hash=31366d759648af0f2181634335b9a796b84a9338b735c3ad907afd353479342e&host=68042c943591013ac2b2430a89b270f6af2c76d8dfd086a07176afe7c76c2c61&pii=S1617138118300232&tid=spdf-69f51aa4-e438-40bd-bf9b-fa86c1b46cf7&sid=05d25e953a1b1448e48be396c93b5408ff94gxrq	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	https://pdf.sciencedirectassets.com/273182/1-s2.0-S1617138118X00053/1-s2.0-S1617138118300232/main.pdf?X-Amz-Security-Token=IQoJb3JpZ2luX2VjEGkaCXVzLWVhc3QtMSJHMEUCIQDc8m2PJnnbKZ42LpUSBfBoQegF7CSGzz8ITKl2PwKAqgIgZT7LRnEwkyfoC1pJqm5DnwhYUI1ZBZWnL5qJGNe%2Ftxwq%2BgMIMRAEGgwwNTkwMDM1NDY4NjUiDLCp1Blg4SPIedhM9SrXA5XmAGJcYVIfJYMG90O2uiMkSgrk%2BFoSkcpVCnGR24ao%2BhDtLBRANNmV7HpYQAZnrR2wF2Ql2O5TqJ2pr%2B72gP5djuFfbTTGDNTlOrXsU0Dh7w8V2hLQA%2FM4utaQXG3ih%2BGw2n%2FwacOWTME%2FexjUcqMq%2F5pxmyZzITOjdS0bzxc1J0DhxMrnL11cWi4mzqYxg3PhBFcnLKAyBVY2%2BW08qYaThKh4HfGKofH2sT4WJfLi7odtm9ZwJkJKzRuXou1s%2FweqAmG7JSBsBAzkd2txyLFAknM7ImVdKgqzf9kOl6QxiymEtpDe0R7Y9aurVqSwlSLsMhL7fQgVTZ0ixSzfgUIsdHQ144pwsacCtBzkg6gS3BLL%2FeeSXIkkKoSTIDsS2Dfzv7bBWYOvxYw854d2k6WIa4osE6FZMyO%2F4naDzSGmbWx%2FDnQwdAFFcuBwdLba1mbTSTdSJYXxCiSbFwQIh7WlxorP6vhJZLtdJkjYhtO4yi79XOC34%2BnwZOaiTCCS2sQGbBFvOZUWKUpC10yTxYTyQe%2B%2FSyDjfEXv1jDsW%2BpFoO5hDCLfPpiHIBOzT01IIHmaMWybLu0UGuIK4N%2BBdTCzifiJom0vzkK39yPl6etp0k%2BJdRwlrDDegu%2BMBjqlAUpMAYHFnuj4vujKO5BxGXN3kTs7V4TzLKFQh6dwGzxEQKsQZMk02dTOexVSNClOjwCYVxgfeAaPkyG%2FitN6mhrMtPxorL%2FdN9ZihI6dVkFQcQ2YJsCxBPuoNVRZ1Uw2mwttvfKc4HZf%2BqmeVN9UT%2FAHR5DOgC1aoxV9iRAipOSoyqEdWPBV9cW51cOLUtH0AgfHYtWC8AwShL2uND4wQGfM1aPGTw%3D%3D&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Date=20211122T162442Z&X-Amz-SignedHeaders=host&X-Amz-Expires=300&X-Amz-Credential=ASIAQ3PHCVTY2SYFFQ6V%2F20211122%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Signature=3860ad8e3b8989785bcc56eb131bfc4007f3485e12a5c4045371e5a28e9c93c2&hash=31366d759648af0f2181634335b9a796b84a9338b735c3ad907afd353479342e&host=68042c943591013ac2b2430a89b270f6af2c76d8dfd086a07176afe7c76c2c61&pii=S1617138118300232&tid=spdf-69f51aa4-e438-40bd-bf9b-fa86c1b46cf7&sid=05d25e953a1b1448e48be396c93b5408ff94gxrq	Medium

52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	https://pdf.sciencedirectassets.com/273182/1-s2.0-S1617138118X00053/1-s2.0-S1617138118300232/main.pdf?X-Amz-Security-Token=IQoJb3JpZ2luX2VjEGkaCXVzLWVhc3QtMSJHMEUCIQDc8m2PJnnbKZ42LpUSBfBoQegF7CSGzz8ITKl2PwKAqgIgZT7LRnEwkyfoC1pJqm5DnwhYUI1ZBZWnL5qJGNe%2Ftxwq%2BgMIMRAEGgwwNTkwMDM1NDY4NjUiDLCp1Blg4SPIedhM9SrXA5XmAGJcYVIfJYMG90O2uiMkSgrk%2BFoSkcpVCnGR24ao%2BhDtLBRANNmV7HpYQAZnrR2wF2Ql2O5TqJ2pr%2B72gP5djuFfbTTGDNTlOrXsU0Dh7w8V2hLQA%2FM4utaQXG3ih%2BGw2n%2FwacOWTME%2FexjUcqMq%2F5pxmyZzITOjdS0bzxc1J0DhxMrnL11cWi4mzqYxg3PhBFcnLKAyBVY2%2BW08qYaThKh4HfGKofH2sT4WJfLi7odtm9ZwJkJKzRuXou1s%2FweqAmG7JSBsBAzkd2txyLFAknM7ImVdKgqzf9kOl6QxiymEtpDe0R7Y9aurVqSwlSLsMhL7fQgVTZ0ixSzfgUIsdHQ144pwsacCtBzkg6gS3BLL%2FeeSXIkkKoSTIDsS2Dfzv7bBWYOvxYw854d2k6WIa4osE6FZMyO%2F4naDzSGmbWx%2FDnQwdAFFcuBwdLba1mbTSTdSJYXxCiSbFwQIh7WlxorP6vhJZLtdJkjYhtO4yi79XOC34%2BnwZOaiTCCS2sQGbBFvOZUWKUpC10yTxYTyQe%2B%2FSyDjfEXv1jDsW%2BpFoO5hDCLfPpiHIBOzT01IIHmaMWybLu0UGuIK4N%2BBdTCzifiJom0vzkK39yPl6etp0k%2BJdRwlrDDegu%2BMBjqlAUpMAYHFnuj4vujKO5BxGXN3kTs7V4TzLKFQh6dwGzxEQKsQZMk02dTOexVSNClOjwCYVxgfeAaPkyG%2FitN6mhrMtPxorL%2FdN9ZihI6dVkFQcQ2YJsCxBPuoNVRZ1Uw2mwttvfKc4HZf%2BqmeVN9UT%2FAHR5DOgC1aoxV9iRAipOSoyqEdWPBV9cW51cOLUtH0AgfHYtWC8AwShL2uND4wQGfM1aPGTw%3D%3D&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Date=20211122T162442Z&X-Amz-SignedHeaders=host&X-Amz-Expires=300&X-Amz-Credential=ASIAQ3PHCVTY2SYFFQ6V%2F20211122%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Signature=3860ad8e3b8989785bcc56eb131bfc4007f3485e12a5c4045371e5a28e9c93c2&hash=31366d759648af0f2181634335b9a796b84a9338b735c3ad907afd353479342e&host=68042c943591013ac2b2430a89b270f6af2c76d8dfd086a07176afe7c76c2c61&pii=S1617138118300232&tid=spdf-69f51aa4-e438-40bd-bf9b-fa86c1b46cf7&sid=05d25e953a1b1448e48be396c93b5408ff94gxrq	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Probably will stay the same	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	https://pdf.sciencedirectassets.com/273182/1-s2.0-S1617138118X00053/1-s2.0-S1617138118300232/main.pdf?X-Amz-Security-Token=IQoJb3JpZ2luX2VjEGkaCXVzLWVhc3QtMSJHMEUCIQDc8m2PJnnbKZ42LpUSBfBoQegF7CSGzz8ITKl2PwKAqgIgZT7LRnEwkyfoC1pJqm5DnwhYUI1ZBZWnL5qJGNe%2Ftxwq%2BgMIMRAEGgwwNTkwMDM1NDY4NjUiDLCp1Blg4SPIedhM9SrXA5XmAGJcYVIfJYMG90O2uiMkSgrk%2BFoSkcpVCnGR24ao%2BhDtLBRANNmV7HpYQAZnrR2wF2Ql2O5TqJ2pr%2B72gP5djuFfbTTGDNTlOrXsU0Dh7w8V2hLQA%2FM4utaQXG3ih%2BGw2n%2FwacOWTME%2FexjUcqMq%2F5pxmyZzITOjdS0bzxc1J0DhxMrnL11cWi4mzqYxg3PhBFcnLKAyBVY2%2BW08qYaThKh4HfGKofH2sT4WJfLi7odtm9ZwJkJKzRuXou1s%2FweqAmG7JSBsBAzkd2txyLFAknM7ImVdKgqzf9kOl6QxiymEtpDe0R7Y9aurVqSwlSLsMhL7fQgVTZ0ixSzfgUIsdHQ144pwsacCtBzkg6gS3BLL%2FeeSXIkkKoSTIDsS2Dfzv7bBWYOvxYw854d2k6WIa4osE6FZMyO%2F4naDzSGmbWx%2FDnQwdAFFcuBwdLba1mbTSTdSJYXxCiSbFwQIh7WlxorP6vhJZLtdJkjYhtO4yi79XOC34%2BnwZOaiTCCS2sQGbBFvOZUWKUpC10yTxYTyQe%2B%2FSyDjfEXv1jDsW%2BpFoO5hDCLfPpiHIBOzT01IIHmaMWybLu0UGuIK4N%2BBdTCzifiJom0vzkK39yPl6etp0k%2BJdRwlrDDegu%2BMBjqlAUpMAYHFnuj4vujKO5BxGXN3kTs7V4TzLKFQh6dwGzxEQKsQZMk02dTOexVSNClOjwCYVxgfeAaPkyG%2FitN6mhrMtPxorL%2FdN9ZihI6dVkFQcQ2YJsCxBPuoNVRZ1Uw2mwttvfKc4HZf%2BqmeVN9UT%2FAHR5DOgC1aoxV9iRAipOSoyqEdWPBV9cW51cOLUtH0AgfHYtWC8AwShL2uND4wQGfM1aPGTw%3D%3D&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Date=20211122T162442Z&X-Amz-SignedHeaders=host&X-Amz-Expires=300&X-Amz-Credential=ASIAQ3PHCVTY2SYFFQ6V%2F20211122%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Signature=3860ad8e3b8989785bcc56eb131bfc4007f3485e12a5c4045371e5a28e9c93c2&hash=31366d759648af0f2181634335b9a796b84a9338b735c3ad907afd353479342e&host=68042c943591013ac2b2430a89b270f6af2c76d8dfd086a07176afe7c76c2c61&pii=S1617138118300232&tid=spdf-69f51aa4-e438-40bd-bf9b-fa86c1b46cf7&sid=05d25e953a1b1448e48be396c93b5408ff94gxrq	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Probably no change	Medium

Statistics	
Scores	
BRA	**20.0**
BRA Outcome	**Medium**
BRA+CCA	**26.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**6.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*0.0*

3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**14.0**
4. Undesirable (or persistence) traits	*2.0*
5. Resource exploitation	*2.0*
6. Reproduction	*6.0*
7. Dispersal mechanisms	*3.0*
8. Tolerance attributes	*1.0*
C. Climate change	**6.0**
9. Climate change	*6.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**5**
Environmental	**2**
Species or population nuisance traits	**21**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.70**
BRA	**0.72**
CCA	**0.54**

Date and Time
23/11/2021 17:00:42

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Ludwigia peploides*
Common name	floating primrose-willow
Assessor	Tena Radočaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	It is most likely that escape from aquaculture explains most of the adventive introductions; this plant is very commonly sold as an ornamental (CABI, 2020)	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	It is most likely that escape from aquaculture explains most of the adventive introductions; this plant is very commonly sold as an ornamental (CABI, 2020)	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No evidence	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	The similarity of climatic conditions between native areas and the RA area is low (Climatch)	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climatch and CABI	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	Buzjak, S., & Sedlar, Z. (2018). Ludwigia peploides (Kunth.) PH Raven–Floating Water Primrose, a new species in Croatian flora from the list of invasive alien species of Union concern. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 27(2),	Medium
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	Machinery and equipment, Ornamental purposes, Horticulture (CABI, 2020)	Low
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Italy (Galasso, G., Domina, G., Adorni, M., Ardenghi, N. M., Bonari, G., Buono, S., ... & Nepi, C. (2018). Notulae to the Italian alien vascular flora: 5. Italian Botanist, 5, 45).	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Verloove, F., & Alves, P. (2016). New vascular plant records for the western part of the Iberian Peninsula (Portugal and Spain). Folia Botanica Extremadurensis, (10), 5-23.	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	This species causes declines in biodiversity. Due to the species' allelopathic activity, it poses a severe threat to vulnerable native flora (CABI, 2020)	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No evidence	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	This species has an allelopathic effect that impacts water quality throughout the year. Its tendency to grow in thick mats also contributes to physical alteration of the environment, making it unsuitable for sensitive species. (CABI, 2020)	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	This plant can grow very densely, impeding navigation and interfering with hunting, fishing and other recreational activities (CEH, 2007). (CABI, 2020)	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	No evidence	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	RUAUX, B. (2008). Invasive plants in river corridors (biological characteristics, the impacts of Ludwigia peploides and L. grandiflora in the Middle Loire and the implications for	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No evidence	Medium
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Vuković, N., Šegota, V., Rimac, A., Koletić, N., & Alegro, A. (2021). New records of alien plants–Ludwigia peploides (Kunth) PH Raven, Reynoutria sachalinensis (F. Schmidt) Nakai and Nicotiana glauca Graham in Croatia. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 30(1), 27-35.	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	For Croatia yet no information, but I think L. peploides will be adverse impact. It is generally considered a threat to biodiversity in its introduced range. (CABI, 2020)	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	For Croatia yet no information, but I think L. peploides will be adverse impact. This plant can cause substantial nuisance to recreational users by impeding navigation and interfering with hunting, fishing and other recreational activities (CABI, 2020)	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	No	No cases of pathogen pollution are reported for L. peploides (Robert, H., Lafontaine, R.-M., Beudels-Jamar, R.C., Delsinne, T. (2013). Risk analysis of the Water Primrose Ludwigia peploides (Kunth) P.H. Raven. - Risk analysis report of non-native organisms in Belgium from the Royal Belgian Institute of Natural Sciences for the Federal Public Service Health, Food chain safety and Environment. 35 p)	Medium

21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No cases of pathogen pollution are reported for L. peploides (Robert, H., Lafontaine, R.-M., Beudels-Jamar, R.C., Delsinne, T. (2013). Risk analysis of the Water Primrose Ludwigia peploides (Kunth) P.H. Raven. - Risk analysis report of non-native organisms in Belgium from the Royal Belgian Institute of Natural Sciences for the Federal Public Service Health, Food chain safety and Environment. 35 p)	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Vuković, N., Šegota, V., Rimac, A., Koletić, N., & Alegro, A. (2021). New records of alien plants–Ludwigia peploides (Kunth) PH Raven, Reynoutria sachalinensis (F. Schmidt) Nakai and Nicotiana glauca Graham in Croatia. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 30(1), 27-35.	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	L. peploides can be found in wetlands, on shorelines, in slow-flowing rivers, ponds, rice fields, marshes and in other freshwater environments (CABI, 2020)	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	This species has an allelopathic effect that impacts water quality throughout the year. Where it is invasive, it often has far reaching and negative effects on multiple trophic levels (CABI, 2020)	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Vuković, N., Šegota, V., Rimac, A., Koletić, N., & Alegro, A. (2021). New records of alien plants–Ludwigia peploides (Kunth) PH Raven, Reynoutria sachalinensis (F. Schmidt) Nakai and Nicotiana glauca Graham in Croatia. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 30(1), 27-35.	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	Not applicable	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information	Medium
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	Not applicable	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Vuković, N., Šegota, V., Rimac, A., Koletić, N., & Alegro, A. (2021). New records of alien plants–Ludwigia peploides (Kunth) PH Raven, Reynoutria sachalinensis (F. Schmidt) Nakai and Nicotiana glauca Graham in Croatia. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 30(1), 27-35.	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No evidence	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	Reproduction in Ludwigia peploides includes both sexual and asexual reproduction (Ramstetter, J., Marlboro, V., & Mott-White, J. Ludwigia polycarpa Short & Peter. Many-Fruited False-	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	This species can grow in a broad range of habitats due to its high degree of genetic polymorphism and phenotypic plasticity (CABI, 2020)	Medium
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	L. peploides is self-compatible and the species has a very high potential seed output (10,000 – 14,000 seeds per square metre) (CABI, 2020)	Medium
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	Robert, H., Lafontaine, R.-M., Beudels-Jamar, R.C., Delsinne, T. (2013). Risk analysis of the Water Primrose Ludwigia peploides (Kunth) P.H. Raven. - Risk analysis report of non-native organisms in Belgium from the Royal Belgian Institute of Natural Sciences for the Federal Public Service Health, Food chain safety and Environment. 35 p.	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Botanical gardens and zoos, Flooding and other natural disasters, Interconnected waterways.. (CABI, 2020)	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Flooding, Interconnected waterways.. (CABI, 2020)	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No information	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	No evidence (Robert, H., Lafontaine, R.-M., Beudels-Jamar, R.C., Delsinne, T. (2013). Risk analysis of the Water Primrose Ludwigia peploides (Kunth) P.H. Raven. - Risk analysis report of non-native organisms in Belgium from the Royal Belgian Institute of Natural Sciences for the Federal Public Service Health, Food chain safety and Environment. 35 p).	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Stem fragments are spread by water currents, animals and humans (Robert, H., Lafontaine, R.-M., Beudels-Jamar, R.C., Delsinne, T. (2013). Risk analysis of the Water Primrose Ludwigia peploides (Kunth) P.H. Raven. - Risk analysis report of non-native organisms in Belgium from the Royal Belgian Institute of Natural Sciences for the Federal Public Service Health, Food chain safety and Environment. 35 p).	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Not applicable	Medium
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	spread by animals, humans (CABI, 2020)	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Flooding (CABI, 2020)	Medium

43	7.09	Is dispersal of the taxon density dependent?	No	Robert, H., Lafontaine, R.-M., Beudels-Jamar, R.C., Delsinne, T. (2013). Risk analysis of the Water Primrose Ludwigia peploides (Kunth) P.H. Raven. - Risk analysis report of non-native organisms in Belgium from the Royal Belgian Institute of Natural Sciences for the Federal Public Service Health, Food chain safety and Environment. 35 p.	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	No evidence	Medium
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	This species can grow in a broad range of habitats due to its high degree of genetic polymorphism and phenotypic plasticity (CABI, 2020).	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	Several herbicides have been used with reported success, including halosulfuron-methyl, glyphosate and triclopyr (CABI, 2020). Sterile grass carp, Ctenopharyngodon idella, have been used to control L. peploides (CABI, 2020)	Medium
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	L. peploides can tolerate from environmental disturbance. It is also tolerant of flooding (CABI, 2020)	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	No evidence. Freshwater species	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Maybe, some insects..	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Vuković, N., Šegota, V., Rimac, A., Koletić, N., & Alegro, A. (2021). New records of alien plants–Ludwigia peploides (Kunth) PH Raven, Reynoutria sachalinensis (F. Schmidt) Nakai and Nicotiana glauca Graham in Croatia. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 30(1), 27-35.	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	The Mediterranean populations of L. peploides could be better adapted to rising temperature. These abilities could allow them to take advantage from climate warming if the temperature is not warming up to temperature above a critical threshold. (Thiébaut, G., Tarayre, M., Jambon, O., Le Bris, N., Colinet, H., & Renault, D. (2021). Variation of thermal plasticity for functional traits between populations of an invasive aquatic plant from two climatic regions. Hydrobiologia, 848(9), 2077-2091.)	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	The Mediterranean populations of L. peploides could be better adapted to rising temperature. These abilities could allow them to take advantage from climate warming if the temperature is not warming up to temperature above a critical threshold. (Thiébaut, G., Tarayre, M., Jambon, O., Le Bris, N., Colinet, H., & Renault, D. (2021). Variation of thermal plasticity for functional traits between populations of an invasive aquatic plant from two climatic regions. Hydrobiologia, 848(9), 2077-2091.)	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	The Mediterranean populations of L. peploides could be better adapted to rising temperature. These abilities could allow them to take advantage from climate warming if the temperature is not warming up to temperature above a critical threshold. (Thiébaut, G., Tarayre, M., Jambon, O., Le Bris, N., Colinet, H., & Renault, D. (2021). Variation of thermal plasticity for functional traits between populations of an invasive aquatic plant from two climatic regions. Hydrobiologia, 848(9), 2077-2091.)	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	The Mediterranean populations of L. peploides could be better adapted to rising temperature. These abilities could allow them to take advantage from climate warming if the temperature is not warming up to temperature above a critical threshold. (Thiébaut, G., Tarayre, M., Jambon, O., Le Bris, N., Colinet, H., & Renault, D. (2021). Variation of thermal plasticity for functional traits between populations of an invasive aquatic plant from two climatic regions. Hydrobiologia, 848(9), 2077-2091.)	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	The Mediterranean populations of L. peploides could be better adapted to rising temperature. These abilities could allow them to take advantage from climate warming if the temperature is not warming up to temperature above a critical threshold. (Thiébaut, G., Tarayre, M., Jambon, O., Le Bris, N., Colinet, H., & Renault, D. (2021). Variation of thermal plasticity for functional traits between populations of an invasive aquatic plant from two climatic regions. Hydrobiologia, 848(9), 2077-2091.)	Medium

Statistics	
Scores	
BRA	**26.5**
BRA Outcome	**High**
BRA+CCA	**36.5**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**13.5**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*10.5*
B. Biology/Ecology	**13.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*0.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*0.0*

C. Climate change	**10.0**
9. Climate change	*10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**14**
Environmental	**11**
Species or population nuisance traits	**16**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.52**
BRA	**0.52**
CCA	**0.54**

Date and Time
06/12/2021 20:55:55

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Myriophyllum heterophyllum*
Common name	twoleaf watermilfoil
Assessor	Tena Radočaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Aquaria and garden ponds (Global Invasive Species Database (2021) Species profile: Myriophyllum heterophyllum).	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Aquaria and garden ponds (Global Invasive Species Database (2021) Species profile: Myriophyllum heterophyllum).	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No evidence	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	The similarity of climatic conditions between native areas and the RA area is medium (Climatch)	Medium
5	2.02	What is the quality of the climate matching data?	Medium	I used climatch and distribution map of CABI	Low
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Myriophyllum heterophyllum Michx. (Haloragaceae) has had the status of invasive species in freshwater ecosystems since 2012. During phytosociological research in the Neretva River Delta in July 2016 (Myriophyllum heterophyllum Michx. (Haloragaceae) u Hrvatskoj (str.99-103) European invasion in progress: Myriophyllum heterophyllum Michx. (Haloragaceae) in Croatia (str.99-103) engleskipdf 2 MB Nenad Jasprica, Anđelka Lasić, Dubravka Hafner, Ana Bratoš Cetinić)	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	None	It is present in the RA area.	Low
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	No	It is present in the RA area.	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Myriophyllum heterophyllum is present as an alien species in nine European countries: Austria, Belgium, France, Germany, Hungary, the Netherlands, Spain, Switzerland and the United Kingdom (Jasprica, N., Lasić, A., Hafner, D., & Bratoš Cetinić, A. (2017). Myriophyllum heterophyllum Michx.(Haloragaceae) u Hrvatskoj. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici,	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Thick mats often out-competing native vegetation (Global Invasive Species Database (2021) Species profile: Myriophyllum heterophyllum.) Dense mono-specific growth of any aquatic plant species can incur impacts on native plant communities and other aquatic organisms such as invertebrates and fish.	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No evidence	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	M. heterophyllum is highly competitive and able to outcompete other aquatic plants. It forms dense mats of submergent vegetative material throughout the water column and at the water surface, which can prevent water flow, reduce sunlight and reduce oxygen availability. The resulting low oxygen conditions can harm or kill aquatic organisms (CABI, 2020)	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	M. heterophyllum forms dense stands in water bodies, which have negative effects on boating, swimming and aesthetics. (CABI,	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Global Invasive Species Database (2021) Species profile: Myriophyllum heterophyllum.	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No evidence	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No evidence	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	It can tolerate high summer temperatures as well as cold winter temperatures where it can be covered by ice during the winter months.	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	M. heterophyllum is highly competitive and able to outcompete other aquatic plants. It forms dense mats of submergent vegetative material throughout the water column and at the water surface, which can prevent water flow, reduce sunlight and reduce oxygen availability. The resulting low oxygen conditions can harm or kill aquatic organisms (CABI, 2020)	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	M. heterophyllum forms dense stands in water bodies, which have negative effects on boating, swimming and aesthetics. (CABI,	Medium

20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	No	No evidence (Global Invasive Species Database (2021) Species profile: Myriophyllum heterophyllum.) EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.ht	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No evidence (Global Invasive Species Database (2021) Species profile: Myriophyllum heterophyllum.) EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.ht	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	, Global Invasive Species Database (2021) Species profile: Myriophyllum heterophyllum. EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.ht	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Suitable habitats for this species include freshwater ponds, lakes, ditches, standing and slow flowing waters (Global Invasive Species Database (2021) Species profile: Myriophyllum	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Dense mats of M. heterophyllum reduce light to other submerged plants and can affect water quality by reducing oxygen levels resulting in fish avoiding the infested area (EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.ht)	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Jasprica, N., Lasić, A., Hafner, D., & Bratoš Cetinić, A. (2017). Myriophyllum heterophyllum Michx.(Haloragaceae) u Hrvatskoj. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 26(1), 99-103.	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	Not applicable	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	Not applicable	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Jasprica, N., Lasić, A., Hafner, D., & Bratoš Cetinić, A. (2017). Myriophyllum heterophyllum Michx.(Haloragaceae) u Hrvatskoj. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 26(1), 99-103.	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	M. heterophyllum x M. laxum (Tavalire, H. F., Bugbee, G. E., LaRue, E. A., & Thum, R. A. (2012). Hybridization, cryptic diversity, and invasiveness in introduced variable-leaf watermilfoil. Evolutionary Applications, 5(8), 892-900).	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	Reproduction may occur through asexual vegetative propagation and also sexual reproduction (seed production). Asexual vegetative propagation is thought to be the dominant mode of reproduction in introduced populations (CABI, 2020)	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.ht	Medium
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm	Medium
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable habitats nearby)?	>1	the aquatic plant trade, Ship hull fouling, Floating vegetation and debris (EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm)	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Ship hull fouling (EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm)	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	Yes	May be commonly transported among water bodies on boats and boat trailers (CABI, 2020)	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	Seeds may also be dispersed by animal vectors. (CABI, 2020)	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	M. heterophyllum is capable of spreading through vegetative fragments (CABI, 2020)	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Not applicable	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	Seeds may also be dispersed by animal vectors. (CABI, 2020)	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	It can be moved around by any number of water and animal vectors and may be commonly transported among water bodies on boats and boat trailers. Seeds may also be dispersed by animal vectors. (CABI, 2020).	Medium

43	7.09	Is dispersal of the taxon density dependent?	No	EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	No evidence	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	Yes	Myriophyllum heterophyllum can grow in a wide range of physical and chemical conditions (EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm)	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	Triclopyr may be another option. Results from Getsinger et al. (2003) suggest that triclopyr may be efficacious against M. heterophyllum in the field over a wide range of concentrations and exposure times. (Global Invasive Species Database (2021) Species profile: Myriophyllum heterophyllum).	Medium
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	(EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm)	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	No evidence; Freshwater species	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Insects (CABI, 2020)	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	Not applicable	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	The risk of establishment may potentially increase with temperature increases. Those areas which are currently unsuitable for the occurrence of M. heterophyllum may become more suitable with increased number of day degrees. Extreme weather events, flooding etc., may increase the occurrence and potential areas of establishment for the plant. (EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm)	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	The risk of establishment may potentially increase with temperature increases. Those areas which are currently unsuitable for the occurrence of M. heterophyllum may become more suitable with increased number of day degrees. Extreme weather events, flooding etc., may increase the occurrence and potential areas of establishment for the plant. (EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm)	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	With increased temperature, C02 levels and nitrogen deposition, the impacts of M. heterophyllum may be more profound within native plant communities. M. heterophyllum has high phenotypic plasticity which will enable the species to persist and outcompete species with restricted habitat requirements. (EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.h	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	With increased temperature, C02 levels and nitrogen deposition, the impacts of M. heterophyllum may be more profound within native plant communities. M. heterophyllum has high phenotypic plasticity which will enable the species to persist and outcompete species with restricted habitat requirements. (EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.h	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	(EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm	Medium

Statistics	
Scores	
BRA	**27.5**
BRA Outcome	**High**
BRA+CCA	**37.5**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**12.5**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*10.5*
B. Biology/Ecology	**15.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*0.0*
6. Reproduction	*6.0*
7. Dispersal mechanisms	*6.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**10.0**

9. Climate change	*10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**13**
Environmental	**11**
Species or population nuisance traits	**17**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.53**
BRA	**0.52**
CCA	**0.58**

Date and Time
06/12/2021 21:27:33

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Najas graminea*
Common name	ricefield waternymph
Assessor	Tena Radočaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	This plant is also commercialized in the aquarium trade. (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	This plant is also commercialized in the aquarium trade. (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No evidence	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	The similarity of climatic conditions between native areas and the RA area is medium (Climatch)	Medium
5	2.02	What is the quality of the climate matching data?	Medium	I used climatch and distribution map of CABI	Low
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	N. graminea is present in the RA area. (Lansdown, R. V., Anastasiu, P., Barina, Z., Bazos, I., Çakan, H., Caković, D., ... & Király, G. (2016). Review of alien freshwater vascular plants in South-east Europe. ESENIAS Scientific Reports, 1, 137-154).	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	None	N. graminea is present in the RA area. (Lansdown, R. V., Anastasiu, P., Barina, Z., Bazos, I., Çakan, H., Caković, D., ... & Király, G. (2016). Review of alien freshwater vascular plants in South-east Europe. ESENIAS Scientific Reports, 1, 137-154).	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	No	N. graminea is present in the RA area. (Lansdown, R. V., Anastasiu, P., Barina, Z., Bazos, I., Çakan, H., Caković, D., ... & Király, G. (2016). Review of alien freshwater vascular plants in South-east Europe. ESENIAS Scientific Reports, 1, 137-154).	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	It has become naturalised in Spain, Italy, Bulgaria, the Crimea (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Medium
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	No records of impacts from the introductions were found. With known established populations, but a lack of information on impacts, the history of invasiveness for this species	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	No records of impacts from the introductions were found. With known established populations, but a lack of information on impacts, the history of invasiveness for this species	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No records of impacts from the introductions were found. With known established populations, but a lack of information on impacts, the history of invasiveness for this species	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	No information on threats to humans was found for Najas graminea. (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	This species is wide-spread in tropical and subtropical regions. (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No records of impacts from the introductions were found. This species is wide-spread in tropical and subtropical regions, in the RA area climate is temperate.	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No records of impacts from the introductions were found. This species is wide-spread in tropical and subtropical regions, in the RA area climate is temperate.	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No records of diseases were found for Najas graminea. (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No records of diseases were found for Najas graminea. (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Stems up to 60 cm high (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Medium

23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	This aquatic plant grows in ponds, river, streams, lakes and paddy fields, usually in still or slow-moving water. (Zhuang X. 2017. Najas graminea. The IUCN Red List of Threatened Species 2017: e.T164296A67788915. Available: https://www.iucnredlist.org/species/164296/67788915)	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	(Zhuang X. 2017. Najas graminea. The IUCN Red List of Threatened Species 2017: e.T164296A67788915. Available: https://www.iucnredlist.org/species/164296/67788915)	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	(Zhuang X. 2017. Najas graminea. The IUCN Red List of Threatened Species 2017: e.T164296A67788915. Available: https://www.iucnredlist.org/species/164296/67788915)	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	Not applicable	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	Not applicable	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	No evidence (Zhuang X. 2017. Najas graminea. The IUCN Red List of Threatened Species 2017: e.T164296A67788915. Available: https://www.iucnredlist.org/species/164296/67788915)	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No evidence (Zhuang X. 2017. Najas graminea. The IUCN Red List of Threatened Species 2017: e.T164296A67788915. Available: https://www.iucnredlist.org/species/164296/67788915)	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No evidence (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Medium
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	(U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	(U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	escape from pond gardens (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Interconnected waterways (Personal opinion, no information)	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No evidence (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Not applicable	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No evidence (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Floods (Personal opinion)	Low
43	7.09	Is dispersal of the taxon density dependent?	No	No evidence	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	No information	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	Silprasit K, Ngamniyom A, Kerksakul P, Thumajitsakul S. 2016. Using morphology and genomic template stability (GTS) to track herbicide effect on some submersed aquatic plants. Applied Environmental Research 38:75–85	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	resistance to aquatic pesticides water (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	This species resistance to aquatic pesticides; were found to be remained alive in glyphosate-contaminated water (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	This species can tolerate high salinity waters (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Probably some insects (Presonal opinion, no information)	Low
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	The risks of entry into the RA area by the taxon are likely to no change, only by human impact..	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.	Medium

Statistics	
Scores	
BRA	**14.5**
BRA Outcome	**Medium**
BRA+CCA	**14.5**
BRA+CCA Outcome	**Medium**
Score partition	
A. Biogeography/Historical	**3.5**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*1.5*
B. Biology/Ecology	**11.0**
4. Undesirable (or persistence) traits	*3.0*
5. Resource exploitation	*0.0*
6. Reproduction	*3.0*
7. Dispersal mechanisms	*0.0*
8. Tolerance attributes	*5.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**5**
Environmental	**1**
Species or population nuisance traits	**12**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.45**
BRA	**0.44**
CCA	**0.50**

Date and Time
06/12/2021 21:54:45

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Najas guadalupensis*
Common name	southern waternymph
Assessor	Mihaela Britvec
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	No	no reference	Low
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	used in aquaria	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	for example Najas graminea, Najas gracillima and Najas orientalis	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	no reference	Low
5	2.02	What is the quality of the climate matching data?	Medium	no reference	Low
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	no data	Low
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	It produces a large amount of seed.	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Hussner, A. (2012). Alien aquatic plant species in European countries. Weed Research, 52 (4), 297-306.	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Hussner, A. (2012). Alien aquatic plant species in European countries. Weed Research, 52 (4), 297-306.	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	no reference	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	no reference	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	no reference	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	no reference	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	no reference	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	sometimes forming mats	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	no reference	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	no reference	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	Forms dense weed beds.	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Forms dense weed beds in shallow water interfering with recreational activities.	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	no reference	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	no reference	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Not applicable	no reference	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	may be found in springs, fresh and brackish lakes, ponds, and canals	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Forms dense weed beds.	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Species has dorminant form - seed.	Low

5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	is not carnivore species	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	The impacts of the plant are not well documented but they are theorized to compete with native species by shading.	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	no reference	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	no reference	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	no reference	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	no reference	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	no reference	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Najas guadalupensis is a fast-growing aquatic plant species that produces a large amount of seed.	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	6	6 months	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	seeds may be spread by waterfowl	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	no reference	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no reference of acitively attaching	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	seeds may be spread by waterfowl	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	as seeds and fragments	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	has not active dispersal mechanisms	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	pkants can be dispersed by animals between water bodies	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Species is a fast growing plant.	High
43	7.09	Is dispersal of the taxon density dependent?	Yes	when its population density increases - increases the number of	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	no reference	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Species is little tolerant on a few factors: light, temperature, and pH.	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	https://www.doc.govt.nz/documents/science-and-technical/sfc141.pdf	Medium
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Seasonal flooding can also result in the spread of the organism locally.	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	no reference	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	no reference	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	professional judgement	High

54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	professional judgement	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	professional judgement	Low

Statistics	
Scores	
BRA	**13.5**
BRA Outcome	**Medium**
BRA+CCA	**25.5**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**3.5**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*1.5*
B. Biology/Ecology	**10.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*2.0*
6. Reproduction	*-1.0*
7. Dispersal mechanisms	*4.0*
8. Tolerance attributes	*0.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**4**
Environmental	**8**
Species or population nuisance traits	**16**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.46**
BRA	**0.44**
CCA	**0.58**

Date and Time
12/12/2021 13:07:35

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Nelumbo nucifera*
Common name	sacred lotus
Assessor	Mihaela Britvec
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Nelumbo nucifera has been in cultivation in China for more than 3,000 years, and has been grown not only for its cultural and ornamental value, but also for medicinal uses and for its edible 'seeds' and rhizomes. In China, Japan and India, for example, the rhizomes are roasted, pickled, candied or sliced and fried as chips. A paste made from the nutlets is used as a filling in 'mooncakes', traditional Chinese pastries. The young leaves, leaf stalks and flowers are eaten as vegetables in India. https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:6054	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Although abundant in cultivation, with many different cultivars having been bred over the centuries, local wild populations of sacred lotus in central mainland China have been greatly reduced due to the rapid development of the aquaculture industry. https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:6054	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Nelumbo lutea, according https://invazivnevrste.haop.hr/katalog	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	N. nucifera prefers warm-temperate to tropical climates.	Medium
5	2.02	What is the quality of the climate matching data?	Low	lack of information	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	no reference	Medium
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	via human translocations (https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf)	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	doi: 10.1111/j.1365-3180.2012.00926.x	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Hussner, A. (2012). Alien aquatic plant species in European countries. Weed Research, 52 (4), 297-306.	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	No records were found of documented impacts from introductions. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No records were found of documented impacts from introductions. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	No records were found of documented impacts from introductions. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No records were found of documented impacts from introductions. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	No information on threat to humans was found. (https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf)	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	The impacts of the plant are not well documented but they are theorized to compete with native species by shading. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	no reference	Medium
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Nelumbo nucifera is a species native to Japan, India, Australia, India and the surrounding areas. The species has been introduced to areas in Europe, North Africa, North America, and Europe. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	It is expected that sooner or later the physiognomy of the pond will become monotypic and be represented mainly by the tall and large surface covering plant, Nelumbo. (https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf)	High

20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	no reference	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	no reference	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Not applicable	no reference	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	N. nucifera are adapted to grow in the flood plains of slow-moving rivers, delta areas, wetland habitats, including flood plains, ponds, lakes, pools, lagoons, marshes, swamps and the backwaters of reservoirs.	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Nelumbo, which develops leaves on and above the pond's surface, has the most advantage in the pond and the shade-intolerant species under cover are compelled to be eliminated. It is expected that sooner or later the physiognomy of the pond will become monotypic and be represented mainly by the tall and large surface covering plant, Nelumbo. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	N. nucifera have remarkable power of dormancy and indeed the proved longevity of its seeds exceeds that of any known species of flowering plant. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	N. nucifera is not carnivore species.	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	The impacts of the plant are not well documented but they are theorized to compete with native species by shading. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Medium
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	no reference	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	https://www.sciencedirect.com/science/article/abs/pii/S0031942296008801	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	no reference	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	no reference	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	no reference	Medium
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Stands of lotus drop hundreds of thousands of seeds every year to the bottom of the pond. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	6	6 months	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	via human translocations	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	no reference	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no reference of acitively attaching	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	This species propagates by seeds and rhizomes.	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	This species propagates by seeds and rhizomes.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	has not active dispersal mechanisms	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	pkants can be dispersed by animals between water bodies	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	High
43	7.09	Is dispersal of the taxon density dependent?	Yes	when its population density increases - increases the number of	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	seeds can remain dormant for an extensive period of time as the pond silts in and dries out https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Low

46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	https://www.icid.org/weed_report.pdf	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Seasonal flooding can also result in the spread of the organism locally.	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	no reference	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	https://www.cabi.org/isc/datasheet/68490#tohostPlants	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement (https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf)	Low
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement (https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf)	Low
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement (https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf)	Low
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	professional judgement	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	professional judgement (https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf)	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	professional judgement (https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf)	Low

Statistics	
Scores	
BRA	**23.0**
BRA Outcome	**Medium**
BRA+CCA	**35.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**6.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**17.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*7.0*
6. Reproduction	*0.0*
7. Dispersal mechanisms	*4.0*
8. Tolerance attributes	*0.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**6**
Environmental	**13**
Species or population nuisance traits	**18**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.54**
BRA	**0.57**
CCA	**0.29**

Date and Time
11/12/2021 17:17:50

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Nymphaea candida*
Common name	-
Assessor	Tena Radočaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	ornamental value (Nierbauer, K. U., Kanz, B., & Zizka, G. (2014). The widespread naturalisation of Nymphaea hybrids is masking the decline of wild-type Nymphaea alba in Hesse, Germany. Flora-Morphology, Distribution, Functional Ecology of Plants, 209(2),	Medium
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	ornamental value (Nierbauer, K. U., Kanz, B., & Zizka, G. (2014). The widespread naturalisation of Nymphaea hybrids is masking the decline of wild-type Nymphaea alba in Hesse, Germany. Flora-Morphology, Distribution, Functional Ecology of Plants, 209(2),	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No evidence	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	The similarity of climatic conditions between native areas and the RA area is medium (Climatch)	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Nowak, A., Nobis, M., Dajdok, Z., Zalewska-Galosz, J., Nowak, S., Nobis, A., ... & Krawczyk, R. (2010). Revision of Nymphaea candida range-new data on the distribution and habitat preferences of the species in southern Poland. Acta Societatis Botanicorum Poloniae, 79(4).	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	N. candida is present in the RA area. (Boršić I, Kutleša P, Desnica S, Bošnjak D, Slivar S, Wong L J, Pagad S (2021). Global Register of Introduced and Invasive Species- Croatia. Version 2.8. Invasive Species Specialist Group ISSG. Checklist dataset https://doi.org/10.15468/rhmen3 accessed via GBIF.org.)	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	None	N. candida is present in the RA area. (Boršić I, Kutleša P, Desnica S, Bošnjak D, Slivar S, Wong L J, Pagad S (2021). Global Register of Introduced and Invasive Species- Croatia. Version 2.8. Invasive Species Specialist Group ISSG. Checklist dataset https://doi.org/10.15468/rhmen3 accessed via GBIF.org.)	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	No	N. candida is present in the RA area. (Boršić I, Kutleša P, Desnica S, Bošnjak D, Slivar S, Wong L J, Pagad S (2021). Global Register of Introduced and Invasive Species- Croatia. Version 2.8. Invasive Species Specialist Group ISSG. Checklist dataset https://doi.org/10.15468/rhmen3 accessed via GBIF.org.)	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Czech Republic, Southern regions of Germany, eastern France, Switzerland, south-western Romania, Austria, Hungary (Nowak, A., Nobis, M., Dajdok, Z., Zalewska-Galosz, J., Nowak, S., Nobis, A., ... & Krawczyk, R. (2010). Revision of Nymphaea candida range-new data on the distribution and habitat preferences of the species in southern Poland. Acta Societatis Botanicorum Poloniae,	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	No evidence (Bilz, M., Kell, S.P., Maxted, N. and Lansdown, R.V. 2011. European Red List of Vascular Plants. Luxembourg: Publications Office of the European Union)	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No evidence (Bilz, M., Kell, S.P., Maxted, N. and Lansdown, R.V. 2011. European Red List of Vascular Plants. Luxembourg: Publications Office of the European Union)	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	No evidence (Bilz, M., Kell, S.P., Maxted, N. and Lansdown, R.V. 2011. European Red List of Vascular Plants. Luxembourg: Publications Office of the European Union)	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No evidence (Bilz, M., Kell, S.P., Maxted, N. and Lansdown, R.V. 2011. European Red List of Vascular Plants. Luxembourg: Publications Office of the European Union)	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	No evidence (Bilz, M., Kell, S.P., Maxted, N. and Lansdown, R.V. 2011. European Red List of Vascular Plants. Luxembourg: Publications Office of the European Union)	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No evidence (Bilz, M., Kell, S.P., Maxted, N. and Lansdown, R.V. 2011. European Red List of Vascular Plants. Luxembourg: Publications Office of the European Union)	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No evidence (Bilz, M., Kell, S.P., Maxted, N. and Lansdown, R.V. 2011. European Red List of Vascular Plants. Luxembourg: Publications Office of the European Union)	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Boršić I, Kutleša P, Desnica S, Bošnjak D, Slivar S, Wong L J, Pagad S (2021). Global Register of Introduced and Invasive Species- Croatia. Version 2.8. Invasive Species Specialist Group ISSG. Checklist dataset https://doi.org/10.15468/rhmen3	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No evidence	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No evidence	Low

20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No evidence	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No evidence	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Spread 60cm flower up to size 20 cm. (https://www.naturescape.co.uk/product/dwarf-white-water-lily-bareroot/)	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	The plant grows only in water, as it is an aquatic plant, mainly in ponds, lakes, and slow flowing streams (https://inaturalist.ca/taxa/196966-Nymphaea-candida	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	No evidence (Bilz, M., Kell, S.P., Maxted, N. and Lansdown, R.V. 2011. European Red List of Vascular Plants. Luxembourg: Publications Office of the European Union)	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Nowak, A., Nobis, M., Dajdok, Z., Zalewska-Galosz, J., Nowak, S., Nobis, A., ... & Krawczyk, R. (2010). Revision of Nymphaea candida range-new data on the distribution and habitat preferences of the species in southern Poland. Acta Societatis	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	Not applicable	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	Not applicable	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	(Boršić I, Kutleša P, Desnica S, Bošnjak D, Slivar S, Wong L J, Pagad S (2021). Global Register of Introduced and Invasive Species- Croatia. Version 2.8. Invasive Species Specialist Group ISSG. Checklist dataset https://doi.org/10.15468/rhmen3	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Nymphaea alba – N. candida (Vít, P. (2017). Evolutionary and conservation consequences of interspecific hybridization in rare plant species.)	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 795-	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Nowak, A., Nobis, M., Dajdok, Z., Zalewska-Galosz, J., Nowak, S., Nobis, A., ... & Krawczyk, R. (2010). Revision of Nymphaea candida range-new data on the distribution and habitat preferences of the species in southern Poland. Acta Societatis Botanicorum Poloniae, 79(4)	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 795-804	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 795-804	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	the aquatic plant trade	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	No information	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No information	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 795-804.	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 795-804.	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Not applicable	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 795-	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 795-804.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 795-	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 795-804.	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 795-804.	Low
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 795-804.	Low

47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	SKLIAR, I., SKLIAR, V., KLYMENKO, A., SHERSTIUK, M., & ZUBTSOVA, I. (2020). GROWTH SIGNS OF Nymphaea candida IN VARIOUS ECOLOGICAL AND CENOTIC CONDITIONS OF DESNA BASIN (UKRAINE). AgroLife Scientific Journal, 9(1), 316-323.	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	SKLIAR, I., SKLIAR, V., KLYMENKO, A., SHERSTIUK, M., & ZUBTSOVA, I. (2020). GROWTH SIGNS OF Nymphaea candida IN VARIOUS ECOLOGICAL AND CENOTIC CONDITIONS OF DESNA BASIN (UKRAINE). AgroLife Scientific Journal, 9(1), 316-323.	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	No evidence	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	N. candida is present in the RA area. (Boršić I, Kutleša P, Desnica S, Bošnjak D, Slivar S, Wong L J, Pagad S (2021). Global Register of Introduced and Invasive Species- Croatia. Version 2.8. Invasive Species Specialist Group ISSG. Checklist dataset https://doi.org/10.15468/rhmen3 accessed via GBIF.org.)	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Low
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Low
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Low

Statistics	
Scores	
BRA	**6.5**
BRA Outcome	**Medium**
BRA+CCA	**10.5**
BRA+CCA Outcome	**Medium**
Score partition	
A. Biogeography/Historical	**3.5**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*1.5*
B. Biology/Ecology	**3.0**
4. Undesirable (or persistence) traits	*2.0*
5. Resource exploitation	*0.0*
6. Reproduction	*6.0*
7. Dispersal mechanisms	*-3.0*
8. Tolerance attributes	*-2.0*
C. Climate change	**4.0**
9. Climate change	*4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**3**
Environmental	**0**
Species or population nuisance traits	**8**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.37**
BRA	**0.37**
CCA	**0.38**

Date and Time
06/12/2021 22:35:16

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Nymphaea lotus*
Common name	white Egyptian lotus
Assessor	Marina Piria
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	The leaves, petioles, roots and seeds are all used in medicine in Nigeria (Lim, 2014)	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Pet/aquarium trade https://www.cabi.org/isc/datasheet/115821#touses	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Nymphaea odorata http://www.columbia.edu/itc/cerc/danoff-burg/invasion_bio/inv_spp_summ/Nymphaea_odorata.html	Medium
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	N. lotus is widespread in Africa and parts of temperate and tropical Asia to which it is native (Plant Gene Resources of Canada, 2016) but tolerate Bs climate	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climatch	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	Horizon species, found in Hungary	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	water, floating vegetation https://www.cabi.org/isc/datasheet/115821#topathwayVectors	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	in Hungary, Hussner et al 2012	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Costarika, Salvador https://www.cabi.org/isc/datasheet/115821#todistribution	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	having moderate negative impacts on wildlife or natural communities in Louisiana, but of limited concern and/or extent	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	The plant has also been reported as a weed of fish ponds in Nigeria (Adesina et al., 2015).	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	Negatively impacts livelihoods	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	. lotus has many uses as a human food; th	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	N. lotus produces a dense mat-like canopy that is heavy enough to break tillers of rice during vegetative growth periods and can reduce crop yield, particularly in direct seeded rice (Mohamed and Serag, 2003). H	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	it is not parasite	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	n Louisiana, USA, the plant is listed as a Tier II invasive species, (having moderate negative impacts on wildlife or natural communities in Louisiana, but of limited concern and/or extent),	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	no evidences but potentially can affect fishery	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	no evidence	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	In Ghana, Annang and Addo-Boadu (2012) recorded twenty-eight genera of algae belonging to five phyla in association with N. lotus.	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	it is large plant	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	require calm, shallow (<2 m) water, full sunlight and neutral to slightly alkaline pH	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	N. lotus could possibly be used for the removal of heavy metals from polluted water sources (Mohamed and Serag, 2003).	High

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Species of Nymphaea reproduce sexually though show variability between species e.g. flower opening times, flower colour and function of the various flower parts. Agamospermous reproduction is not seen in species of Nymphaea, however several modes are exhibited e.g. detachable tubers and stolon formation.	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	no	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Probably	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	no.	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Species of Nymphaea reproduce sexually though show variability between species e.g. flower opening times, flower colour and function of the various flower parts. Agamospermous reproduction is not seen in species of Nymphaea, however several modes are exhibited e.g. detachable tubers and stolon formation.	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No evidence but other Nymphea species can hybridize https://pbsociety.org.pl/journals/index.php/asbp/article/view/asbp.2015.016/0	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Species of Nymphaea reproduce sexually though show variability between species e.g. flower opening times, flower colour and function of the various flower parts. Agamospermous reproduction is not seen in species of Nymphaea, however several modes are exhibited e.g. detachable tubers and stolon formation.	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	No	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	debris, water, birds	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	birds https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no data https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	not yet present	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	not yet present	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	na	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Medium
43	7.09	Is dispersal of the taxon density dependent?	No	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Very high
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	Herbicides if allowed	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	no	Very high
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	preferring warm temperatures	High

51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	prefer warm temperatures	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	watercourses are not connected	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	if introduced with increase temp. have better chance fully establish	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	if there is better chance to establish and distribute than can have higher impact	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	probably will affect fisheries	Low

Statistics	
Scores	
BRA	**14.5**
BRA Outcome	**Medium**
BRA+CCA	**24.5**
BRA+CCA Outcome	**Medium**
Score partition	
A. Biogeography/Historical	**15.5**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*10.5*
B. Biology/Ecology	**-1.0**
4. Undesirable (or persistence) traits	*3.0*
5. Resource exploitation	*2.0*
6. Reproduction	*-1.0*
7. Dispersal mechanisms	*-1.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**10.0**
9. Climate change	*10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**13**
Environmental	**10**
Species or population nuisance traits	**5**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.67**
BRA	**0.69**
CCA	**0.46**

Date and Time
23/11/2021 17:01:41

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Pistia stratiotes*
Common name	water lettuce
Assessor	Tena Radočaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	P. stratiotes is a popular ornamental plant, used in ponds and aquariums. (Global Invasive Species Database (2021) Species profile: Pistia stratiotes)	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	P. stratiotes is a popular ornamental plant, used in ponds and aquariums. (Global Invasive Species Database (2021) Species profile: Pistia stratiotes)	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No evidence	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Low	The similarity of climatic conditions between native areas and the RA area is low (Climatch)	Medium
5	2.02	What is the quality of the climate matching data?	Medium	I used climatch and distribution map of CABI	Low
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	P. stratiotes is present in RA area (Boršić, I., Rubinić, T., 2018: First record of Pistia stratiotes L. (Araceae) in Croatia, with the consideration of possible introduction pathways. In: Jelaska, S.D. (ed.), Zbornik sažetaka 3. Hrvatskog simpozija o invazivnim vrstama, 96. Hrvatsko ekološko društvo, Zagreb)	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	None	P. stratiotes is present in RA area (Boršić, I., Rubinić, T., 2018: First record of Pistia stratiotes L. (Araceae) in Croatia, with the consideration of possible introduction pathways. In: Jelaska, S.D. (ed.), Zbornik sažetaka 3. Hrvatskog simpozija o invazivnim vrstama, 96. Hrvatsko ekološko društvo, Zagreb)	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	No	P. stratiotes is present in RA area (Boršić, I., Rubinić, T., 2018: First record of Pistia stratiotes L. (Araceae) in Croatia, with the consideration of possible introduction pathways. In: Jelaska, S.D. (ed.), Zbornik sažetaka 3. Hrvatskog simpozija o invazivnim vrstama, 96. Hrvatsko ekološko društvo, Zagreb)	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	It was introduced into Europe in the 20th century and has since spread to 15 European countries (Živković, M. M., Anđelković, A. A., Cvijanović, D. L., Novković, M. Z., Vukov, D. M., Šipoš, Š. Š., ... & Radulović, S. B. (2019). The beginnings of Pistia stratiotes L. invasion in the lower Danube delta: the first record for the Province of Vojvodina (Serbia). BioInvasions Record, 8(2))	Medium
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Its growth habit can make it a weed in waterways, where it can kill native submerged plants and reduce biodiversity. (CABI, 2020)	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No evidence	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	Mats of P. stratiotes can also disrupt natural ecosystems. They can lead to a lower concentration of oxygen in covered waters and sediments by blocking air-water interface and root respiration. (Global Invasive Species Database (2021) Species profile: Pistia stratiotes.)	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	P. stratiotes can inflict a severe impact on the environment and economy of infested areas. The dense mats created by connected rosettes of the plant lead to the majority of problems encountered with water lettuce. These mats can have a negative economic effect by blocking waterways, thus increasing the difficulty of navigation and hindering flood control efforts. (Global Invasive Species Database (2021) Species profile: Pistia stratiotes.)	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Global Invasive Species Database (2021) Species profile: Pistia stratiotes.)	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Such rigorous growth often leads to drastic reductions in the diversity of native aquatic plant and animal communities (Živković, M. M., Anđelković, A. A., Cvijanović, D. L., Novković, M. Z., Vukov, D. M., Šipoš, Š. Š., ... & Radulović, S. B. (2019). The beginnings of Pistia stratiotes L. invasion in the lower Danube delta: the first record for the Province of Vojvodina (Serbia).	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No evidence (Global Invasive Species Database (2021) Species profile: Pistia stratiotes.	Low

17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Its temperature tolerance limits are 15°C (59°F) and 35°C (95°F); the optimal growth temperature range for the plant is 22-30°C. Over the years it has been introduced to a number of European countries, e.g. Czech Republic, Spain and Russia but without forming self-replacing populations. (Živković, M. M., Anđelković, A. A., Cvijanović, D. L., Novković, M. Z., Vukov, D. M., Šipoš, Š. Š., ... & Radulović, S. B. (2019). The beginnings of Pistia stratiotes L. invasion in the lower Danube delta: the first record for the Province of Vojvodina (Serbia). BioInvasions Record, 8(2).	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	In the RA area it cannot survive the winter, but it can probably have a adverse impact on the ecosystem in the short period when it is present. Ecological impacts of P. stratiotes and note that they include increased rates of siltation, slowing of water velocities, degradation of fish nesting sites, increased nutrient loading, thermal stratification, increase in alkalinity and fish and macroinvertebrate mortality. (CABI, 2020)	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Consequently, such dense stands of Pistia may have serious negative effects on the multifunctional human use of waterbodies. These harmful effects include impediment of the transport of irrigation and drainage water, interference with hydro-electric schemes from artificial lakes, hindering navigation and fishing and the creation of habitats favourable for the transmittance of water-borne diseases (CABI, 2020)	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No evidence (Global Invasive Species Database (2021) Species profile: Pistia stratiotes).	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No evidence (Global Invasive Species Database (2021) Species profile: Pistia stratiotes).	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Živković, M. M., Anđelković, A. A., Cvijanović, D. L., Novković, M. Z., Vukov, D. M., Šipoš, Š. Š., ... & Radulović, S. B. (2019). The beginnings of Pistia stratiotes L. invasion in the lower Danube delta: the first record for the Province of Vojvodina (Serbia). BioInvasions Record, 8(2).	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	Pistia stratiotes grows in slow-moving rivers and reservoirs, irrigation channels, ponds, lakes, canals and ditches (Živković, M. M., Anđelković, A. A., Cvijanović, D. L., Novković, M. Z., Vukov, D. M., Šipoš, Š. Š., ... & Radulović, S. B. (2019). The beginnings of Pistia stratiotes L. invasion in the lower Danube delta: the first record for the Province of Vojvodina (Serbia). BioInvasions	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Ecological impacts of P. stratiotes and note that they include increased rates of siltation, slowing of water velocities, degradation of fish nesting sites, increased nutrient loading, thermal stratification, increase in alkalinity and fish and	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Živković, M. M., Anđelković, A. A., Cvijanović, D. L., Novković, M. Z., Vukov, D. M., Šipoš, Š. Š., ... & Radulović, S. B. (2019). The beginnings of Pistia stratiotes L. invasion in the lower Danube delta: the first record for the Province of Vojvodina (Serbia). BioInvasions Record, 8(2).),	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	Not applicable	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	Not applicable	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Maybe, (Global Invasive Species Database (2021) Species profile: Pistia stratiotes).	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No information (CABI, 2020); Global Invasive Species Database (2021) Species profile: Pistia stratiotes.	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	Reproduces asexually (CABI, 2020) ; Global Invasive Species Database (2021) Species profile: Pistia stratiotes.	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Global Invasive Species Database (2021) Species profile: Pistia stratiotes.	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Rapid vegetative reproduction allows water lettuce to cover an entire lake, from shore to shore, with a dense mat of connected rosettes in a short period of time. (Global Invasive Species Database (2021) Species profile: Pistia stratiotes	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	Global Invasive Species Database (2021) Species profile: Pistia stratiotes	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Escape from confinement or garden escape, Ornamental purposes, Nursery trade (CABI, 2020)	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Fragments, or whole plants, can be spread via boats or fishing equipment from an infested area to a clean body of water. (Global Invasive Species Database (2021) Species profile: Pistia stratiotes)	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No (CABI, 2020) ; Global Invasive Species Database (2021) Species profile: Pistia stratiotes.	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	P. stratiotes reproduces vegetatively and by seed. (Global Invasive Species Database (2021) Species profile: Pistia stratiotes.)	High

39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Global Invasive Species Database (2021) Species profile: Pistia stratiotes	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Not applicable	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	CABI 2020; Global Invasive Species Database (2021) Species profile: Pistia stratiotes	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Ship ballast water; Floating vegetation and debris (CABI, 2020)	Low
43	7.09	Is dispersal of the taxon density dependent?	No	CABI 2020; Global Invasive Species Database (2021) Species profile: Pistia stratiotes	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	It can survive for extended periods on moist soil. (CABI, 2020)	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	No information (CABI, 2020)	Low
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	Chemical control methods that have been successful in treating P. stratiotes include the herbicide endothall, which can act quickly and kill all plant cells that it contacts. (Global Invasive Species Database (2021) Species profile: Pistia stratiotes)	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Global Invasive Species Database (2021) Species profile: Pistia stratiotes	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	P. stratiotes has a low salinity tolerance; salt concentrations of 1.66% are toxic to the plant (Haller et al., 1974).	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	No	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	Not applicable	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Low
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Low
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Medium

Statistics	
Scores	
BRA	**18.0**
BRA Outcome	**Medium**
BRA+CCA	**18.0**
BRA+CCA Outcome	**Medium**
Score partition	
A. Biogeography/Historical	**9.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*7.0*
B. Biology/Ecology	**9.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*0.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*0.0*
8. Tolerance attributes	*-2.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*

8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**9**
Environmental	**6**
Species or population nuisance traits	**6**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.51**
BRA	**0.51**
CCA	**0.50**

Date and Time
07/12/2021 08:00:17

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Rotala macrandra*
Common name	-
Assessor	Tena Radočaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Rotala macrandra is popular in the global aquarium trade (Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Rotala macrandra is popular in the global aquarium trade (Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	R. rotundifolia	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Low	The similarity of climatic conditions between native areas and the RA area is low (Climatch)	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala	Low
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	R. macrandra is not present in the RA area	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	The aquarium trade (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Hungary (Hussner, A. (2012). Alien aquatic plant species in European countries. Weed Research, 52(4), 297-306	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	It has escaped from cultivation in Hungary, where the plants survive in thermal water bodies. (Hussner, A. (2012). Alien aquatic plant species in European countries. Weed Research,	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	No evidence that R. macrandra has any negative impacts in natural environments, urban and suburban settings, or production systems. (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No evidence that R. macrandra has any negative impacts in natural environments, urban and suburban settings, or production systems. (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	No evidence that R. macrandra has any negative impacts in natural environments, urban and suburban settings, or production systems. (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No evidence that R. macrandra has any negative impacts in natural environments, urban and suburban settings, or production systems. (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No evidence that R. macrandra has any negative impacts in natural environments, urban and suburban settings, or production systems. (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No evidence	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Native area is India, and in Hungary survive in thermal water bodies. (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No evidence	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No evidence	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No evidence	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No evidence	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	The shoots of R. macrandra can grow 60 cm in length (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Medium

23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	R. macrandra occurs in streams, temporary ponds, and flooded paddy fields. (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	No evidence that R. macrandra has any negative impacts in natural environments, urban and suburban settings, or production systems. (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Botond, M., and B.-D. Zoltan (eds.). 2004. Biologiai Invaziok Magyarorszagon: Ozonnovenyek [Biological Invasions in Hungary: Invasive Plants]. TermészetBÚVÁR Alapítvány Kiadó, Budapest. 409 pp.,	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	Not applicable	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	Not applicable	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	No information- I think not, because of low temperatures in the RA area	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No evidence	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	Botond, M., and B.-D. Zoltan (eds.). 2004. Biologiai Invaziok Magyarorszagon: Ozonnovenyek [Biological Invasions in Hungary: Invasive Plants]. TermészetBÚVÁR Alapítvány Kiadó, Budapest. 409 pp	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No evidence	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Botond, M., and B.-D. Zoltan (eds.). 2004. Biologiai Invaziok Magyarorszagon: Ozonnovenyek [Biological Invasions in Hungary: Invasive Plants]. TermészetBÚVÁR Alapítvány Kiadó, Budapest. 409 pp.	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	Botond, M., and B.-D. Zoltan (eds.). 2004. Biologiai Invaziok Magyarorszagon: Ozonnovenyek [Biological Invasions in Hungary: Invasive Plants]. TermészetBÚVÁR Alapítvány Kiadó, Budapest. 409 pp.	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Escape from garden	Low
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Personal opinion- flood or boat	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No evidence	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	No evidence	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	No evidence	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Not applicable	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No evidence	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Floods	Low
43	7.09	Is dispersal of the taxon density dependent?	No	(Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	(Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	(Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Low
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	(Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala).	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala).	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	No	Low
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	The risks of entry into the RA area by the taxon are likely to no change, only by human impact.	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Medium

Statistics	
Scores	
BRA	**8.0**
BRA Outcome	**Medium**
BRA+CCA	**8.0**
BRA+CCA Outcome	**Medium**
Score partition	
A. Biogeography/Historical	**5.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*1.0*
B. Biology/Ecology	**3.0**
4. Undesirable (or persistence) traits	*1.0*
5. Resource exploitation	*0.0*
6. Reproduction	*3.0*
7. Dispersal mechanisms	*-3.0*
8. Tolerance attributes	*2.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**4**
Environmental	**1**
Species or population nuisance traits	**5**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.40**
BRA	**0.39**
CCA	**0.50**

Date and Time
07/12/2021 08:17:04

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Rotala rotundifolia*
Common name	dwarf rotala
Assessor	Tena Radočaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	It is widely grown as an aquarium plant (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	It is widely grown as an aquarium plant (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	R.macrandra	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Low	Rotala rotundifolia is native to South and Southeast Asia from Japan to India. (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup) The similarity of climatic conditions between native areas and the RA area is low (Climatch)	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climatch and Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	R. rotundifolia is not present in the RA area.	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Pet trade (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	No	Rotala rotundifolia has become naturalized iin thermal water bodies in Hungary (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Rotala rotundifolia has become naturalized in Australia in Queensland and New South Wales and in thermal water bodies in Hungary (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup),	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	that shades out native vegetation (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No evidence	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	Rotala rotundifolia is targeted for control in natural systems because this species forms a dense layer on the water surface and restricts water flow. It is prohibited in Western Australia, Tasmania and Honduras. Rotala rotundifolia is also controlled in residential areas because dense populations interfere with drainage, preventing water control canals from working properly. (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup),	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No evidence	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	No evidence	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No evidence	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No evidence	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Native area to South and Southeast Asia from Japan to India, and in Hungary survive in thermal water bodies (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup),	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No evidence	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No evidence	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No evidence	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No evidence	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Its stems can be creeping or floating and can grow to 70 cm long (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Medium

23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	R. rotundifolia grows in marshes, swamps, and shallow ponds at high altitudes. (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	changes habitat light regime and slows water flow (Zlatković, B. K., & Bogosavljević, S. S. (2020). Risk analysis of alien plants recorded in thermal waters of Serbia. Weed Research, 60(1), 85-95)	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No evidence	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	Not applicable	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	Not applicable	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	Low temperatures	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No evidence	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No evidence	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	(Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	(Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	R. rotundifolia is known to disperse by water (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	By water (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No evidence	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	reproduce by seed (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Fragments also can be dispersed easily in water bodies, providing rapid distribution purely by vegetative means. (Ervin, G. N., & White, R. A. Assessing vegetative growth potential of exotic Rotala rotundifolia (Roxb.) Koehne (roundleaf toothcup), in comparison with Alternanthera philoxeroides (Mart.) Griseb.(alligator weed), a known successful invader.)	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Not applicable	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Ervin, G. N., & White, R. A. Assessing vegetative growth potential of exotic Rotala rotundifolia (Roxb.) Koehne (roundleaf toothcup), in comparison with Alternanthera philoxeroides (Mart.) Griseb.(alligator weed), a known successful invader	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Water (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	High
43	7.09	Is dispersal of the taxon density dependent?	No	No evidence	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	Rotala rotundifolia is a water-loving plant that can grow fully submerged, as an emerged aquatic plant, and as a terrestrial plant in dry gravel. (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	Yes	This species has the potential to grow in a broad range of conditions (Ervin, G. N., & White, R. A. Assessing vegetative growth potential of exotic Rotala rotundifolia (Roxb.) Koehne (roundleaf toothcup), in comparison with Alternanthera philoxeroides (Mart.) Griseb.(alligator weed), a known successful	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	the contact herbicide diquat and the sys temic herbicides glyphosate, imazapyr, penoxsulam, and triclopyr are likely to provide effective control (Ervin, G. N. Roundleaf toothcup [Rotala rotundifolia (Roxb.) Koehne].)	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	No evidence	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Freshwater species	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	No	Low
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Only by humans	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium

Statistics	
Scores	
BRA	**16.0**
BRA Outcome	**Medium**
BRA+CCA	**16.0**
BRA+CCA Outcome	**Medium**
Score partition	
A. Biogeography/Historical	**10.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*5.0*
B. Biology/Ecology	**6.0**
4. Undesirable (or persistence) traits	*2.0*
5. Resource exploitation	*0.0*
6. Reproduction	*3.0*
7. Dispersal mechanisms	*1.0*
8. Tolerance attributes	*0.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**7**
Environmental	**4**
Species or population nuisance traits	**8**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.50**
BRA	**0.50**
CCA	**0.50**

Date and Time
07/12/2021 08:35:33

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Sagittaria subulata*
Common name	awl-leaf arrowhead
Assessor	Tena Radočaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Garden ponds (http://freshwateraquariumplants.com/plantprofiles/narrowsag.html)	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Garden ponds (http://freshwateraquariumplants.com/plantprofiles/narrowsag.ht	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No evidence	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Low	The similarity of climatic conditions between native areas and the RA area is low (Climatch)	Low
5	2.02	What is the quality of the climate matching data?	Low	https://tropica.com/en/plants/plantdetails/Sagittariasubulata(079)/4530	Low
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	S. subulata is not present in the RA area	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Pet trade	Low
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Hungary (Brunel, S. (2009). Pathway analysis: aquatic plants imported in 10 EPPO countries. EPPO bulletin, 39(2), 201-213)	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Slovakia (Hrivnák, R., Medvecká, J., Baláži, P., Bubíková, K., Oťaheľová, H., & Svitok, M. (2019). Alien aquatic plants in Slovakia over 130 years: historical overview, current distribution and future perspectives. NeoBiota, 49, 37)	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Low risk (Brunel, S. (2009). Pathway analysis: aquatic plants imported in 10 EPPO countries. EPPO bulletin, 39(2), 201-213.)	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Low risk (Brunel, S. (2009). Pathway analysis: aquatic plants imported in 10 EPPO countries. EPPO bulletin, 39(2), 201-213.)	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	Low risk (Brunel, S. (2009). Pathway analysis: aquatic plants imported in 10 EPPO countries. EPPO bulletin, 39(2), 201-213.)	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Low risk (Brunel, S. (2009). Pathway analysis: aquatic plants imported in 10 EPPO countries. EPPO bulletin, 39(2), 201-213.)	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	No information	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	Low risk (Brunel, S. (2009). Pathway analysis: aquatic plants imported in 10 EPPO countries. EPPO bulletin, 39(2), 201-213.)	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No information	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Native area is South America	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No information	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No information	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No information	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No information	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Place individual plants 2-4 cm apart. This plant may cause problems because in certain conditions it suddenly grows to a height of 50 cm when it grows older	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	The remaining alien plants were recorded in shallow or even very shallow waters (< 0.4 m, Sagittaria subulata). (Hrivnák, R., Medvecká, J., Baláži, P., Bubíková, K., Oťaheľová, H., & Svitok, M. (2019). Alien aquatic plants in Slovakia over 130 years: historical overview, current distribution and future perspectives. NeoBiota,	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	No information	Low

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No information	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	Not applicable	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	Not applicable	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	Sutton, D. L. (1990). Growth of Sagittaria subulata and interaction with hydrilla. Journal of Aquatic Plant Management, 28, 20-22.	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Sutton, D. L. (1990). Growth of Sagittaria subulata and interaction with hydrilla. Journal of Aquatic Plant Management, 28, 20-22.	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	Sutton, D. L. (1990). Growth of Sagittaria subulata and interaction with hydrilla. Journal of Aquatic Plant Management, 28, 20-22.	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Sutton, D. L. (1990). Growth of Sagittaria subulata and interaction with hydrilla. Journal of Aquatic Plant Management, 28, 20-22.	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	No	Sutton, D. L. (1990). Growth of Sagittaria subulata and interaction with hydrilla. Journal of Aquatic Plant Management, 28, 20-22.	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	Sutton, D. L. (1990). Growth of Sagittaria subulata and interaction with hydrilla. Journal of Aquatic Plant Management, 28, 20-22.	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Pet trade	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	No evidence	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	No evidence	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	No evidence	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Not applicable	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Adair, R. J., Keener, B. R., Kwong, R. M., Sagliocco, J. L., & Flower, G. E. (2012). The Biology of Australian weeds 60.'Sagittaria platyphylla'(Engelmann) JG Smith and'Sagittaria calycina'Engelmann. Plant Protection Quarterly, 27(2), 47-58.	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	Adair, R. J., Keener, B. R., Kwong, R. M., Sagliocco, J. L., & Flower, G. E. (2012). The Biology of Australian weeds 60.'Sagittaria platyphylla'(Engelmann) JG Smith and'Sagittaria calycina'Engelmann. Plant Protection Quarterly, 27(2), 47-58.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	Adair, R. J., Keener, B. R., Kwong, R. M., Sagliocco, J. L., & Flower, G. E. (2012). The Biology of Australian weeds 60.'Sagittaria platyphylla'(Engelmann) JG Smith and'Sagittaria calycina'Engelmann. Plant Protection Quarterly, 27(2), 47-58.	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Adair, R. J., Keener, B. R., Kwong, R. M., Sagliocco, J. L., & Flower, G. E. (2012). The Biology of Australian weeds 60.'Sagittaria platyphylla'(Engelmann) JG Smith and'Sagittaria calycina'Engelmann. Plant Protection Quarterly, 27(2), 47-58.	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Adair, R. J., Keener, B. R., Kwong, R. M., Sagliocco, J. L., & Flower, G. E. (2012). The Biology of Australian weeds 60.'Sagittaria platyphylla'(Engelmann) JG Smith and'Sagittaria calycina'Engelmann. Plant Protection Quarterly, 27(2), 47-58.	Low
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	Adair, R. J., Keener, B. R., Kwong, R. M., Sagliocco, J. L., & Flower, G. E. (2012). The Biology of Australian weeds 60.'Sagittaria platyphylla'(Engelmann) JG Smith and'Sagittaria calycina'Engelmann. Plant Protection Quarterly, 27(2), 47-58.	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Adair, R. J., Keener, B. R., Kwong, R. M., Sagliocco, J. L., & Flower, G. E. (2012). The Biology of Australian weeds 60.'Sagittaria platyphylla'(Engelmann) JG Smith and'Sagittaria calycina'Engelmann. Plant Protection Quarterly, 27(2), 47-58.	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Humphreys, A., Gorsky, A. L., Bilkovic, D. M., & Chambers, R. M. (2021). Changes in plant communities of low-salinity tidal marshes in response to sea-level rise. Ecosphere, 12(7), e03630.	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	No	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Only by humans	Medium

51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium

Statistics	
Scores	
BRA	**6.0**
BRA Outcome	**Medium**
BRA+CCA	**6.0**
BRA+CCA Outcome	**Medium**
Score partition	
A. Biogeography/Historical	**8.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*6.0*
B. Biology/Ecology	**-2.0**
4. Undesirable (or persistence) traits	*0.0*
5. Resource exploitation	*0.0*
6. Reproduction	*2.0*
7. Dispersal mechanisms	*-5.0*
8. Tolerance attributes	*1.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**7**
Environmental	**0**
Species or population nuisance traits	**-1**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.36**
BRA	**0.34**
CCA	**0.50**

Date and Time
07/12/2021 08:55:45

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Utricularia gibba*
Common name	humped bladderwort
Assessor	Marina Piria
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	U. gibba is commonly cultivated as an ornamental plant (Biosecurity New Zealand, 2008); it may have been introduced originally as an aquarium plant (Webb et al., 1988). I	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	U. gibba is commonly cultivated as an ornamental plant (Biosecurity New Zealand, 2008); it may have been introduced originally as an aquarium plant (Webb et al., 1988). I	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Utricularia aurea	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	prefer Cs - Warm temperate climate with dry summer	High
5	2.02	What is the quality of the climate matching data?	High	Cs - Warm temperate climate with dry summer; Climatch	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	https://www.cabi.org/isc/datasheet/117747	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	machinery, water,pet trade	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Hungary; Husner 2012	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Nwe Zealand	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Impact on wild native species https://www.cabi.org/isc/datasheet/117747	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	Has high reproductive potential, U. gibba forms mats over the water surface; in New Zealand it has been reported that this could be a problem for irrigation and drainage (Champion and Clayton, 2000; Biosecurity New Zealand, 2008).	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	Damaged ecosystem services	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	. gibba is reported as a weed in botanic gardens throughout the world; it poses no known harm to human health (Biosecurity New Zealand, 2008).	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	. gibba is reported as a weed in botanic gardens throughout the world; it poses no known harm to human health (Biosecurity New Zealand, 2008).	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Competition - monopolizing resources Competition - shading Rapid growth	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	it is not parasitic spec	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	U. gibba is specially adapted to low-nutrient environments such as bogs and swamps (Biosecurity New Zeland, 2008), and increases in abundance when the conditions change from oligotrophic to mesotropic; however, with further change in that direction it decreases in abundance (Preston and Croft, 1997)	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	yes	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	if introduced, yes	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	no data	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	no data	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	it has high growth potential	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	U. gibba prefers slow-moving, warm water and has moderate shade tolerance (NZPCN, 2010). These factors best explain the occurrence of U. gibba in New Zealand (Compton et al., 2012).	Very high

24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	no data	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	The flowers are hermaphrodite and pollinated either by insects or by self-pollination (Salmon, 2001). U. gibba regenerates naturally from seeds (Champion and Clayton, 2000; Compton, et al., 2012). The vegetative reproduction is by re-sprouts from stem fragments or from rhizomes (NZPCN, 2010). U. gibba differs from all these species in that it has no winter buds in its leaf axils, which are the most common propagation method for other species of Utricularia (Zhenyu and Cheek, 2011).	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	specialized carnivorous plant	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Competition - monopolizing resources	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	https://www.cabi.org/isc/datasheet/117747	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	yes, similar conditions as part of New Zealand	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	no evidences	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	The flowers are hermaphrodite and pollinated either by insects or by self-pollination (Salmon, 2001). U. gibba regenerates naturally from seeds (Champion and Clayton, 2000; Compton, et al., 2012). The vegetative reproduction is by re-sprouts from stem fragments or from rhizomes (NZPCN, 2010). U. gibba differs from all these species in that it has no winter buds in its leaf axils, which are the most common propagation method for other species of Utricularia (Zhenyu and Cheek, 2011).	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	no.	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	The flowers are hermaphrodite and pollinated either by insects or by self-pollination (Salmon, 2001). U. gibba regenerates naturally from seeds (Champion and Clayton, 2000; Compton, et al., 2012). The vegetative reproduction is by re-sprouts from stem fragments or from rhizomes (NZPCN, 2010). U. gibba differs from all these species in that it has no winter buds in its leaf axils, which are the most common propagation method for other species of Utricularia (Zhenyu and Cheek, 2011).	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	The flowers are hermaphrodite and pollinated either by insects or by self-pollination (Salmon, 2001). U. gibba regenerates naturally from seeds (Champion and Clayton, 2000; Compton, et al., 2012). The vegetative reproduction is by re-sprouts from stem fragments or from rhizomes (NZPCN, 2010). U. gibba differs from all these species in that it has no winter buds in its leaf axils, which are the most common propagation method for other species of Utricularia (Zhenyu and Cheek, 2011).	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	vector organisms, machinery, water	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	can be transferred by birds	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	passive yes, active no	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	The flowers are hermaphrodite and pollinated either by insects or by self-pollination (Salmon, 2001). U. gibba regenerates naturally from seeds (Champion and Clayton, 2000; Compton, et al., 2012). The vegetative reproduction is by re-sprouts from stem fragments or from rhizomes (NZPCN, 2010). U. gibba differs from all these species in that it has no winter buds in its leaf axils, which are the most common propagation method for other species of Utricularia (Zhenyu and Cheek, 2011).	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	The flowers are hermaphrodite and pollinated either by insects or by self-pollination (Salmon, 2001). U. gibba regenerates naturally from seeds (Champion and Clayton, 2000; Compton, et al., 2012). The vegetative reproduction is by re-sprouts from stem fragments or from rhizomes (NZPCN, 2010). U. gibba differs from all these species in that it has no winter buds in its leaf axils, which are the most common propagation method for other species of Utricularia (Zhenyu and Cheek, 2011).	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	no.	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	yes	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	probably not	Low

43	7.09	Is dispersal of the taxon density dependent?	No	The flowers are hermaphrodite and pollinated either by insects or by self-pollination (Salmon, 2001). U. gibba regenerates naturally from seeds (Champion and Clayton, 2000; Compton, et al., 2012). The vegetative reproduction is by re-sprouts from stem fragments or from rhizomes (NZPCN, 2010). U. gibba differs from all these species in that it has no winter buds in its leaf axils, which are the most common propagation method for other species of Utricularia (Zhenyu and Cheek, 2011).	Very high
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	Has propagules that can remain viable for more than one year	Medium
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	mezortophic cinditions, eutrophic cant stand	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No information is available on any chemical control methods attempted on this species. Only mechanical removal	Medium
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	probably not	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	No data	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Rook (2004) reports that in America, U. gibba is occasionally eaten by muskrats, ducks and other waterfowl.	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	preferred warm climates	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	preferred warm climates	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	not connected waterbodies	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	U. gibba has been identified as outcompeting and threatening native, endangered bladderworts including U. dichotoma and U. delicatula, and sundews including Drosera auriculata, D. peltata and the forked sundew D. binate	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	probably higher	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	on fishing activities	Medium

Statistics	
Scores	
BRA	**32.0**
BRA Outcome	**High**
BRA+CCA	**42.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**20.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*14.0*
B. Biology/Ecology	**12.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*2.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*3.0*
8. Tolerance attributes	*-2.0*
C. Climate change	**10.0**
9. Climate change	*10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**16**
Environmental	**11**
Species or population nuisance traits	**19**

Thresholds	
BRA	24.75
BRA+CCA	24.75
Confidence	
BRA+CCA	0.65
BRA	0.66
CCA	0.54

Date and Time
23/11/2021 17:02:46

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Vallisneria australis*
Common name	-
Assessor	Marina Piria
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Mediterranean region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	For aquaria https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	for aquaria https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	Low
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Valisneria neotropicalis https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	climatch	Medium
5	2.02	What is the quality of the climate matching data?	Medium	climatch	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Hungary, Germany but previously was misidentified as V. nana or V. americana https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	Medium
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	accidental, release from aquaria https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Hungary https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	no data https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	probably displace other species of submerged hydrophytes)similarly as other Valisneria species <https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	probably Damage ecosystem services as other Valisneria sp. https://www.cabi.org/isc/datasheet/56573#toimpactSummary	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	V. spiralis can impede water flow in irrigation canals and storage dams, affect drainage, choke hydro turbines, and impact on navigational, recreational and agricultural use of water bodies. Probably has similar effect	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	High

15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No data https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y; According to our experience in Hungarian populations, this species is a very strong competitor and can replace other submerged invasive species (Hydrilla verticillata (L.f.) Royle, Cabomba caroliniana A. Gray) in thermal water canals.	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	it is not parasitic https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	even tropical species, found survived populations on -15 C https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	Other Valisneria spec disrupts - Ecosystem change/ habitat alteration https://www.cabi.org/isc/datasheet/56573#tohabitat ; According to our experience in Hungarian populations, this species is a very strong competitor and can replace other submerged invasive species (Hydrilla verticillata (L.f.) Royle, Cabomba caroliniana A. Gray) in thermal water canals.	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	Other valisneria - Damaged ecosystem services https://www.cabi.org/isc/datasheet/56573#tohabitat	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	No	no data https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	no data https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	High
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	V. spiralis was found in stagnant, slow and fast running (up to 0.8 m/s) water to depths of 1 m, and on muddy, sandy or gravelly sediment (Hussner and Lösch, 2005). Probably is for V americana similar.	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	probably yes but no data for this species https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Probably yes because of releseas from aquaria usually occur in low densities https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	probably yes as other Valisneria	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	found in Japan https://www.sciencedirect.com/science/article/abs/pii/S0304377015300176	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	in Russia Valisneria sp. Flowering plants were observed only with female inflorescences (author's observation in 2016) suggesting that reproduction was only vegetative; he most common form of propagation for Vallisneria is through runners. These will grow all over the aquarium and each new plant will quickly start sending out runners of its own. They can very quickly take over the entire tank this way. https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8YFlowering plants were https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y	High

32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y#bib0090	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	he pistillate flowers, attached to submerged plants by long, flexuous peduncles, orient their opening at the water surface and pollination occurs when anthers of the floating staminate flowers contact the stigmas of the pistillate flowers. After fertilization the peduncle coils into a spiral, thus drawing the developing fruit underwater where it matures; he most common form of propagation for Vallisneria is through runners. These will grow all over the aquarium and each new plant will quickly start sending out runners of its own. They can very quickly take over the entire	Medium
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	he pistillate flowers, attached to submerged plants by long, flexuous peduncles, orient their opening at the water surface and pollination occurs when anthers of the floating staminate flowers contact the stigmas of the pistillate flowers. After fertilization the peduncle coils into a spiral, thus drawing the developing fruit underwater where it matures	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	release from aquaria	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	not yet present	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	based on reproduction, no	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	by plant remains; All known populations probably resulted from plant remains released in drainage water from aquariums. https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y#bib0090	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	V. spiralis spreads asexually by means of runners, https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y#bib0090	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	n.a.	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	not known for V.australis	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	distributed locally elsewhere, Adriatic area with disconnected waterbodies	Very high
43	7.09	Is dispersal of the taxon density dependent?	No	he most common form of propagation for Vallisneria is through runners. These will grow all over the aquarium and each new plant will quickly start sending out runners of its own. They can very quickly take over the entire tank this way.	Very high
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	yes in other valisneria	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	Yes	All populations were detected in artificial or strongly modified water bodies; no plants were found so far in unregulated water systems. As these plants have been observed across multiple growing seasons, these can be considered as self-sustaining populations. However, the survival of these plants in all known populations, pointing at. While, at least at present, continental cold winters are posing a barrier for the "giant" alien Vallisneria species, these may become invasive species in western Europe in	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	In New Zealand, the species is considered virtually impossible to eliminate once established, but small infestations can be controlled by divers hand-pulling plants (Auckland Regional Council, 2010a). Also generalist herbivoreous fishes can maybe	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	All populations were detected in artificial or strongly modified water bodies; no plants were found so far in unregulated water systems. As these plants have been observed across multiple growing seasons, these can be considered as self-sustaining populations. However, the survival of these plants in all known populations, pointing at. While, at least at present, continental cold winters are posing a barrier for the "giant" alien Vallisneria species, these may become invasive species in western Europe in	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	V. spiralis known to tolerate low salinity.	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	locally grass carp	Low
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	Our study confirms that V. australis has become established in some parts of Europe. Firstly, this species naturalised in Hungary although in this country it only occurs in thermally heated canals. Later, this species was also recorded from Italy, Belgium and Germany where it occurs in strongly modified water bodies (rice fields, canals, gravel pits), but these are not thermally heated. This means that this species can adapt to the Atlantic climate and potentially may become an invasive species in the near future.	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	Our study confirms that V. australis has become established in some parts of Europe. Firstly, this species naturalised in Hungary although in this country it only occurs in thermally heated canals. Later, this species was also recorded from Italy, Belgium and Germany where it occurs in strongly modified water bodies (rice fields, canals, gravel pits), but these are not thermally heated. This means that this species can adapt to the Atlantic climate and potentially may become an invasive species in the near future.	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	because of not connected waterbodies	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	Our study confirms that V. australis has become established in some parts of Europe. Firstly, this species naturalised in Hungary although in this country it only occurs in thermally heated canals. Later, this species was also recorded from Italy, Belgium and Germany where it occurs in strongly modified water bodies (rice fields, canals, gravel pits), but these are not thermally heated. This means that this species can adapt to the Atlantic climate and potentially may become an invasive species in the near future.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	Our study confirms that V. australis has become established in some parts of Europe. Firstly, this species naturalised in Hungary although in this country it only occurs in thermally heated canals. Later, this species was also recorded from Italy, Belgium and Germany where it occurs in strongly modified water bodies (rice fields, canals, gravel pits), but these are not thermally heated. This means that this species can adapt to the Atlantic climate and potentially may become an invasive species in the near future.	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	Our study confirms that V. australis has become established in some parts of Europe. Firstly, this species naturalised in Hungary although in this country it only occurs in thermally heated canals. Later, this species was also recorded from Italy, Belgium and Germany where it occurs in strongly modified water bodies (rice fields, canals, gravel pits), but these are not thermally heated. This means that this species can adapt to the Atlantic climate and potentially may become an invasive species in the near future.	Medium

Statistics	
Scores	
BRA	**21.5**
BRA Outcome	**Medium**
BRA+CCA	**31.5**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**6.5**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*1.5*
B. Biology/Ecology	**15.0**
4. Undesirable (or persistence) traits	*4.0*
5. Resource exploitation	*2.0*
6. Reproduction	*6.0*
7. Dispersal mechanisms	*-1.0*
8. Tolerance attributes	*4.0*
C. Climate change	**10.0**
9. Climate change	*10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**6**
Environmental	**5**
Species or population nuisance traits	**22**

Thresholds	
BRA	**24.75**
BRA+CCA	**24.75**
Confidence	
BRA+CCA	**0.60**
BRA	**0.59**
CCA	**0.67**

Date and Time
23/11/2021 17:03:25

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Azolla cristata*
Common name	-
Assessor	Mihaela Britvec
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Azolla cristata is of commercial importance in cultivation in southern and eastern Asia as a bio-fertilizer, valued for its nitrogen-fixing ability, which benefits crops such as rice when the fern is grown under it and reduces the need for artificial fertilizer addition. The thick mat of fronds also suppresses weed growth. Harvested fronds are also used as a food for fish and poultry. It is also often used as a floating plant in both coldwater and tropical aquaria, as well as in outdoor ponds. doi:	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Harvested fronds are also used as a food for fish and poultry.It is also often used as a floating plant in both coldwater and tropical aquaria, as well as in outdoor ponds.	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	It is closely related to Azolla filiculoides.	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	doi: 10.1111/j.1365-3180.2012.00926.x	High
5	2.02	What is the quality of the climate matching data?	High	doi: 10.1111/j.1365-3180.2012.00926.x	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	doi: 10.1111/j.1365-3180.2012.00926.x	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	soil, sand and gravel	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	doi: 10.1111/j.1365-3180.2012.00926.x	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	A. cristata is native to the America, but has been recorded as an invasive species in Kashmir, India, and South Africa.	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Azolla species have negatively impacts animal health (https://www.cabi.org/isc/datasheet/8119#toriskAndImpactFactors).	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	A. cristata reduce the light and oxygen levels in water bodies.	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	Azolla species are known to be able to damaged ecosystem services and leaded to ecosystem change/ habitat alteration.	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	Social impacts of Azolla species have centred around the reduction of useful water surface area for recreation (fishing, swimming and water skiing) and water transport.	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	No physical threats to humans were found. https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Multiple peer-reviewed reports document competing with other plants. https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	no reference	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	A. cristata form thick mats.	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Multiple peer-reviewed reports document negative impacts of introduction including forming thick mats, competing with other plants, blocking navigation, and increasing difficulty and costs to commercial fishing. https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	no reference	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	no reference	Low

22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	no reference	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	This species inhabits in still or slow moving water of lakes, ponds, and streams. https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Multiple peer-reviewed reports document negative impacts of introduction including forming thick mats and competing with other plants. https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	no reference	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	A. cristata is not carnivore.	Medium
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	competing with other plants: https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	Medium
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	no evedence	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	no reference	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	no reference	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	no reference	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	This fern is a nitrogen fixer.	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Has high reproductive potential.	Medium
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	2 days: The plants most usually reproduce asexually by fragmentation of the fronds as frequently as every two days. https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable habitats nearby)?	>1	Although waterfowl dispersal was regarded as a possible vector, the urban location of these occurrences [in Ottawa, Ontario and Gatineau, Quebec] suggested to those investigators that the 2003 occurrence most likely resulted from the dumping of home aquaria (Darbyshire and Thomson 2004) https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	through water flow between the organism's locations, cleaning of home aquaria	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no reference of actively attaching	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	In winter, Azolla survives as either sporocarps, which fall to the bottom of water bodies, or as sporophytes that float. https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	A. cristata is able to undergo rapid vegetative reproduction by the elongation and fragmentation of the small fronds.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	has not active dispersal mechanisms	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	fragments can be dispersed by animals between water bodies	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	A. cristata is able to undergo rapid vegetative reproduction throughout the year by the elongation and fragmentation.	Medium
43	7.09	Is dispersal of the taxon density dependent?	No	no reference	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	no reference	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Still or slow moving water of lakes, ponds, and streams.	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	data for taxonomically-related species A. fiiliculoides: https://www.cabi.org/isc/datasheet/8119#topreventionAndControl	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Seasonal flooding can also result in the spread of the organism locally. Still another possibility involves common use of Azolla as a freshwater aquarium plant; when aquarium water is released it may be transported into sewers and waterways (Whitley et al. 1999). https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	High

48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	no evidence	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	no evidence	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Azolla-cristata-FINAL-July2021.pdf	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	professional judgement	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	professional judgement	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	professional judgement	Medium

Statistics	
Scores	
BRA	**33.0**
BRA Outcome	**High**
BRA+CCA	**45.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**24.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*18.0*
B. Biology/Ecology	**9.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*2.0*
6. Reproduction	*-2.0*
7. Dispersal mechanisms	*4.0*
8. Tolerance attributes	*0.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**21**
Environmental	**12**
Species or population nuisance traits	**17**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.53**
BRA	**0.51**
CCA	**0.67**

Date and Time
10/12/2021 12:05:27

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Azolla filiculoides*
Common name	Pacific mosquitofern
Assessor	Mihaela Britvec
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Members of the genus Azolla are utilized throughout the world for a wide variety of purposes besides its widespread uses as an ornamental in fish ponds and tanks (Lumpkin and Plucknett, 1980; 1982). A. filiculoides is used as a green manure in rice paddies, mainly in Asia, as an inhibitor of weed growth in rice cultivation in China and Vietnam (Kröck and Alkämper, 1991), and as an alternative high protein fodder for cattle, swine, poultry and fish, and possibly as an alternative food source for humans, again, mainly in Asia. It has also been used as a nitrate-rich compost which potentially increases soil organic nitrogen levels and cation exchange capacity. It is used for purification of water, removal of heavy metals (Sanyahumbi et al., 1998) and removal of nitrogen and phoshorous from wastewater (Forni et al., 2001). It has also been used variously as an ingredient in soap production, a cure for sore throats and as a control for mosquitoes in southern India as complete mats disrupt larval development (Rajendran and	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Members of the genus Azolla are utilized throughout the world for a wide variety of purposes besides its widespread uses as an ornamental in fish ponds and tanks (Lumpkin and Plucknett, 1980; 1982). A. filiculoides is used as a green manure in rice paddies, mainly in Asia, as an inhibitor of weed growth in rice cultivation in China and Vietnam (Kröck and Alkämper, 1991), and as an alternative high protein fodder for cattle, swine, poultry and fish, and possibly as an alternative food source for humans, again, mainly in Asia. It has also been used as a nitrate-rich compost which potentially increases soil organic nitrogen levels and cation exchange capacity. It is used for purification of water, removal of heavy metals (Sanyahumbi et al., 1998) and removal of nitrogen and phoshorous from wastewater (Forni et al., 2001). It has also been used variously as an ingredient in soap production, a cure for sore throats and as a control for mosquitoes in southern India as complete mats disrupt larval development (Rajendran and	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	It is closely related to Azolla cristata and other species within the genus Azolla (https://www.cabi.org/isc/datasheet/8119#tosimilaritiesToOtherSpeciesOrConditions).	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	A. filiculoides is a small fern native to the Americas which has spread widely throughout the world. Climatic requirements include suitably warm months for sporocarp development, adequate radiation and light intensity for vegetative growth, and adequate amounts of rainfall to prevent its aquatic habitat from drying up. This species of tropical origin is thought to have evolved a cold-tolerant strain since its introduction into Britain (Janes, 1998b) and South Africa (McConnachie, 2003). A. filiculoides may be able to survive temperatures as low as -10ºC before death occurs.	Medium
5	2.02	What is the quality of the climate matching data?	High	doi: 10.1016/j.limno.2014.05.003	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	doi: 10.3391/ai.2016.11.4.04	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	https://www.cabi.org/isc/datasheet/8119#topathwayVectors	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	doi: 10.3391/ai.2016.11.4.04	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	A. filiculoides is native to the Rocky Mountain states of the western USA and Canada, through Central America and to most of South America. It has been introduced to Europe, North and sub-Saharan Africa, China, Japan, New Zealand, Australia, the Caribbean and Hawaii.	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Negatively impacts animal health (https://www.cabi.org/isc/datasheet/8119#toriskAndImpactFactors).	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	It has commonly been utilised as an ornamental in fishponds and tanks and has spread from these foci, exhibiting a weedy phenology in nutrient enriched reservoirs and roadside canals (T. Center, Senior Researcher, Aquatic Weeds, United States Department of Agriculture, personal communication).	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	Damaged ecosystem services, ecosystem change/ habitat alteration	Very high

13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	Primarily, social impacts of A. filiculoides have centred around the reduction of useful water surface area for recreation (fishing, swimming and water skiing) and water transport.	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	Yes	Negatively impacts human health: A. filiculoides, coupled with the lack of light penetration, creates an anaerobic environment which can reduce the quality of drinking water and make survival for other organisms in the water impossible.	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	A. filiculoides, coupled with the lack of light penetration, creates an anaerobic environment which make survival for other organisms in the water impossible.	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	no reference	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Highly adaptable to different environments (https://www.cabi.org/isc/datasheet/8119#toriskAndImpactFactors).	Very high
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	In eutrophic water systems, A. filiculoides grows rapidly, easily outcompeting indigenous vegetation. Decaying root and leaf matter below a mat of A. filiculoides, and the lack of light penetration, creates an anaerobic environment.	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Primarily, social impacts of A. filiculoides have centred around the reduction of useful water surface area for recreation (fishing, swimming and water skiing) and water transport.	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	no reference	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	no reference	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	no reference	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	A. filiculoides in its native areas (South America and western North America) is a plant of slow flowing streams and rivers, ponds and lakes (Reed, 1962; Lumpkin and Plucknett, 1980;	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	In eutrophic water systems, A. filiculoides grows rapidly, easily outcompeting indigenous vegetation. Decaying root and leaf matter below a mat of A. filiculoides, coupled with the lack of light penetration, creates an anaerobic environment which can reduce the quality of drinking water and make survival for other organisms in the water impossible.	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Has propagules that can remain viable for more than one year.	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	Azolla filiculoides is not cornivore.	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	In eutrophic water systems, A. filiculoides grows rapidly, easily outcompeting indigenous vegetation.	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	no evidence	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	has propangules	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	no reference	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	no evidence	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	A. filiculoides grows in association with the heterocystous cyanobacterium (blue-green alga) Anabaena azollae (Nostocales: Nostocaceae), within the dorsal leaf lobe cavities (Ashton and Walmsley, 1984). The alga has the ability to fix atmospheric nitrogen and is able to fulfil the nitrogen requirements of the fern making it successful in nitrogen-deficient waters (Ashton, 1982).	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	has high reproductive potential, has propagules	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	1 months	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	https://www.cabi.org/isc/datasheet/8119#topathwayVectors	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	through water flow between the organism's locations	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no reference of actively attaching	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	has propangules	High

39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	A. filiculoides is able to undergo rapid vegetative reproduction throughout the year by the elongation and fragmentation of the small fronds.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	has not active dispersal mechanisms	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	fragments can be dispersed by animals between water bodies	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	A. filiculoides is able to undergo rapid vegetative reproduction throughout the year by the elongation and fragmentation of the small fronds.	High
43	7.09	Is dispersal of the taxon density dependent?	No	no reference	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	Tolerates fire.	Medium
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	A. filiculoides is a plant of slow flowing streams and rivers, ponds and lakes.	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	https://www.cabi.org/isc/datasheet/8119#topreventionAndControl	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Seasonal flooding can also result in the spread of the organism locally.	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	no evidence	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	No	Host records from around the globe show that the genus Azolla is attacked by generalist herbivores and that very few specialist insect species have evolved on these plants (Hill, 1997). However, four beetle species, the weevils Stenopelmus rufinasus and S. brunneus and the two flea beetles Pseudolampsis guttata and P. darwinii, appear to have specialized on the genus Azolla (Richerson and Grigarick, 1967; Habeck, 1979; Hill, 1999) and were identified as potential biological control agents for A. filiculoides in South Africa (Hill, 1997). Following host range testing, Stenopelmus rufinasus was released in 1997 as a biocontrol of A. filiculoides in South Africa (McConnachie et al.	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	https://doi.org/10.1016/j.sajb.2015.07.017	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	professional judgement	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	professional judgement	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	professional judgement	Medium

Statistics	
Scores	
BRA	**30.0**
BRA Outcome	**High**
BRA+CCA	**42.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**15.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*9.0*
B. Biology/Ecology	**15.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*2.0*
6. Reproduction	*0.0*
7. Dispersal mechanisms	*4.0*
8. Tolerance attributes	*2.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*

2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**15**
Environmental	**10**
Species or population nuisance traits	**22**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.66**
BRA	**0.67**
CCA	**0.63**

Date and Time
09/12/2021 11:38:47

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Cabomba caroliniana*
Common name	Carolina fanwort
Assessor	Tena Radočaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	C. caroliniana is a highly adaptable submersed aquatic macrophyte whose attractive flowers and finely dissected leaves have lead to widespread use and trade in the aquatic industry	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	C. caroliniana is a highly adaptable submersed aquatic macrophyte whose attractive flowers and finely dissected leaves have lead to widespread use and trade in the aquatic industry; aquarium plant (CABI, 2020)	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	no data available	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Low	The similarity of climatic conditions between native areas and the RA area is low (Climatch)	Medium
5	2.02	What is the quality of the climate matching data?	Medium	I used climatch and distribution map of CABI	Low
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	C. caroliniana is not present in the RA area.	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	Aircraft, Aquaculture stock, Machinery and equipment, Ship structures above the water line (CABI, 2020)	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	C. caroliniana is present in Hungary and Serbia (Király, G., Steták, D., & Bányász, Á. (2007). Spread of invasive macrophytes in Hungary. Neobiota, 7, 123-131.) Vukov, D., Jurca, T., Rućando, M., Igić, R., & Miljanović, B. (2013). Cabomba caroliniana A. Gray 1837: A new, alien and potentially invasive species in Serbia. Archives of Biological Sciences, 65(4), 1515-1520.	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	It is a popular aquarium plant native to South America (Brazil, Uruguay, Paraguay, and northeastern Argentina) and, according to some authors, to southeastern United States. It was introduced into the rest of the USA, Canada, Australia, Asia (China, Malaysia, India, Japan), and in many regions of its new range it is considered an invasive and noxious aquatic weed. In Europe, it was found in the United Kingdom (introduced to England), Belgium, the Netherlands, and Hungary. Newly recorded populations in Serbia are restricted to the canals in Bačka. Populations are established only on two localities (Mali Stapar and Odžaci). (Vukov, D., Jurca, T., Rućando, M., Igić, R., & Miljanović, B. (2013). Cabomba caroliniana A. Gray 1837: A new, alien and potentially invasive species in Serbia. Archives of Biological	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	It has a different ecological niche than most other aquatic plants, thus impacting native species (Zhang et al., 2003). C. caroliniana populations are often associated with areas with decreased species diversity (Cao et al., 2006). Hogsden et al. (2007) showed that while native macrophytes could be found in C. caroliniana beds, their abundance was both low and uneven (CABI, 2020)	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	no data available	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	In Queensland, C. caroliniana have been shown to negatively impact water quality. The winter dieback that occurs in harsher areas of its range can cause substantial nutrient release, especially manganese pulses. This sudden manganese release can impact the manganese cycle and impact water quality. Additionally dense stands can cause water loss through seepage and overflow, thus impacting hydrological regimes (Mackey,	Very high
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	In natural systems the plant can cause substantial nuisance to recreational users by impeding navigation, tangling fishing line and wrapping motor propellers. Thick vegetation can also decrease aesthetic value. This species can also reduce swimming access and potentially cause human health safety issues (CABI,	Very high
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	No (CABI, 2020)	Medium
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Smothers and outcompetes native species, and reduces the overall species diversity in aquatic systems (Weibert, C. (2015). Weed Risk Assessment for Cabomba caroliniana A. Gray (Cabombaceae)–Carolina fanwort.)	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	no data available	Low

17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	The plant prefers warm sub-tropical climates with temperatures from 13-27 degrees C (ISSG, 2008), although it can tolerate below freezing temperatures. This species is able to adapt to a wide variety of climates, and can successfully overwinter in areas that are too cold for continuous growth. (Weibert, C. (2015). Weed Risk Assessment for Cabomba caroliniana A. Gray	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	C. caroliniana is an aggressive plant, and in many instances has seriously impacted biodiversity. C. caroliniana has a broader niche than, and may pose a threat to, native species (CABI, 2020)	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	This species can also reduce swimming access and potentially cause human health safety issues. In natural systems the plant can cause substantial nuisance to recreational users by impeding navigation, tangling fishing line and wrapping motor propellers	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	No	Matthews, J., van der Velde, G., Collas, F. P., de Hoop, L., Koopman, K. R., Hendriks, A. J., & Leuven, R. S. (2017). Inconsistencies in the risk classification of alien species and implications for risk assessment in the European Union.	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	Matthews, J., van der Velde, G., Collas, F. P., de Hoop, L., Koopman, K. R., Hendriks, A. J., & Leuven, R. S. (2017). Inconsistencies in the risk classification of alien species and implications for risk assessment in the European Union.	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=402	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	It grows rooted in the mud of stagnant to slow flowing water including streams, and smaller rivers (Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	In Queensland, C. caroliniana have been shown to negatively impact water quality. The winter dieback that occurs in harsher areas of its range can cause substantial nutrient release, especially manganese pulses. This sudden manganese release can impact the manganese cycle and impact water quality. Additionally dense stands can cause water loss through seepage and overflow, thus impacting hydrological regimes (Mackey,	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Király, G., Steták, D., & Bányász, Á. (2007). Spread of invasive macrophytes in Hungary. Neobiota, 7, 123-131.	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	Not applicable	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No data available	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	Not applicable	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=402	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No data available	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	Cabomba can spread locally via vegetative (asexual) or sexual reproduction (Weibert, C. (2015). Weed Risk Assessment for Cabomba caroliniana A. Gray (Cabombaceae)–Carolina fanwort).	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=402	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Global Invasive Species Database (2021) Species profile: Cabomba caroliniana	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=402	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable habitats nearby)?	>1	Interconnected waterways, Humans are the main vectors of dispersal, probably introducing the plant by either intentional water garden plantings or through inappropriate disposal. Additionally, since the plant reproduces via fragmentation, boating activity facilitates the spread of the plant; fragments are frequently observed in lakes with heavy motorboat activit (CABI,	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Interconnected waterways (CABI, 2020)	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	Yes	The spread of the plant increases with boating activity; it has long, trailing stems that become wrapped around boat propellers and consequently is transported within and among water bodies (CABI, 2020)	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=402	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=402	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Not applicable	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	No evidence, but The plant has been reported to be a source of food for water fowl. (CABI, 2020)	Low

42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	boating activity facilitates the spread of the plant (cabi, 2020)	Low
43	7.09	Is dispersal of the taxon density dependent?	Yes	Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=402	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	No evidence	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	Yes	It can grow in water with pH from 5.7-9.2, is highly tolerant of anaerobic conditions and can survive in high alkalinity water (USDA-NRCS, 2008) and/or water with high turbidity. Growth is highest at medium turbidities, but the plant still thrives in high-turbidity water, and moderate-to-high turbidity water facilitates the production of adventitious roots (Mackey, 1996). The plant prefers warm sub-tropical climates with temperatures from 13-27 degrees C (ISSG, 2008), although it can tolerate below freezing temperatures (CABI, 2020)	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	In the north American region herbicide treatments have been used for cabomba control. Endothall provides excellent control but it is a contact herbicide only (Global Invasive Species Database (2021) Species profile: Cabomba caroliniana. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=402)	Medium
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Flooding and other natural disasters (CABI, 2020)	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	No evidence	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	C. caroliniana does serve as a source of food for wildlife. (CABI, 2020)	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	The risks of entry into the RA area by the taxon are likely to no change. (Matthews, J., Beringen, R., Lamers, L. P. M., Odé, B., Pot, R., Velde, G., ... & Leuven, R. S. (2013). Risk analysis of the non-native Fanwort (Cabomba caroliniana) in the Netherlands.)	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	Potential future changes as a result of e.g. a rise in water temperature due to climate change, may i no change the suitability and area of C. caroliniana habitat and establishment (Matthews, J., Beringen, R., Lamers, L. P. M., Odé, B., Pot, R., Velde, G., ... & Leuven, R. S. (2013). Risk analysis of the non-native Fanwort (Cabomba caroliniana) in the Netherlands.)	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Potential future changes as a result of e.g. a rise in water temperature due to climate change, may no change the suitability and area of C. caroliniana habitat and establishment (Matthews, J., Beringen, R., Lamers, L. P. M., Odé, B., Pot, R., Velde, G., ... & Leuven, R. S. (2013). Risk analysis of the non-native Fanwort (Cabomba caroliniana) in the Netherlands.)	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Matthews, J., Beringen, R., Lamers, L. P. M., Odé, B., Pot, R., Velde, G., ... & Leuven, R. S. (2013). Risk analysis of the non-native Fanwort (Cabomba caroliniana) in the Netherlands.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Matthews, J., Beringen, R., Lamers, L. P. M., Odé, B., Pot, R., Velde, G., ... & Leuven, R. S. (2013). Risk analysis of the non-native Fanwort (Cabomba caroliniana) in the Netherlands.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Matthews, J., Beringen, R., Lamers, L. P. M., Odé, B., Pot, R., Velde, G., ... & Leuven, R. S. (2013). Risk analysis of the non-native Fanwort (Cabomba caroliniana) in the Netherlands.	Medium

Statistics	
Scores	
BRA	**23.0**
BRA Outcome	**High**
BRA+CCA	**23.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**10.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*7.0*
B. Biology/Ecology	**13.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*0.0*
6. Reproduction	*3.0*
7. Dispersal mechanisms	*5.0*
8. Tolerance attributes	*0.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*

5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**10**
Environmental	**6**
Species or population nuisance traits	**11**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.48**
BRA	**0.48**
CCA	**0.50**

Date and Time
06/12/2021 20:31:08

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Egeria densa*
Common name	Brazilian waterweed
Assessor	Mihaela Britvec
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	It is a well known and popular plant for use in aquaria and small ponds, not only for its attractiveness and resilience, but also for its oxygenating capacity which benefits the fish contained therein.	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	https://fau.digital.flvc.org/islandora/object/fau%3A33564/datastream/OBJ/view/Culture_of_the_Aquatic_Plant_Egeria_densa_in_a_Closed_System__Final_Report_for_Contract_No__021065__Submitted_to_the_Division_of_Aquaculture__Florida_Department_of_Agriculture_and_Consumer_Services.pdf	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	It is closely related to Elodea species.	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	https://doi.org/10.1016/j.limno.2005.01.001	Medium
5	2.02	What is the quality of the climate matching data?	High	https://doi.org/10.1016/j.limno.2005.01.001	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	doi: 10.23855/preslia.2018.425	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	https://www.cabi.org/isc/datasheet/20491#topathwayVectors	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	doi: 10.1111/j.1365-3180.2012.00926.x	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	E. densa is native to parts of Argentina, Brazil and Uruguay. Being one of the most common plants for aquaria, it has been widely distributed around the world. In many regions it has escaped and has become an invasive aquatic weed. Most reports come from Central and North America, Europe and Australasia.	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	E. densa is an environmental weed not affecting cultivated crops to any extent, though may impact on agriculture by the blockage of irrigation channels.	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	Although there are positive economic impacts resulting in the trade in aquarium plants including E. densa, this is strongly countered by the costs of control as exercised in many areas where it has become a serious problem. Removal of E. densa from lakes and reservoirs in the USA costs some states several million	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	damaged ecosystem services, ecosystem change/ habitat alteration (https://www.cabi.org/isc/datasheet/20491#toriskAndImpactFacto	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	Dense mats of E. densa will deleteriously affect recreational activities such as fishing, swimming or boating.	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	no data	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	E. densa can out-compete and displace native vegetation (https://www.cabi.org/isc/datasheet/20491#toimpactBiodiversity).	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	no reference	Medium
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	E. densa is native to parts of Argentina, Brazil and Uruguay. Being one of the most common plants for aquaria, it has been widely distributed around the world.	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	When dense mats of E. densa have formed, native species are displaced, oxygen may be depleted and the character of stream and lakes may be changed. The effects on the environment may be substantial, affecting the hydrology also.	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	negatively impacts tourism, reduced amenity values, reduced recreative options	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	no reference	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	no reference	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	E. densa formed dense mats.	Medium

23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Still water is prefered, or slow-running water, mild or warm. Cannot tolerate shaded water.	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	When dense mats of E. densa have formed, native species are displaced, oxygen may be depleted and the character of stream and lakes may be changed. The effects on the environment may be substantial, affecting the hydrology also.	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	no reference	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	Egeria densa is not carnovore species.	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	E. densa is a plant with a great capacity of photosynthesizing when illuminated and releases great quantities of oxygen. When dense mats of E. densa have formed, oxygen may be depleted and the character of stream and lakes may be changed.	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	no reference	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	no reference	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	no reference	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	no reference	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	specific habitat: E. densa cannot tolerate shaded water.	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Has high reproductive potential.	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	3 months	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	https://www.cabi.org/isc/datasheet/20491#toriskAndImpactFactors	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	through water flow between the organism’s locations	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no reference of actively attaching	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	Plants can reproduce by seeds.	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	The principal means of reproduction is vegetative, by fragmentation of stems.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Egeria densa has not active dispersal mechanisms.	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	Seeds and fragments can be dispersed by animals between water bodies.	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Has high reproductive potential, Highly mobile locally	High
43	7.09	Is dispersal of the taxon density dependent?	No	no reference	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	no reference	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	cannot tolerate shaded water	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	Mechanical removal such as cutting, hand pulling or netting is feasible for small infestations, though the ability to propagate from small stem fragments means that repeat clearing will be required, or even that infestations may spread if removal is not adequate. Use of the herbicide diquat has been recommended, although using chemicals in water bodies leads to evident environmental risks. The stocking with certain fish such as grass carp has been suggested, as E. densa is highly palatable, but there are no reports as to the effectiveness of this method.	Medium
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Seasonal flooding can also result in the spread of the organism locally.	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	doi: 10.3391/bir.2018.7.4.05	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	no reference	Low
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	professional judgement (E. densa can out-compete and displace native vegetation)	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	professional judgement	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	professional judgement	Low

Statistics	
Scores	
BRA	**36.0**
BRA Outcome	**High**
BRA+CCA	**48.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**20.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*14.0*
B. Biology/Ecology	**16.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*2.0*
6. Reproduction	*-2.0*
7. Dispersal mechanisms	*4.0*
8. Tolerance attributes	*5.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**17**
Environmental	**12**
Species or population nuisance traits	**24**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.57**
BRA	**0.58**
CCA	**0.50**

Date and Time
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AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Elodea canadensis*
Common name	Canadian waterweed
Assessor	Mihaela Britvec
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	https://www.cabi.org/isc/datasheet/20759#touses	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	https://www.cabi.org/isc/datasheet/20759#touses	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	It is closely related to Elodea nuttallii.	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	https://www.cabi.org/isc/datasheet/20759#toclimate	High
5	2.02	What is the quality of the climate matching data?	High	https://www.cabi.org/isc/datasheet/20759#toclimate	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Elodea canadensis originates from North America, concentrated around the St Lawrence Valley and the Great Lakes regions and the Pacific West Coast (Bowmer et al., 1995), but now occurs throughout the USA. The plant was introduced to the UK in the mid-1800s and has spread eastwards through Western Europe with the apparent exception, so far, of Iberia and northern Scandinavia. It is considered an invasive plant in Europe and has been reported as one of the most widespread invasive species in Russia (Vinogradova et al., 2018). E. canadensis is widespread and abundant in New Zealand (Bowmer et al., 1995) and is ranked as a medium risk with a weed potential score of 46 in New Zealand by the Aquatic Weed Risk Assessment Model (AWRM) (Champion et al., 2007). It has become naturalized in water bodies in the south-eastern parts of Australia, particularly in areas near major cities. It is most common in southern and eastern New South Wales, Victoria and Tasmania. It is also recorded from south-eastern South Australia and is sparingly naturalized in south-eastern Queensland (EWA, 2016). It has been recorded in	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	https://www.cabi.org/isc/datasheet/20759#topathwayVectors	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	Hussner, A. (2012). Alien aquatic plant species in European countries. Weed Research, 52 (4), 297-306.	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	https://www.cabi.org/isc/datasheet/20759#todistribution	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	https://www.cabi.org/isc/datasheet/20759#toimpactEconomic	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	information is not avaible	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	https://www.cabi.org/isc/datasheet/20759#toimpactEnvironmental	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	https://www.cabi.org/isc/datasheet/20759#toimpactSocial	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	Yes	Species of Elodea are known to accumulate metals from the sediment and release them into the waterbody.	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	https://www.cabi.org/isc/datasheet/20759#toimpactEnvironmental	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	no reference	Medium

17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Evidence shows that this plant is very adaptable and has can spread under a wide range of conditions and nutrient concentrations ranging from oligotrophic to eutrophic (Cook and Urmi-König 1985; Simpson, 1990). E. canadensis has a wide climatic tolerance (it is present from Alaska to Puerto Rico), though it may be less common at the extremes of its range, being predominant in temperate areas of North America and Europe. In studies of maximum depths at which a number of submerged aquatic plants were found, the maximum recorded for any species was 12-14 m for Elodea (Sheldon and Boylen, 1977; Pip and Simmons, 1986; Wells et al., 1997). Its average height is about 1.2 m, having a maximum height of 2.5 m (Wells et al., 1997). In Europe it can survive in water depths of up to 4 m (McGavigan, 2012) in slow moving water. This species can survive and even grow slowly under ice cover (Bowmer et al., 1995). In North America it has been recorded in neutral to slightly alkaline inland waters and in fresh to slightly brackish coastal waters (Holm et al., 1997). Riis et al. (2012), compared the effects of temperature and light availability on the growth and morphology of E. canadensis, Egeria densa and Lagarosiphon major and suggested that, in general, subject to variations due to timing of introductions, E. densa will dominate warmer, shallower waters, L. major will dominate in colder, clear-water lakes, whilst E. canadensis will continue its role as a pioneer species which is rapidly replaced by the two taller species after their arrival. Elodea canadensis prefers clean water with a current from 0 to 1 m/s. Optimum water temperatures range from 10 to 20°C, and silty water or water with organic sediment is preferred to a sandy substrate (Bowmer et al., 1995, Barrat-Segretain et al., 2002). The habitat preference of E. canadensis in lakes is towards large and deep lakes located at high altitudes, with long water-retention times and high water quality (Kolada and Kutyła 2016). E. canadensis exhibits positive growth under experimental conditions of high-salt concentrations (Stoler et al., 2018). Consequently,	Very high
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	https://doi.org/10.1899/03-097.1	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Elodea canadensis can form large and dense stands that interfere with boating, fishing and thereby adversely affect recreation activities (McGavigan, 2017). It makes it difficult for boats to travel through invaded waterways (Bowmer et. al., 1995) reduces recreational opportunities and diminishes aesthetics for the environment (Josefsson and Andersson, 2001).	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	doi: 10.1111/j.1600-0587.2013.00296.x	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	doi: 10.1111/j.1600-0587.2013.00296.x	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Elodea canadensis is dioecious and male plants are less common than female in its native range. Only female plants are currently found in Europe, and male plants have not been reported since 1903 (Cook and Urmi-König, 1985), so reproduction is only vegetative, involving vegetative fragments and turions (overwintering buds). Very small plant fragments are able to form roots from nodes and start growing (McGavigan, 2017). The main growing season is between mid-April and October. Plants die back in Autumn. Turions or short, densely-leaved resistant stems, develop then break off to float around the water body before they sink to the bottom over winter, where they rest until they re-grow in spring (Millane and Caffrey, 2014). Over-wintering buds and fragments of the brittle branches are easily detached by waves, currents, foraging animals and boat traffic. New roots develop quickly on the nodes of these fragments which are carried downstream to form new stands. This method of propagation gives E. canadensis a considerable advantage over annual species and resulted in its rapid spread throughout Europe following its	High
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Elodea canadensis prefers clean water with a current from 0 to 1 m/s.	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	https://www.cabi.org/isc/datasheet/20759#toriskAndImpactFactors	High

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Elodea canadensis is dioecious and male plants are less common than female in its native range. Only female plants are currently found in Europe, and male plants have not been reported since 1903 (Cook and Urmi-König, 1985), so reproduction is only vegetative, involving vegetative fragments and turions (overwintering buds). Very small plant fragments are able to form roots from nodes and start growing (McGavigan, 2017). The main growing season is between mid-April and October. Plants die back in Autumn. Turions or short, densely-leaved resistant stems, develop then break off to float around the water body before they sink to the bottom over winter, where they rest until they re-grow in spring (Millane and Caffrey, 2014). Over-wintering buds and fragments of the brittle branches are easily detached by waves, currents, foraging animals and boat traffic. New roots develop quickly on the nodes of these fragments which are carried downstream to form new stands. This method of propagation gives E. canadensis a considerable advantage over annual species and resulted in its rapid spread throughout Europe following its	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	E. canadensis is not carnivore species.	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	https://www.cabi.org/isc/datasheet/20759#toriskAndImpactFactors	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	no reference	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	https://www.cabi.org/isc/datasheet/20759#toriskAndImpactFactors	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	no reference	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	no reference	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	no reference	Medium
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Elodea canadensis is dioecious and male plants are less common than female in its native range. Only female plants are currently found in Europe, and male plants have not been reported since 1903 (Cook and Urmi-König, 1985), so reproduction is only vegetative, involving vegetative fragments and turions (overwintering buds). Very small plant fragments are able to form roots from nodes and start growing (McGavigan, 2017). The main growing season is between mid-April and October. Plants die back in Autumn. Turions or short, densely-leaved resistant stems, develop then break off to float around the water body before they sink to the bottom over winter, where they rest until they re-grow in spring (Millane and Caffrey, 2014). Over-wintering buds and fragments of the brittle branches are easily detached by waves, currents, foraging animals and boat traffic. New roots develop quickly on the nodes of these fragments which are carried downstream to form new stands. This method of propagation gives E. canadensis a considerable advantage over annual species and resulted in its rapid spread throughout Europe following its	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	3 months	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	https://www.cabi.org/isc/datasheet/20759#topathwayVectors	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	reduced native biodiversity, threat to/ loss of endangered species	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no reference of acitively attaching	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Elodea canadensis is dioecious and male plants are less common than female in its native range. Only female plants are currently found in Europe, and male plants have not been reported since 1903 (Cook and Urmi-König, 1985), so reproduction is only vegetative, involving vegetative fragments and turions	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Elodea canadensis is dioecious and male plants are less common than female in its native range. Only female plants are currently found in Europe, and male plants have not been reported since 1903 (Cook and Urmi-König, 1985), so reproduction is only vegetative, involving vegetative fragments and turions	Very high
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	E. canadensis has not active dispersal mechanisms.	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	Over-wintering buds and fragments of the brittle branches are easily detached by waves, currents, foraging animals and boat	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be rapid?	Yes	Over-wintering buds and fragments of the brittle branches are easily detached by waves, currents, foraging animals and boat traffic. New roots develop quickly on the nodes of these fragments which are carried downstream to form new stands. This method of propagation gives E. canadensis a considerable advantage over annual species and resulted in its rapid spread.	High
43	7.09	Is dispersal of the taxon density dependent?	No	no reference	Medium
8. Tolerance attributes					

44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	This species can survive and even grow slowly under ice cover (Bowmer et al., 1995).	Medium
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	https://www.cabi.org/isc/datasheet/20759#towaterTolerances	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	https://www.cabi.org/isc/datasheet/20759#topreventionAndControl	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Seasonal flooding can also result in the spread of the organism locally (Barrat-Segretain and Elger, 2004).	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	E. canadensis exhibits positive growth under experimental conditions of high-salt concentrations (Stoler et al., 2018). Consequently, salt marshes and brackish waters are likely to be invaded by this species if salt concentration is lower than to 3 g/l of salt (Thouvenot and Thiébaut, 2018).	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	Control by aquatic herbivores has been investigated in numerous countries (National Academy of Sciences, 1976). Species tested include Tilapia melanopleura, T. mossambica and the Chinese grass carp Ctenopharyngodon idella. Since the latter is an exotic species, introduction is only allowed when the species can be confined to a particular waterbody and, therefore, investment in fences is a prerequisite. Nevertheless, several successful examples of control are known from Western Europe and the USA (Stott et al. 1971; Willey et al., 1974; Mitzner, 1978; Fowler, 1984) and more recent experiments have found medium efficiency in the use of stocking grass carps (Bonar et al., 2002, Pípalová, 2006). There are some disadvantages in using grass carp, as these fish are generalist feeders and may also damage native plant species (see Vernon and Hamilton, 2011 for further	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	doi: 10.3897/neobiota.49.34318	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	doi: 10.3897/neobiota.49.34318	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	professional judgement	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	professional judgement	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	professional judgement	Medium

Statistics	
Scores	
BRA	**39.0**
BRA Outcome	**High**
BRA+CCA	**51.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**20.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*14.0*
B. Biology/Ecology	**19.0**
4. Undesirable (or persistence) traits	*9.0*
5. Resource exploitation	*2.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*5.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**

9. Climate change	*6*
Sectors affected	
Commercial	**17**
Environmental	**12**
Species or population nuisance traits	**27**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.68**
BRA	**0.68**
CCA	**0.63**

Date and Time
08/12/2021 08:26:31

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Elodea nuttallii*
Common name	western waterweed
Assessor	Mihaela Britvec
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	E. nuttallii is used in cool water aquariums. Elodea species are often a preferred food for waterfowl or crayfish (Lodge, 1991; van Donk and Otte, 1996), and can also be used as shelter for small fishes and aquatic invertebrates.	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Elodea species are often a preferred food for waterfowl or crayfish (Lodge, 1991; van Donk and Otte, 1996), and can also be used as shelter for small fishes and aquatic invertebrates. E. nuttallii is used in cool water aquariums.	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	It is closely related to Elodea canadensis and Egereia densa. https://www.cabi.org/isc/datasheet/20761#tosimilaritiesToOtherSpeciesOrConditions	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	https://www.cabi.org/isc/datasheet/20761#toclimate	High
5	2.02	What is the quality of the climate matching data?	Medium	https://www.cabi.org/isc/datasheet/20761#toclimate	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Hussner, A. (2012). Alien aquatic plant species in European countries. Weed Research, 52 (4), 297-306.	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	https://www.cabi.org/isc/datasheet/20761#topathwayCauses	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	Hussner, A. (2012). Alien aquatic plant species in European countries. Weed Research, 52 (4), 297-306.	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	E. nuttallii is native to temperate North America common throughout most of the USA and south Canada and has a similar distribution to E. canadensis (eFloras, 2009; USDA-ARS, 2009; USDA-NRCS, 2009). In its non-native distribution, it is found in central and western Europe and Japan (Cook and Urmi-König,	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	no reference	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	negatively impacts aquaculture (https://www.cabi.org/isc/datasheet/20761#toriskAndImpactFactors)	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	damaged ecosystem services, ecosystem change (https://www.cabi.org/isc/datasheet/20761#toriskAndImpactFactors)	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	It is a submerged plant, and just like E. canadensis it forms large and dense stands that interfere with boating, fishing and adversely affect recreation activities.	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	Yes	Species of Elodea are known to accumulate metals from the sediment and release them into the waterbody.	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	It often forms dense, monospecific stands and displaces other aquatic plants from many localities (Simpson, 1984, 1990; Barrat-Segretain, 2005). Threat to/ loss of native species (https://www.cabi.org/isc/datasheet/20761#toriskAndImpactFactors).	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	no reference	Medium
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Waterweeds are competitive and well adapted to a broad array of environmental conditions (Cook and Urmi-König, 1985; Simpson, 1990).	Very high
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	The spread of E. nuttallii has resulted in displacement of E. canadensis (itself an invasive alien from N. America) from many localities where the latter had previously become well established in Europe (Simpson, 1990; Thiébaut et al., 1997; Barrat-Segretain, 2001; Larson, 2007). E. nuttallii is itself being replaced by Lagarosiphon major. Where it establishes it can form exceptionally dense monocultures, excluding native species	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	E. nuttallii have the potential to develop into dense submerged beds, which prevent the use of water for recreational and professional purposes (Larson, 2003), navigation and port infrastructure (CPS-SKEW, 2008). The plant can also clog and impede drainage waterways.	Very high

20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	doi: 10.1111/j.1600-0587.2013.00296.x	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	doi: 10.1111/j.1600-0587.2013.00296.x	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Introduced E. nuttallii exposed to environmental stresses show great phenotypic plasticity variations with increasing water nutrient enrichment and increases in leaf area with decreases in internode length, while the shorter broad-leaved phenotype typically occurs in shallow streams, whereas the longer spacer narrow-leaved phenotype occurs in lakes. Larger leaf width and higher number of lateral shoots - when nutrients are not limiting - may enhance plant performance (Simpson, 1988; Vanderpoorten	High
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	E. nuttallii has been found growing in a wide range of water bodies, in general in quiet water such as shorelines of lakes, reservoirs and ponds, along rivers and streams, and also in wetlands, canals and ditches (Hickman, 1993). In England, it has been recorded in lowland habitats only (Preston and Croft, 1997).	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Modification of nutrient regime (https://www.cabi.org/isc/datasheet/20761#toriskAndImpactFactors).	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Vegetative reproduction seems to be the dominant method of propagation - essentially by fragmentation and division of the stems and the production of winter buds from stem tips (Preston and Croft, 1997). It has been observed that, when introduced to a new habitat, the establishment of Elodea buds is rapid, since the propagules sink into the sediment and grow rapidly (Barrat-	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	E. nuttallii is not carnivore species.	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Iit can form exceptionally dense monocultures, excluding native species through competition.https://www.cabi.org/isc/datasheet/20761#tosummaryOfInvasiveness	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	no reference	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Vegetative reproduction seems to be the dominant method of propagation - essentially by fragmentation and division of the stems and the production of winter buds from stem tips (Preston and Croft, 1997).	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	no reference	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	no reference	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	no reference	Medium
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Vegetative reproduction seems to be the dominant method of propagation - essentially by fragmentation and division of the stems and the production of winter buds from stem tips (Preston and Croft, 1997). It has been observed that, when introduced to a new habitat, the establishment of Elodea buds is rapid, since the propagules sink into the sediment and grow rapidly (Barrat-	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	3 months	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	https://www.cabi.org/isc/datasheet/20761#topathwayCauses, https://www.cabi.org/isc/datasheet/20761#topathwayVectors	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	through water flow between the organism’s locations	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no reference of acitively attaching	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Vegetative reproduction seems to be the dominant method of propagation - essentially by fragmentation and division of the stems and the production of winter buds from stem tips.	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Vegetative reproduction seems to be the dominant method of propagation - essentially by fragmentation.	Very high
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	E. nuttallii has not active dispersal mechanisms.	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	Several traits of the species are typical of successful invaders: rapid growth, vegetative reproduction through fragments and easily dispersed by waterfowl .	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	fast growing, has high reproductive potential, reproduces asexually	High
43	7.09	Is dispersal of the taxon density dependent?	No	no reference	Medium
8. Tolerance attributes					

44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	Tolerates fire, for example.	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	Yes	Waterweeds are competitive and well adapted to a broad array of environmental conditions (Cook and Urmi-König, 1985; Simpson, 1990). E. nuttallii is able to grow in turbid, highly eutrophic waters (Cook and Urmi-König, 1985; Ozimek et al., 1993; Thiébaut and Muller, 1999), as well as in clear oligo-mesotrophic waters (Thiébaut et al., 1997; Barrat-Segretain, 2001; Nagasaka, 2004) with a certain degree of organic pollution (Best et al., 1996). Growth of E. nuttallii is stimulated by fertilization with nitrogen and benefits from an excess of ammonia (Dendène et al., 1993). It can occur to depths of 3 m (Simpson, 1990) and 5 m (Ikusima, 1984) where it develops into dense pure stands, but it is most frequently found in shallow water. Optimum pH has been found to be between 7 and 9 (Jones et al., 1993). It is tolerant of disturbance, oil pollution and is typically found in calcareous water, from fresh to slightly brackish coastal water (St John, 1965) up to 14 ppt salinity, and in fine sediment soil, where it is	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	https://www.cabi.org/isc/datasheet/20761#topreventionAndControl	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Seasonal flooding can also result in the spread of the organism locally.	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	highly adaptable to different environments, habitat generalist	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	no reference	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement (E. nuttallii is highly adaptable to different environments).	Very high
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	professional judgement	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	professional judgement (https://www.cabi.org/isc/datasheet/20761#toriskAndImpactFactors)	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	professional judgement (negatively impacts aquaculture/fisheries, negatively impacts tourism, reduced amenity values, reduced native biodiversity, damaged ecosystem services, ecosystem change/ habitat alteration, infrastructure damage, modification of	Medium

Statistics	
Scores	
BRA	**41.0**
BRA Outcome	**High**
BRA+CCA	**53.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**20.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*14.0*
B. Biology/Ecology	**21.0**
4. Undesirable (or persistence) traits	*9.0*
5. Resource exploitation	*2.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*7.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	

Commercial	**17**
Environmental	**12**
Species or population nuisance traits	**29**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.68**
BRA	**0.67**
CCA	**0.75**

Date and Time
08/12/2021 08:25:45

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Gymnocoronis spilanthoides*
Common name	Senegal tea plant
Assessor	Marina Piria
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	https://www.cabi.org/isc/datasheet/26246#topathwayCauses	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	No	https://www.cabi.org/isc/datasheet/26246#topathwayCauses	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	native to Peru, N Argentina, Bolivia, Paraguay, Uruguay and S Brazil. Climatch used and with the most of regions climatic conditions matches	Medium
5	2.02	What is the quality of the climate matching data?	High	Climatch	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	Escape, flooding, pet trade https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Hungary, Italy https://www.cabi.org/isc/datasheet/26246#toidentity	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	In Hungary from 1988; New Zealand from 1980s https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	Gymnocoronis spilanthoides forms large and dense populations but only in habitats modified by human activities, https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	Recreational activities, irrigation and navigation may also be affected. https://www.cabi.org/isc/datasheet/26246#toidentity	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	https://www.cabi.org/isc/datasheet/26246#toidentity	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	Yes	https://www.cabi.org/isc/datasheet/26246#toidentity	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	https://www.cabi.org/isc/datasheet/26246#toidentity	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	High
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	5.5-8 pH https://www.cabi.org/isc/datasheet/26246#toidentity	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	https://www.cabi.org/isc/datasheet/26246#toidentity	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	grow 15 cm per week up to 1.5m high https://www.cabi.org/isc/datasheet/26246#toidentity	High

23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	It can invade and degrade natural wetlands, competing strongly with slower growing native plants and affecting wetland birds and other animals depend upon them. Native species can also be submerged causing death.	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Medium
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	https://www.cabi.org/isc/datasheet/26246#toidentity	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	can reproduce by seeds and vegetatively from stem fragments https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	https://www.cabi.org/isc/datasheet/26246#toidentity	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	water, flodding,pet trade https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Personal opinion	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	https://www.cabi.org/isc/datasheet/26246#toidentity	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	https://www.cabi.org/isc/datasheet/26246#toidentity	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
43	7.09	Is dispersal of the taxon density dependent?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	Low pH and persistant to chemicals https://www.cabi.org/isc/datasheet/26246#toidentity	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	G. spilanthoidesis very hard to kill and herbicides are effective only on the upper parts of the plant, as submerged parts are not killed and can regrow. Following repeated efforts, glyphosate has proven to be ineffective in south Queensland, and it shows some resistance to the most commonly approved aquatic herbicides https://www.cabi.org/isc/datasheet/26246#toidentity	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Gymnocoronis spilanthoides forms large and dense populations but only in habitats modified by human activities. https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	cannot tolerate saline or brackish water. https://www.cabi.org/isc/datasheet/26246#toidentity	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	https://www.cabi.org/isc/datasheet/26246#toidentity	Low
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	neotropical species https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-	Very high
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	Very high
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	https://bioone.org/journals/willdenowia/volume-46/issue-2/wi.46.46208/Gymnocoronis-spilanthoides-Asteraceae-Eupatorieae-a-new-naturalized-and-potentially-invasive/10.3372/wi.46.46208.full	Very high

Statistics	
Scores	
BRA	**28.0**
BRA Outcome	**High**
BRA+CCA	**40.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**11.0**
1. Domestication/Cultivation	*0.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*10.0*
B. Biology/Ecology	**17.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*0.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*3.0*
8. Tolerance attributes	*4.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**9**
Environmental	**11**
Species or population nuisance traits	**23**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.68**
BRA	**0.65**
CCA	**0.92**

Date and Time
23/11/2021 17:04:10

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Hygrophila polysperma*
Common name	Indian swampweed
Assessor	Marina Piria
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Aquarium plant https://www.cabi.org/isc/datasheet/28135	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	for aquarium purposes https://www.cabi.org/isc/datasheet/28135	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Eleven of the taxa characterised as high risk (Cyperus papyrus, C. sp., Hygrophila difformis, H. balsamica, H. corymbosa, H. sp., Microsorum pteropus, Spathiphyllum sp., Taxiphyllum barbieri, Teucrium scordium and Typha minima) should be restricted from use. If these taxa are not restricted, based on their establishment and dispersal characteristics, they have a high risk of becoming invasive. https://onlinelibrary.wiley.com/doi/full/10.1111/wre.12135?casa_token=7GBeRf6xub0AAAAA%3A2bED9v6GI1xdJqlX3U38rTvqRIcNOg	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Mediterranean climate matches with India, Bangladesh using climatch	Low
5	2.02	What is the quality of the climate matching data?	Medium	climatch tolerate Cs - Warm temperate climate with dry summer - which is present in Adriatic basin	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	Not in RA area; H. polysperma has recently been reported in Europe for the first time, where plants were found in North Rhine-Westphalia, Germany and Hungary https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	biofouling, water, mail, debris https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	has recently been reported in Europe for the first time, where plants were found in North Rhine-Westphalia and Hungary	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Germany, USA https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	H. polysperma reduces biodiversity by competing with and displacing native vegetation, and is capable of changing the fauna and flora of an ecosystem. H. polysperma can form dense monocultures which exclude all native plants and do not provide habitat or food for wildlife. H. polysperma is an excellent competitor due to its low light compensation and saturation points, which allow it to start growing in low light conditions before other native plants do. H. polysperma is also able to rapidly change resource acquisition in response to changing environmental conditions, allowing it to outcompete many other species (Spencer and Bowes, 1985). Decomposing mats of H. polysperma also have the ability to cause fish kills by creating low	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	Negatively impacts aquaculture/fisheries, dense populations; H. polysperma has limited water flow in irrigations channels and flood-control systems (UFL-IFAS, 2005). H. polysperma is also reported as being a threat to rice fields (Krombholz, 1996). CABI	Very high
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	unsightly mats of vegetation decrease aesthetic values. These declines in recreational and aesthetic values can decrease tourism, which can be a major source of livelihood within the community.	Very high
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	H. polysperma can form dense mats that impede recreational activities such as boating, fishing, swimming, water skiing, canoeing, and kayaking. Herbicides typically used in controlling H. polysperma are estimated at costing between US$988 to US$1482 per hectare (US $400 to US $600 per acre), and total costs are even higher when labour and equipment are included (Cuda and Sutton, 2000). In an extreme case involving the use of fluridone in flowing water, control was achieved for a period of 20 months at a cost of US $34,580 per hectare (Sutton, 1996).	Very high
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	Very high

17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Low oxygen conditions https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	Very high
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	Not evidences https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No information https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	up to 3 m high https://www.cabi.org/isc/datasheet/28135#totaxonomicTree	High
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	H. polysperma can grow submersed in water up to 3m (10 ft) deep and as an immersed plant along banks, preferring flowing waters, but also found growing in slow-moving systems such as lakes, marshes, canals, rivers, swamps, wetlands, and irrigation ditches (FNW Disseminules, 2007).	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	reduces level of oxygen	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	probably yes https://www.cabi.org/isc/datasheet/28135#tohabitat	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	https://www.cabi.org/isc/datasheet/28135#tohabitat	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	https://www.cabi.org/isc/datasheet/28135#tohabitat	Medium
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	https://www.cabi.org/isc/datasheet/28135#tohabitat	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	https://www.cabi.org/isc/datasheet/28135#tohabitat	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No data	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	asexual reproduction https://www.cabi.org/isc/datasheet/28135#tohabitat	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	https://www.cabi.org/isc/datasheet/28135#tohabitat	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	inFlorida high spore production https://www.cabi.org/isc/datasheet/28135#tohabitat	Medium
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	1 year https://www.cabi.org/isc/datasheet/28135#tohabitat	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	water, pet trade, biofouling https://www.cabi.org/isc/datasheet/28135#tohabitat	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	Not yet present	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	Yes	https://www.cabi.org/isc/datasheet/28135#tohabitat	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	https://www.cabi.org/isc/datasheet/109069	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	https://www.cabi.org/isc/datasheet/109069	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	it is not migratory species	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	H. polysperma can be transported with wildlife and carried to new locations (DCR, 2003).	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Has high reproductive potential, Has propagules that can remain viable for more than one year	High
43	7.09	Is dispersal of the taxon density dependent?	No	It is not density dependent	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	Has propagules that can remain viable for more than one year	High

45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	Yes	. polysperma is an excellent competitor due to its low light compensation and saturation points, which allow it to start growing in low light conditions before other native plants do. H. polysperma is also able to rapidly change resource acquisition in response to changing environmental conditions, allowing it to outcompete many other species (Spencer and Bowes, 1985). Decomposing mats of H. polysperma also have the ability to cause fish kills by creating low oxygen levels in the water (DCR, 2003).	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	Herbicides typically used in controlling H. polysperma are estimated at costing between US$988 to US$1482 per hectare (US $400 to US $600 per acre), and total costs are even higher when labour and equipment are included (Cuda and Sutton, 2000). In an extreme case involving the use of fluridone in flowing water, control was achieved for a period of 20 months at a cost of US $34,580 per hectare (Sutton, 1996).	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	https://www.cabi.org/isc/datasheet/28135#tohabitat	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	No data, but probably can't	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	Introduced grass carp can control it http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1059.7979&rep=rep1&type=pdf ; https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1095-8649.1981.tb02809.x	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	Prefered climate is worm temperate climate and tropical wet and dry, so with increased temp. black sea basin can become more appropriate	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	The optimum temperature for H. polysperma is 22-28°C (71-82°F), with a minimum temperature of 4°C (39°F), and maximum temperature of 30°C (	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	https://www.cabi.org/isc/datasheet/28135#tohabitat	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	H. polysperma reduces biodiversity by competing with and displacing native vegetation, and is capable of changing the fauna and flora of an ecosystem. H. polysperma can form dense monocultures which exclude all native plants and do not provide habitat or food for wildlife.;	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	The dense stands and mats of vegetation that are characteristic of this species when introduced outside of its native range can decrease the oxygen levels by limiting water circulation and increased decomposition of dead plants. Damaged ecosystem	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	CABI	Medium

Statistics	
Scores	
BRA	**35.5**
BRA Outcome	**High**
BRA+CCA	**47.5**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**18.5**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*13.5*
B. Biology/Ecology	**17.0**
4. Undesirable (or persistence) traits	*8.0*
5. Resource exploitation	*2.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*5.0*
8. Tolerance attributes	*-2.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**17**
Environmental	**10**
Species or population nuisance traits	**24**

Thresholds	
BRA	22.75
BRA+CCA	22.75
Confidence	
BRA+CCA	0.72
BRA	0.73
CCA	0.63

Date and Time
23/11/2021 17:04:53

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Lemna aequinoctialis*
Common name	lesser duckweed
Assessor	Marina Piria
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Lemna aequinoctialis has been introduced to temperate areas in Europe, central North America, northern China and Japan through rice cultivation, as fish food and for ornamental purposes (Bengtsson et al., 1999; Ryman and Anderberg, 1999). I	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Lemna aequinoctialis has been introduced to temperate areas in Europe, central North America, northern China and Japan through rice cultivation, as fish food and for ornamental purposes (Bengtsson et al., 1999; Ryman and Anderberg, 1999). I	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Lemna minuta https://www.cabi.org/isc/datasheet/108968	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Preferred climate Cs - Warm temperate climate with dry summer similar as RA	Low
5	2.02	What is the quality of the climate matching data?	High	Climatch	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	https://www.cabi.org/isc/datasheet/121132#tosimilaritiesToOtherSpeciesOrConditions	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	Aquaculture, debris, animals, https://www.cabi.org/isc/datasheet/121132#topathwayVectors	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Hungary aturalized https://www.cabi.org/isc/datasheet/121132#tointroductions	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Germany, Hungary https://www.cabi.org/isc/datasheet/121132#38a70df6-0555-43c1-9d8d-fd2304676293	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	L. aequinoctialis is one of the species that restricts the proper functioning of ponds, and contributes to eutrophication (Sengupta et al., 2010). Generally, invasive aquatic plants can affect microinvertebrate communities (Lukács et al., 2016).	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	L. aequinoctialis is one of the species that restricts the proper functioning of ponds, and contributes to eutrophication (Sengupta et al., 2010).	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	amenities https://www.cabi.org/isc/datasheet/121132#38a70df6-0555-43c1-9d8d-fd2304676293	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	can impact human activities such as boating, swimming and hydroelectric power plants (Hussner et al., 2010).	Very high
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	The species is useful as an indicator of phytotoxic contaminants in irrigation water in urbanized areas (Bengtsson et al., 1999). It is a good food source for humans and livestock due to its high protein content and high digestibility (Leng et al., 1995; Appenroth et al., 2017).	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Dense aggregations of duckweeds in eutrophic waters can reduce light penetration and pond aeration causing anoxia and fish death (Bengtsson et al., 1999)	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	https://www.cabi.org/isc/datasheet/121132#38a70df6-0555-43c1-9d8d-fd2304676293	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	It will tolerate temperatures from 6 to 33°C and pH from 3.2 to 9; optimal growth occurs at 20-28°C and pH 6.5-7.5. A minimum water depth of 0.30 m is desirable and levels of 60 mg/l of soluble nitrogen and 1 mg/l of phosphorus are required for normal growth (Gherardi, 2007). It grows abundantly at high phosphorus and chlorophyll a concentrations (Mukhopadhyay and Dewanji, 2005). Cs - Warm temperate climate with dry summer Preferred Warm average temp. > 10°C, Cold average temp. > 0°C, dry summers	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	the submerged vegetation is reduced when L. aequinoctialis cover is higher than 40% (Sengupta et al., 2010). Dense aggregations of duckweeds in eutrophic waters can reduce light penetration and pond aeration causing anoxia and fish death (Bengtsson et al., 1999). Generally, invasive aquatic plants can affect microinvertebrate communities (Lukács et al., 2016).	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	nvasive aquatic plants can impact human activities such as boating, swimming and hydroelectric power plants (Hussner et al.,	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	Nodata https://www.cabi.org/isc/datasheet/121132#38a70df6-0555-43c1-9d8d-fd2304676293	Low

21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No datahttps://www.cabi.org/isc/datasheet/121132#38a70df6-0555-43c1-9d8d-fd2304676293	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	a tiny free-floating aquatic plan	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	can be found in mesotrophic to eutrophic lentic waters of lakes, pools, ponds, rice fields and ditches and warm-temperate to tropical climates from sea level to 2800 m (Landolt, 1992; Beentje and Lansdown, 2018; Flora of China Editorial Committee, 2017).	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Dense aggregations of duckweeds in eutrophic waters can reduce light penetration and pond aeration causing anoxia and fish death (Bengtsson et al., 1999).	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	the species has a high reproductive capability that is advantageous in eutrophic lentic water (Appenroth et al., 2013).	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	https://www.cabi.org/isc/datasheet/121132#tohabitat	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	https://www.cabi.org/isc/datasheet/121132#tohabitat	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	https://www.cabi.org/isc/datasheet/121132#tohabitat	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	https://www.cabi.org/isc/datasheet/121132#tohabitat	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Vegetative reproduction occurs but natural hybridization is likely possible https://link.springer.com/article/10.1007/s00425-014-	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	reproduces vegetatively by plant buds	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	https://www.cabi.org/isc/datasheet/121132#tobiologyAndEcology	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	https://www.cabi.org/isc/datasheet/121132#tobiologyAndEcology	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	https://www.cabi.org/isc/datasheet/121132#tobiologyAndEcology	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	water, debris, birds and ducks, aquaculture https://www.cabi.org/isc/datasheet/121132#tobiologyAndEcology	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	It is not yet present in captivity of RA	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	it is floating plant	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	may be introduced to new water areas by slow-moving water along interconnected watercourses and by floods (Hicks, 1937).	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	may be introduced to new water areas by slow-moving water along interconnected watercourses and by floods (Hicks, 1937).	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	it is not migratory species	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	Lemna species can be distributed by birds, fish and mammals over short distances (Hicks, 1937; Flora of North America Editorial Committee, 2017).	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Duckweeds may be introduced to new water areas by slow-moving water along interconnected watercourses and by floods (Hicks, 1937).	Very high
43	7.09	Is dispersal of the taxon density dependent?	No	https://www.cabi.org/isc/datasheet/121132#tomeansOfMovementAndDispersal	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	seeds probably yes	Medium
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	can be found in mesotrophic to eutrophic lentic waters of lakes, pools, ponds, rice fields and ditches and warm-temperate to tropical climates from sea level to 2800 m	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	allowed pesticides; Physical/Mechanical Control -Lemna species can be removed mechanically from invaded waterways (Centre for Ecology & Hydrology, 2004).; Biological Control - Lemna species in general can be controlled by herbivorous fish such as grass carp (Centre for Ecology & Hydrology, 2004).Problem in mediterranean are endemic fish, pesticides not recommended and lack of herbivoreous fish.	Medium
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	In mediterranean region yes particularly after hydropover plant instalation in still water.	High

48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Can tolerate but not clear if can persist in brackish water https://link.springer.com/article/10.1007/s00425-015-2264-x	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	introduced herbivoreouus are present	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	Environmental requirements limit its spread into temperate areas (Crawford et al., 2001), but climate change could potentially expand the range of distribution.Vélez-Gavilán J, 2017. Lemna aequinoctialis (lesser duckweed). Invasive Species Compendium. Wallingford, UK: CABI. DOI:10.1079/ISC.121132.20203483098	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	Environmental requirements limit its spread into temperate areas (Crawford et al., 2001), but climate change could potentially expand the range of distribution. Establishment likely will increase in RA	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	Environmental requirements limit its spread into temperate areas (Crawford et al., 2001), but climate change could potentially expand the range of distribution.	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	Environmental requirements limit its spread into temperate areas (Crawford et al., 2001), but climate change could potentially expand the range of distribution.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	Environmental requirements limit its spread into temperate areas (Crawford et al., 2001), but climate change could potentially expand the range of distribution.	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	Environmental requirements limit its spread into temperate areas (Crawford et al., 2001), but climate change could potentially expand the range of distribution.Preferred climate is Cs - Warm temperate climate with dry summer which in Danube basin can appear with global warming	High

Statistics	
Scores	
BRA	**40.0**
BRA Outcome	**High**
BRA+CCA	**52.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**23.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*18.0*
B. Biology/Ecology	**17.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*0.0*
6. Reproduction	*6.0*
7. Dispersal mechanisms	*3.0*
8. Tolerance attributes	*2.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**20**
Environmental	**11**
Species or population nuisance traits	**24**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.72**
BRA	**0.72**
CCA	**0.71**

Date and Time
23/11/2021 17:05:45

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Lemna minuta*
Common name	least duckweed
Assessor	Marina Piria
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	reared in garden ponds and escaped https://www.cabi.org/isc/datasheet/108968#todescription	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	for garden ponds https://www.cabi.org/isc/datasheet/108968#todescription	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Lemna aequinocitalis, L. turionifera https://www.tandfonline.com/doi/full/10.1080/11263504.2014.987846	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	This is cosmopilitan species native of temperate and subtropical areas of North and South America. From South America extending through to Central America and West Indies extended northward along the high mountains to Mexico and California (Flora of North America, 2008; Armstrong, 2009). Very common throughout the southeastern and southwestern United States (USDA-ARS, 2009) with some scarce distribution in the centre of the country (Flora of North America, 2008). Larson and Searcy (2007) reported its presence in Massachussetts recently (2005). The species has been introduced in western Europe and Japan (Landolt, 1986; Reveal, 1990) and may well be expected to be discovered elsewhere (Reveal, 1990) because it is almost certainly under-recorded, due its similarity with L. minor (Preston and Croft, 1997)	Medium
5	2.02	What is the quality of the climate matching data?	Medium	It occurs in temperate to subtropical regions with relatively mild winters (Flora of North America, 2008) and prefers a Mediterranean climate (Landolt, 1986) with high water	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	https://www.cabi.org/isc/datasheet/108968#todescription	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	water, wind, pet trade https://www.cabi.org/isc/datasheet/108968#todescription	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Hungary - Danube basin, Poland, Germany	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	https://www.cabi.org/isc/datasheet/108968#todescription	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	https://www.cabi.org/isc/datasheet/108968#todescription	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	https://www.cabi.org/isc/datasheet/108968#todescription	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	Reduced amenity values https://www.cabi.org/isc/datasheet/108968#todescription	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	Carpets (mats) can occasionally impede activities (navigation, bathing, fishing) and are sometimes perceived by the local residents as a symbol of contamination of waters; https://www.cabi.org/isc/datasheet/108968#todescription	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	https://www.cabi.org/isc/datasheet/108968#todescription	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	often grows with the other duckweeds (e.g., Spirodela, Landoltia, Wolffia, Wolffiella) and occupy a similar niche to Azolla filiculoides (Armstrong, 2009).	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	https://www.cabi.org/isc/datasheet/108968#todescription	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Prefer warm climates , Mediterrnean climate tolerale	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	A blanketing growth over a large area leads to deoxygenation and fish-kills in hot weather, as well as a decrease in invertebrate diversity (Bramley et al., 1995). These thick, floating mats of vegetation could reduce submerged plant diversity by selecting a few tolerant species (Janes et al., 1996).	Very high
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	sports on the water, fishing	Very high
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	Not enough data on this topic https://www.cabi.org/isc/datasheet/108968#todescription	Medium

21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	Not enough data https://www.cabi.org/isc/datasheet/108968#todescription	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	small species	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	grows in slow-moving, calm, freshwater ponds and marshes (Armstrong, 2009), and stagnant freshwater habitats such as wetlands like in the Pantanal (Brazil) (Pott and Cervi, 1999). It occurs in temperate to subtropical regions with relatively mild winters (Flora of North America, 2008) and prefers a Mediterranean climate (Landolt, 1986) with high water temperature in summer. L. minuta is found in its introduced areas in sluggishly moving waters of ponds, pools, lakes, swamps, streams, drainage ditches, canals, and sloughs (Preston and Croft,	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	It affects the ecology of its habitat by forming mats on the water surface, reducing sunlight penetration and oxygen exchange. In Poland, it has been found in a nature reserve (Banaszek and Musial, 2009). Mats of free-floating plants such as L. minuta are well known to cause physico-chemical changes in the water beneath them (e.g. Pokorny and Rejmankova, 1983).	Very high
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Fast growing Has high reproductive potential Has propagules that can remain viable for more than one year Reproduces asexually	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	https://www.cabi.org/isc/datasheet/108968#tohabitat	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Modification of nutrient regime https://www.cabi.org/isc/datasheet/108968#tohabitat	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	https://www.cabi.org/isc/datasheet/108968#tohabitat	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Has propagules that can remain viable for more than one year	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Maybe possible, but not enough data https://link.springer.com/article/10.1007/s00425-014-2053-y	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	asexual	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	https://www.cabi.org/isc/datasheet/108968#tohabitat	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Fast growing Has high reproductive potential Has propagules that can remain viable for more than one year Reproduces asexually	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	https://www.cabi.org/isc/datasheet/108968#tohabitat	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	pet trade, by birds and mammals, fish restocking	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	not yet present	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no.	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	fragments, seeds	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Possibility of natural dispersal between basins is low,but could be possible by wind	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	not migratory species	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	yes by birds and mammals	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	https://www.cabi.org/isc/datasheet/108968#tohabitat	High
43	7.09	Is dispersal of the taxon density dependent?	No	https://www.cabi.org/isc/datasheet/108968#tohabitat	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	seeds	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	Highly adaptable to different environments Is a habitat generalist Tolerates, or benefits from, cultivation, browsing pressure, mutilation, fire etc Pioneering in disturbed areas Tolerant of shadeand, are strongly resistant to pollution	High

46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	Destroying the duckweed layer with herbicides does not solve the problem of excess nutrients in the water. Because of the exponential growth rate of Lemnaceae, herbicides must be used repeatedly (perhaps several times a year). Ideally, it is best to eliminate the inflow of nutrients, and the repetitive removal of the duckweed layer will greatly reduce the growth of duckweeds (Armstrong, 2009). Biological control using ducks, fish, turtles and crustaceans (water shrimp, crayfish, ostracods, freshwater prawns, daphnia, amphipods, etc.) may also help to control duckweed populations. There are a number of species of freshwater fish that eat duckweeds to supplement their diets, including grass carp (Ctenopharyngodon idella) for example. Duckweeds are also eaten by pacu (Colossoma bidens), a freshwater fish native to the Amazon River (Armstrong, 2009)	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Tolerates, or benefits from, cultivation, browsing pressure, mutilation, fire etc Pioneering in disturbed areas Tolerant of shade Highly mobile locally Benefits from human association (i.e. it is a	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	https://link.springer.com/article/10.1007/s00425-015-2264-x	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	Biological control using ducks, fish, turtles and crustaceans (water shrimp, crayfish, ostracods, freshwater prawns, daphnia, amphipods, etc.) may also help to control duckweed populations. There are a number of species of freshwater fish that eat duckweeds to supplement their diets, including grass carp (Ctenopharyngodon idella) for example.	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	https://www.cabi.org/isc/datasheet/108968#tohabitat	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	https://www.cabi.org/isc/datasheet/108968#tohabitat	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	https://www.cabi.org/isc/datasheet/108968#tohabitat	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	https://www.cabi.org/isc/datasheet/108968#tohabitat	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	https://www.cabi.org/isc/datasheet/108968#tohabitat	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	https://www.cabi.org/isc/datasheet/108968#tohabitat	Medium

Statistics	
Scores	
BRA	**33.0**
BRA Outcome	**High**
BRA+CCA	**43.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**16.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*10.0*
B. Biology/Ecology	**17.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*2.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*3.0*
8. Tolerance attributes	*2.0*
C. Climate change	**10.0**
9. Climate change	*10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**13**
Environmental	**11**
Species or population nuisance traits	**23**

Thresholds	
BRA	22.75
BRA+CCA	22.75
Confidence	
BRA+CCA	0.71
BRA	0.73
CCA	0.50

Date and Time
23/11/2021 17:06:48

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Lemna turionifera*
Common name	turion duckweed
Assessor	Marina Piria
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Used in aquaculture, animal feed etc https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1749-7345.1981.tb00273.x	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1749-7345.1981.tb00273.x	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Lemna aequinocitalis, L. minuta etc. https://www.cabi.org/ISC/abstract/19992302892	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	native in North America and northern Asia. In North America it occurs from Mexico north to Alaska and through much of Canada and the United States east to Nova Scotia, it is largely absent from the southeastern United States. In Asia it occurs in a broad band from Turkey, north and east across Russia to Kamchatka and Sakhalin Island (Landolt 1986). In Eurasia, the western limits of its distribution have been obscured by apparently non-native populations (Muller 2004), where it has been recorded from Austria, Belgium (Hoste & Bruinsma 2007; van Landuyt 2007), the Czech Republic, France (Muller 2004), Germany (Landolt 1986, Wolff and Ortschiedt 1993), Poland (Muller 2004), the Netherlands (Wolff & Bruinsma 2005), Sweden and Norwayhttps://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1	Very high
5	2.02	What is the quality of the climate matching data?	High	https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.667.4194&rep=rep1&type=pdf Climatch confirmed	Very high
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	It is horizon species	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	water, by migrating birds https://www.researchgate.net/profile/Zofija-Sinkeviciene/publication/270506254_FIRST_RECORDS_OF_LEMNA_TURIONIFERA_IN_LITHUANIA/links/54abcd750cf2bce6aa1dba11/	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Hungary, B. A. Lukács, A. Mesterházy, R. Vidéki & G. Király (2014): Alien aquatic vascular plants in Hungary (Pannonian ecoregion): Historical aspects, data set and trends, Plant Biosystems - An International Journal Dealing with all Aspects of Plant Biology: Official Journal of the Societa Botanica Italiana, DOI: 10.1080/11263504.2014.987846	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	https://www.researchgate.net/profile/Zofija-Sinkeviciene/publication/270506254_FIRST_RECORDS_OF_LEMNA_TURIONIFERA_IN_LITHUANIA/links/54abcd750cf2bce6aa1dba11/FIRST-RECORDS-OF-LEMNA-TURIONIFERA-IN-LITHUANIA.pdf	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	Probably similar as other Lemnacee	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	no data. https://www.fao.org/ag/againfo/resources/documents/DW/dw2.ht	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	Impact not recorded https://www.gbif.org/species/2867631	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Not recorded https://www.gbif.org/species/2867631	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	It is not poisonous and not pose risk to humans. Actually represents human food	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No data https://www.gbif.org/species/2867631	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	it is not parasite	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	it is cosmopolitan https://www.researchgate.net/profile/Zofija-Sinkeviciene/publication/270506254_FIRST_RECORDS_OF_LEMNA_TURIONIFERA_IN_LITHUANIA/links/54abcd750cf2bce6aa1dba11/FIRST-RECORDS-OF-LEMNA-TURIONIFERA-IN-LITHUANIA.pdf	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No evidences	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No evidences	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No data	Low

21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	Not known, usually used to remove pathogens and nutrients from polluted water https://link.springer.com/chapter/10.1007/978-1-4020-6027-4_10	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	small bodied species	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	typical for weetlands and tolerate up to 3 m/s	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	For other Lemna is known that reduce habitat quality but no evidence for this species.	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Its species name refers to the fact that it sometimes produces turions, vegetative plantlets that can disperse and go dormant for long periods.	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	No predation behaviour	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Yes would exploit nutrients https://link.springer.com/chapter/10.1007/978-1-4020-6027-4_10	Medium
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	.no.	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	https://gobotany.nativeplanttrust.org/species/lemna/turionifera/	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	with lemna minor https://d-nb.info/1236692624/34	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	Its species name refers to the fact that it sometimes produces turions, vegetative plantlets that can disperse and go dormant for long periods. https://gobotany.nativeplanttrust.org/species/lemna/turionifera/	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Its species name refers to the fact that it sometimes produces turions, vegetative plantlets that can disperse and go dormant for long periods. https://gobotany.nativeplanttrust.org/species/lemna/turionifera/	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	when appear adequate conditions	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable habitats nearby)?	>1	water, by migrating birds https://www.researchgate.net/profile/Zofija-Sinkeviciene/publication/270506254_FIRST_RECORDS_OF_LEMNA_TURIONIFERA_IN_LITHUANIA/links/54abcd750cf2bce6aa1dba11/	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	It is not yet in RA area	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	Probably not,not evidences	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	https://www.researchgate.net/profile/Zofija-Sinkeviciene/publication/270506254_FIRST_RECORDS_OF_LEMNA_TURIONIFERA_IN_LITHUANIA/links/54abcd750cf2bce6aa1dba11/FIRST-RECORDS-OF-LEMNA-TURIONIFERA-IN-LITHUANIA.pdf	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Probably with water currents as other Lemna	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	not migratory	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	by migratory birds https://www.researchgate.net/profile/Zofija-Sinkeviciene/publication/270506254_FIRST_RECORDS_OF_LEMNA_TURIONIFERA_IN_LITHUANIA/links/54abcd750cf2bce6aa1dba11/FIRST-RECORDS-OF-LEMNA-TURIONIFERA-IN-LITHUANIA.pdf	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	by birds https://www.researchgate.net/profile/Zofija-Sinkeviciene/publication/270506254_FIRST_RECORDS_OF_LEMNA_TURIONIFERA_IN_LITHUANIA/links/54abcd750cf2bce6aa1dba11/FIRST-RECORDS-OF-LEMNA-TURIONIFERA-IN-LITHUANIA.pdf	High
43	7.09	Is dispersal of the taxon density dependent?	No	https://en.wikipedia.org/wiki/Lemna_turionifera	Very high
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	capable of producing turions, which are starch-filled fronds that sink to the substrate and remain dormant until germinating when conditions are favorable	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	occurring at nutrient-rich sites more often than at average sites and only exceptionally at poor sites https://pladias.cz/en/taxon/data/Lemna%20turionifera#4	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	yes, probably by pesticides and biological control by herbivoruos fish	Medium
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	No data	Low

48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	survival and reproduction of L. turionifera fronds can be influenced by specific stresses, e.g., salinity https://www.proquest.com/docview/2174512883?pq-origsite=gscholar&fromopenview=true	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	No information related to this species but grasss carp probably will take this Laminacce species too https://www.fao.org/aq/againfo/resources/documents/DW/dw2.ht	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	https://pdf.sciencedirectassets.com/273182/1-s2.0-S1617138118X00053/1-s2.0-S1617138118300232/main.pdf?X-Amz-Security-Token=IQoJb3JpZ2luX2VjEGkaCXVzLWVhc3QtMSJHMEUCIQDc8m2PJnnbKZ42LpUSBfBoQegF7CSGzz8ITKl2PwKAqgIgZT7LRnEwkyfoC1pJqm5DnwhYUI1ZBZWnL5qJGNe%2Ftxwq%2BgMIMRAEGgwwNTkwMDM1NDY4NjUiDLCp1Blg4SPIedhM9SrXA5XmAGJcYVIfJYMG90O2uiMkSgrk%2BFoSkcpVCnGR24ao%2BhDtLBRANNmV7HpYQAZnrR2wF2Ql2O5TqJ2pr%2B72gP5djuFfbTTGDNTlOrXsU0Dh7w8V2hLQA%2FM4utaQXG3ih%2BGw2n%2FwacOWTME%2FexjUcqMq%2F5pxmyZzITOjdS0bzxc1J0DhxMrnL11cWi4mzqYxg3PhBFcnLKAyBVY2%2BW08qYaThKh4HfGKofH2sT4WJfLi7odtm9ZwJkJKzRuXou1s%2FweqAmG7JSBsBAzkd2txyLFAknM7ImVdKgqzf9kOl6QxiymEtpDe0R7Y9aurVqSwlSLsMhL7fQgVTZ0ixSzfgUIsdHQ144pwsacCtBzkg6gS3BLL%2FeeSXIkkKoSTIDsS2Dfzv7bBWYOvxYw854d2k6WIa4osE6FZMyO%2F4naDzSGmbWx%2FDnQwdAFFcuBwdLba1mbTSTdSJYXxCiSbFwQIh7WlxorP6vhJZLtdJkjYhtO4yi79XOC34%2BnwZOaiTCCS2sQGbBFvOZUWKUpC10yTxYTyQe%2B%2FSyDjfEXv1jDsW%2BpFoO5hDCLfPpiHIBOzT01IIHmaMWybLu0UGuIK4N%2BBdTCzifiJom0vzkK39yPl6etp0k%2BJdRwlrDDegu%2BMBjqlAUpMAYHFnuj4vujKO5BxGXN3kTs7V4TzLKFQh6dwGzxEQKsQZMk02dTOexVSNClOjwCYVxgfeAaPkyG%2FitN6mhrMtPxorL%2FdN9ZihI6dVkFQcQ2YJsCxBPuoNVRZ1Uw2mwttvfKc4HZf%2BqmeVN9UT%2FAHR5DOgC1aoxV9iRAipOSoyqEdWPBV9cW51cOLUtH0AgfHYtWC8AwShL2uND4wQGfM1aPGTw%3D%3D&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Date=20211122T162442Z&X-Amz-SignedHeaders=host&X-Amz-Expires=300&X-Amz-Credential=ASIAQ3PHCVTY2SYFFQ6V%2F20211122%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Signature=3860ad8e3b8989785bcc56eb131bfc4007f3485e12a5c4045371e5a28e9c93c2&hash=31366d759648af0f2181634335b9a796b84a9338b735c3ad907afd353479342e&host=68042c943591013ac2b2430a89b270f6af2c76d8dfd086a07176afe7c76c2c61&pii=S1617138118300232&tid=spdf-69f51aa4-e438-40bd-bf9b-fa86c1b46cf7&sid=05d25e953a1b1448e48be396c93b5408ff94gxrq	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	https://pdf.sciencedirectassets.com/273182/1-s2.0-S1617138118X00053/1-s2.0-S1617138118300232/main.pdf?X-Amz-Security-Token=IQoJb3JpZ2luX2VjEGkaCXVzLWVhc3QtMSJHMEUCIQDc8m2PJnnbKZ42LpUSBfBoQegF7CSGzz8ITKl2PwKAqgIgZT7LRnEwkyfoC1pJqm5DnwhYUI1ZBZWnL5qJGNe%2Ftxwq%2BgMIMRAEGgwwNTkwMDM1NDY4NjUiDLCp1Blg4SPIedhM9SrXA5XmAGJcYVIfJYMG90O2uiMkSgrk%2BFoSkcpVCnGR24ao%2BhDtLBRANNmV7HpYQAZnrR2wF2Ql2O5TqJ2pr%2B72gP5djuFfbTTGDNTlOrXsU0Dh7w8V2hLQA%2FM4utaQXG3ih%2BGw2n%2FwacOWTME%2FexjUcqMq%2F5pxmyZzITOjdS0bzxc1J0DhxMrnL11cWi4mzqYxg3PhBFcnLKAyBVY2%2BW08qYaThKh4HfGKofH2sT4WJfLi7odtm9ZwJkJKzRuXou1s%2FweqAmG7JSBsBAzkd2txyLFAknM7ImVdKgqzf9kOl6QxiymEtpDe0R7Y9aurVqSwlSLsMhL7fQgVTZ0ixSzfgUIsdHQ144pwsacCtBzkg6gS3BLL%2FeeSXIkkKoSTIDsS2Dfzv7bBWYOvxYw854d2k6WIa4osE6FZMyO%2F4naDzSGmbWx%2FDnQwdAFFcuBwdLba1mbTSTdSJYXxCiSbFwQIh7WlxorP6vhJZLtdJkjYhtO4yi79XOC34%2BnwZOaiTCCS2sQGbBFvOZUWKUpC10yTxYTyQe%2B%2FSyDjfEXv1jDsW%2BpFoO5hDCLfPpiHIBOzT01IIHmaMWybLu0UGuIK4N%2BBdTCzifiJom0vzkK39yPl6etp0k%2BJdRwlrDDegu%2BMBjqlAUpMAYHFnuj4vujKO5BxGXN3kTs7V4TzLKFQh6dwGzxEQKsQZMk02dTOexVSNClOjwCYVxgfeAaPkyG%2FitN6mhrMtPxorL%2FdN9ZihI6dVkFQcQ2YJsCxBPuoNVRZ1Uw2mwttvfKc4HZf%2BqmeVN9UT%2FAHR5DOgC1aoxV9iRAipOSoyqEdWPBV9cW51cOLUtH0AgfHYtWC8AwShL2uND4wQGfM1aPGTw%3D%3D&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Date=20211122T162442Z&X-Amz-SignedHeaders=host&X-Amz-Expires=300&X-Amz-Credential=ASIAQ3PHCVTY2SYFFQ6V%2F20211122%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Signature=3860ad8e3b8989785bcc56eb131bfc4007f3485e12a5c4045371e5a28e9c93c2&hash=31366d759648af0f2181634335b9a796b84a9338b735c3ad907afd353479342e&host=68042c943591013ac2b2430a89b270f6af2c76d8dfd086a07176afe7c76c2c61&pii=S1617138118300232&tid=spdf-69f51aa4-e438-40bd-bf9b-fa86c1b46cf7&sid=05d25e953a1b1448e48be396c93b5408ff94gxrq	Medium

52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	https://pdf.sciencedirectassets.com/273182/1-s2.0-S1617138118X00053/1-s2.0-S1617138118300232/main.pdf?X-Amz-Security-Token=IQoJb3JpZ2luX2VjEGkaCXVzLWVhc3QtMSJHMEUCIQDc8m2PJnnbKZ42LpUSBfBoQegF7CSGzz8ITKl2PwKAqgIgZT7LRnEwkyfoC1pJqm5DnwhYUI1ZBZWnL5qJGNe%2Ftxwq%2BgMIMRAEGgwwNTkwMDM1NDY4NjUiDLCp1Blg4SPIedhM9SrXA5XmAGJcYVIfJYMG90O2uiMkSgrk%2BFoSkcpVCnGR24ao%2BhDtLBRANNmV7HpYQAZnrR2wF2Ql2O5TqJ2pr%2B72gP5djuFfbTTGDNTlOrXsU0Dh7w8V2hLQA%2FM4utaQXG3ih%2BGw2n%2FwacOWTME%2FexjUcqMq%2F5pxmyZzITOjdS0bzxc1J0DhxMrnL11cWi4mzqYxg3PhBFcnLKAyBVY2%2BW08qYaThKh4HfGKofH2sT4WJfLi7odtm9ZwJkJKzRuXou1s%2FweqAmG7JSBsBAzkd2txyLFAknM7ImVdKgqzf9kOl6QxiymEtpDe0R7Y9aurVqSwlSLsMhL7fQgVTZ0ixSzfgUIsdHQ144pwsacCtBzkg6gS3BLL%2FeeSXIkkKoSTIDsS2Dfzv7bBWYOvxYw854d2k6WIa4osE6FZMyO%2F4naDzSGmbWx%2FDnQwdAFFcuBwdLba1mbTSTdSJYXxCiSbFwQIh7WlxorP6vhJZLtdJkjYhtO4yi79XOC34%2BnwZOaiTCCS2sQGbBFvOZUWKUpC10yTxYTyQe%2B%2FSyDjfEXv1jDsW%2BpFoO5hDCLfPpiHIBOzT01IIHmaMWybLu0UGuIK4N%2BBdTCzifiJom0vzkK39yPl6etp0k%2BJdRwlrDDegu%2BMBjqlAUpMAYHFnuj4vujKO5BxGXN3kTs7V4TzLKFQh6dwGzxEQKsQZMk02dTOexVSNClOjwCYVxgfeAaPkyG%2FitN6mhrMtPxorL%2FdN9ZihI6dVkFQcQ2YJsCxBPuoNVRZ1Uw2mwttvfKc4HZf%2BqmeVN9UT%2FAHR5DOgC1aoxV9iRAipOSoyqEdWPBV9cW51cOLUtH0AgfHYtWC8AwShL2uND4wQGfM1aPGTw%3D%3D&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Date=20211122T162442Z&X-Amz-SignedHeaders=host&X-Amz-Expires=300&X-Amz-Credential=ASIAQ3PHCVTY2SYFFQ6V%2F20211122%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Signature=3860ad8e3b8989785bcc56eb131bfc4007f3485e12a5c4045371e5a28e9c93c2&hash=31366d759648af0f2181634335b9a796b84a9338b735c3ad907afd353479342e&host=68042c943591013ac2b2430a89b270f6af2c76d8dfd086a07176afe7c76c2c61&pii=S1617138118300232&tid=spdf-69f51aa4-e438-40bd-bf9b-fa86c1b46cf7&sid=05d25e953a1b1448e48be396c93b5408ff94gxrq	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Probably will stay the same	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	https://pdf.sciencedirectassets.com/273182/1-s2.0-S1617138118X00053/1-s2.0-S1617138118300232/main.pdf?X-Amz-Security-Token=IQoJb3JpZ2luX2VjEGkaCXVzLWVhc3QtMSJHMEUCIQDc8m2PJnnbKZ42LpUSBfBoQegF7CSGzz8ITKl2PwKAqgIgZT7LRnEwkyfoC1pJqm5DnwhYUI1ZBZWnL5qJGNe%2Ftxwq%2BgMIMRAEGgwwNTkwMDM1NDY4NjUiDLCp1Blg4SPIedhM9SrXA5XmAGJcYVIfJYMG90O2uiMkSgrk%2BFoSkcpVCnGR24ao%2BhDtLBRANNmV7HpYQAZnrR2wF2Ql2O5TqJ2pr%2B72gP5djuFfbTTGDNTlOrXsU0Dh7w8V2hLQA%2FM4utaQXG3ih%2BGw2n%2FwacOWTME%2FexjUcqMq%2F5pxmyZzITOjdS0bzxc1J0DhxMrnL11cWi4mzqYxg3PhBFcnLKAyBVY2%2BW08qYaThKh4HfGKofH2sT4WJfLi7odtm9ZwJkJKzRuXou1s%2FweqAmG7JSBsBAzkd2txyLFAknM7ImVdKgqzf9kOl6QxiymEtpDe0R7Y9aurVqSwlSLsMhL7fQgVTZ0ixSzfgUIsdHQ144pwsacCtBzkg6gS3BLL%2FeeSXIkkKoSTIDsS2Dfzv7bBWYOvxYw854d2k6WIa4osE6FZMyO%2F4naDzSGmbWx%2FDnQwdAFFcuBwdLba1mbTSTdSJYXxCiSbFwQIh7WlxorP6vhJZLtdJkjYhtO4yi79XOC34%2BnwZOaiTCCS2sQGbBFvOZUWKUpC10yTxYTyQe%2B%2FSyDjfEXv1jDsW%2BpFoO5hDCLfPpiHIBOzT01IIHmaMWybLu0UGuIK4N%2BBdTCzifiJom0vzkK39yPl6etp0k%2BJdRwlrDDegu%2BMBjqlAUpMAYHFnuj4vujKO5BxGXN3kTs7V4TzLKFQh6dwGzxEQKsQZMk02dTOexVSNClOjwCYVxgfeAaPkyG%2FitN6mhrMtPxorL%2FdN9ZihI6dVkFQcQ2YJsCxBPuoNVRZ1Uw2mwttvfKc4HZf%2BqmeVN9UT%2FAHR5DOgC1aoxV9iRAipOSoyqEdWPBV9cW51cOLUtH0AgfHYtWC8AwShL2uND4wQGfM1aPGTw%3D%3D&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Date=20211122T162442Z&X-Amz-SignedHeaders=host&X-Amz-Expires=300&X-Amz-Credential=ASIAQ3PHCVTY2SYFFQ6V%2F20211122%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Signature=3860ad8e3b8989785bcc56eb131bfc4007f3485e12a5c4045371e5a28e9c93c2&hash=31366d759648af0f2181634335b9a796b84a9338b735c3ad907afd353479342e&host=68042c943591013ac2b2430a89b270f6af2c76d8dfd086a07176afe7c76c2c61&pii=S1617138118300232&tid=spdf-69f51aa4-e438-40bd-bf9b-fa86c1b46cf7&sid=05d25e953a1b1448e48be396c93b5408ff94gxrq	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Probably no change	Medium

Statistics	
Scores	
BRA	**21.0**
BRA Outcome	**Medium**
BRA+CCA	**27.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**7.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*

3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**14.0**
4. Undesirable (or persistence) traits	*2.0*
5. Resource exploitation	*2.0*
6. Reproduction	*6.0*
7. Dispersal mechanisms	*3.0*
8. Tolerance attributes	*1.0*
C. Climate change	**6.0**
9. Climate change	*6.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**6**
Environmental	**2**
Species or population nuisance traits	**22**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.71**
BRA	**0.73**
CCA	**0.58**

Date and Time
23/11/2021 17:07:34

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Ludwigia peploides*
Common name	floating primrose-willow
Assessor	Tena Radočaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	It is most likely that escape from aquaculture explains most of the adventive introductions; this plant is very commonly sold as an ornamental (CABI, 2020)	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	It is most likely that escape from aquaculture explains most of the adventive introductions; this plant is very commonly sold as an ornamental (CABI, 2020)	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No evidence	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Low	The similarity of climatic conditions between native areas and the RA area is low (Climatch)	Medium
5	2.02	What is the quality of the climate matching data?	Medium	I used climatch and distribution map of CABI	Low
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Buzjak, S., & Sedlar, Z. (2018). Ludwigia peploides (Kunth.) PH Raven–Floating Water Primrose, a new species in Croatian flora from the list of invasive alien species of Union concern. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 27(2),	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	None	It is present in the RA area Buzjak, S., & Sedlar, Z. (2018). Ludwigia peploides (Kunth.) PH Raven–Floating Water Primrose, a new species in Croatian flora from the list of invasive alien species of Union concern. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 27(2), 351-356.	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	No	It is present in the RA area Buzjak, S., & Sedlar, Z. (2018). Ludwigia peploides (Kunth.) PH Raven–Floating Water Primrose, a new species in Croatian flora from the list of invasive alien species of Union concern. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 27(2), 351-356.	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Verloove, F., & Alves, P. (2016). New vascular plant records for the western part of the Iberian Peninsula (Portugal and Spain). Folia Botanica Extremadurensis, (10), 5-23.	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	This species causes declines in biodiversity. Due to the species' allelopathic activity, it poses a severe threat to vulnerable native flora (CABI, 2020)	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No evidence	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	This species has an allelopathic effect that impacts water quality throughout the year. Its tendency to grow in thick mats also contributes to physical alteration of the environment, making it unsuitable for sensitive species. (CABI, 2020)	Very high
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	This plant can grow very densely, impeding navigation and interfering with hunting, fishing and other recreational activities (CEH, 2007). (CABI, 2020)	Very high
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	No evidence	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	RUAUX, B. (2008). Invasive plants in river corridors (biological characteristics, the impacts of Ludwigia peploides and L. grandiflora in the Middle Loire and the implications for	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No evidence	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Vuković, N., Šegota, V., Rimac, A., Koletić, N., & Alegro, A. (2021). New records of alien plants–Ludwigia peploides (Kunth) PH Raven, Reynoutria sachalinensis (F. Schmidt) Nakai and Nicotiana glauca Graham in Croatia. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 30(1), 27-35.	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	For Croatia yet no information, but I think L. peploides will be adverse impact. It is generally considered a threat to biodiversity in its introduced range. (CABI, 2020)	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	For Croatia yet no information, but I think L. peploides will be adverse impact. This plant can cause substantial nuisance to recreational users by impeding navigation and interfering with hunting, fishing and other recreational activities (CABI, 2020)	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	No	No cases of pathogen pollution are reported for L. peploides (Robert, H., Lafontaine, R.-M., Beudels-Jamar, R.C., Delsinne, T. (2013). Risk analysis of the Water Primrose Ludwigia peploides (Kunth) P.H. Raven. - Risk analysis report of non-native organisms in Belgium from the Royal Belgian Institute of Natural Sciences for the Federal Public Service Health, Food chain safety and Environment. 35 p)	Low

21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No cases of pathogen pollution are reported for L. peploides (Robert, H., Lafontaine, R.-M., Beudels-Jamar, R.C., Delsinne, T. (2013). Risk analysis of the Water Primrose Ludwigia peploides (Kunth) P.H. Raven. - Risk analysis report of non-native organisms in Belgium from the Royal Belgian Institute of Natural Sciences for the Federal Public Service Health, Food chain safety and Environment. 35 p)	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Vuković, N., Šegota, V., Rimac, A., Koletić, N., & Alegro, A. (2021). New records of alien plants–Ludwigia peploides (Kunth) PH Raven, Reynoutria sachalinensis (F. Schmidt) Nakai and Nicotiana glauca Graham in Croatia. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 30(1), 27-35.	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	L. peploides can be found in wetlands, on shorelines, in slow-flowing rivers, ponds, rice fields, marshes and in other freshwater environments (CABI, 2020)	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	This species has an allelopathic effect that impacts water quality throughout the year. Where it is invasive, it often has far reaching and negative effects on multiple trophic levels (CABI, 2020)	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Vuković, N., Šegota, V., Rimac, A., Koletić, N., & Alegro, A. (2021). New records of alien plants–Ludwigia peploides (Kunth) PH Raven, Reynoutria sachalinensis (F. Schmidt) Nakai and Nicotiana glauca Graham in Croatia. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 30(1), 27-35.	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	Not applicable	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No data available	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	Not applicable	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Vuković, N., Šegota, V., Rimac, A., Koletić, N., & Alegro, A. (2021). New records of alien plants–Ludwigia peploides (Kunth) PH Raven, Reynoutria sachalinensis (F. Schmidt) Nakai and Nicotiana glauca Graham in Croatia. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 30(1), 27-35.	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No evidence	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	Reproduction in Ludwigia peploides includes both sexual and asexual reproduction (Ramstetter, J., Marlboro, V., & Mott-White, J. Ludwigia polycarpa Short & Peter. Many-Fruited False-	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	This species can grow in a broad range of habitats due to its high degree of genetic polymorphism and phenotypic plasticity (CABI, 2020)	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	L. peploides is self-compatible and the species has a very high potential seed output (10,000 – 14,000 seeds per square metre) (CABI, 2020)	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	Robert, H., Lafontaine, R.-M., Beudels-Jamar, R.C., Delsinne, T. (2013). Risk analysis of the Water Primrose Ludwigia peploides (Kunth) P.H. Raven. - Risk analysis report of non-native organisms in Belgium from the Royal Belgian Institute of Natural Sciences for the Federal Public Service Health, Food chain safety and Environment. 35 p.	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Botanical gardens and zoos, Flooding and other natural disasters, Interconnected waterways.. (CABI, 2020)	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Flooding, Interconnected waterways.. (CABI, 2020)	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No evidence	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	No evidence (Robert, H., Lafontaine, R.-M., Beudels-Jamar, R.C., Delsinne, T. (2013). Risk analysis of the Water Primrose Ludwigia peploides (Kunth) P.H. Raven. - Risk analysis report of non-native organisms in Belgium from the Royal Belgian Institute of Natural Sciences for the Federal Public Service Health, Food chain safety and Environment. 35 p).	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Stem fragments are spread by water currents, animals and humans (Robert, H., Lafontaine, R.-M., Beudels-Jamar, R.C., Delsinne, T. (2013). Risk analysis of the Water Primrose Ludwigia peploides (Kunth) P.H. Raven. - Risk analysis report of non-native organisms in Belgium from the Royal Belgian Institute of Natural Sciences for the Federal Public Service Health, Food chain safety and Environment. 35 p).	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Not applicable	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	spread by animals, humans (CABI, 2020)	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Flooding (CABI, 2020)	Low

43	7.09	Is dispersal of the taxon density dependent?	No	Robert, H., Lafontaine, R.-M., Beudels-Jamar, R.C., Delsinne, T. (2013). Risk analysis of the Water Primrose Ludwigia peploides (Kunth) P.H. Raven. - Risk analysis report of non-native organisms in Belgium from the Royal Belgian Institute of Natural Sciences for the Federal Public Service Health, Food chain safety and Environment. 35 p.	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	No evidence	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	This species can grow in a broad range of habitats due to its high degree of genetic polymorphism and phenotypic plasticity (CABI, 2020).	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	Several herbicides have been used with reported success, including halosulfuron-methyl, glyphosate and triclopyr (CABI, 2020). Sterile grass carp, Ctenopharyngodon idella, have been used to control L. peploides (CABI, 2020)	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	L. peploides can tolerate from environmental disturbance. It is also tolerant of flooding (CABI, 2020)	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	No evidence. Freshwater species	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Maybe, some insects..	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	It is present in RA area. Vuković, N., Šegota, V., Rimac, A., Koletić, N., & Alegro, A. (2021). New records of alien plants–Ludwigia peploides (Kunth) PH Raven, Reynoutria sachalinensis (F. Schmidt) Nakai and Nicotiana glauca Graham in Croatia. Natura Croatica: Periodicum Musei Historiae Naturalis	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	There is no doubt that the species is able to establish, but prefer Mediterranean climate. (Robert, H., Lafontaine, R.-M., Beudels-Jamar, R.C., Delsinne, T. (2013). Risk analysis of the Water Primrose Ludwigia peploides (Kunth) P.H. Raven. - Risk analysis report of non-native organisms in Belgium from the Royal Belgian Institute of Natural Sciences for the Federal Public Service Health, Food chain safety and Environment. 35 p).	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	There is no doubt that the species is able to establish, but prefer Mediterranean climate. (Robert, H., Lafontaine, R.-M., Beudels-Jamar, R.C., Delsinne, T. (2013). Risk analysis of the Water Primrose Ludwigia peploides (Kunth) P.H. Raven. - Risk analysis report of non-native organisms in Belgium from the Royal Belgian Institute of Natural Sciences for the Federal Public Service Health, Food chain safety and Environment. 35 p).	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	There is no doubt that the species is able to establish, but prefer Mediterranean climate. (Robert, H., Lafontaine, R.-M., Beudels-Jamar, R.C., Delsinne, T. (2013). Risk analysis of the Water Primrose Ludwigia peploides (Kunth) P.H. Raven. - Risk analysis report of non-native organisms in Belgium from the Royal Belgian Institute of Natural Sciences for the Federal Public Service Health, Food chain safety and Environment. 35 p).	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	There is no doubt that the species is able to establish, but prefer Mediterranean climate. (Robert, H., Lafontaine, R.-M., Beudels-Jamar, R.C., Delsinne, T. (2013). Risk analysis of the Water Primrose Ludwigia peploides (Kunth) P.H. Raven. - Risk analysis report of non-native organisms in Belgium from the Royal Belgian Institute of Natural Sciences for the Federal Public Service Health, Food chain safety and Environment. 35 p).	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	There is no doubt that the species is able to establish, but prefer Mediterranean climate. (Robert, H., Lafontaine, R.-M., Beudels-Jamar, R.C., Delsinne, T. (2013). Risk analysis of the Water Primrose Ludwigia peploides (Kunth) P.H. Raven. - Risk analysis report of non-native organisms in Belgium from the Royal Belgian Institute of Natural Sciences for the Federal Public Service Health, Food chain safety and Environment. 35 p).	Medium

Statistics	
Scores	
BRA	**22.0**
BRA Outcome	**Medium**
BRA+CCA	**22.0**
BRA+CCA Outcome	**Medium**
Score partition	
A. Biogeography/Historical	**9.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*7.0*
B. Biology/Ecology	**13.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*0.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*0.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**

1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**9**
Environmental	**6**
Species or population nuisance traits	**10**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.47**
BRA	**0.46**
CCA	**0.58**

Date and Time
06/12/2021 20:51:16

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Myriophyllum heterophyllum*
Common name	twoleaf watermilfoil
Assessor	Tena Radočaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Aquaria and garden ponds (Global Invasive Species Database (2021) Species profile: Myriophyllum heterophyllum).	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	M. heterophyllum is a popular plant in the aquarium and water gardening trades and can readily be obtained from any number of aquatic plant vendors under a variety of names. (CABI,2020)	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No evidence	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Low	The similarity of climatic conditions between native areas and the RA area is low (Climatch)	Medium
5	2.02	What is the quality of the climate matching data?	Medium	I used climatch and distribution map of CABI	Low
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	M. heterophyllum is not present in RA area. (Jasprica, N., Lasić, A., Hafner, D., & Bratoš Cetinić, A. (2017). Myriophyllum heterophyllum Michx.(Haloragaceae) u Hrvatskoj. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 26(1), 99-103).	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Pets and aquarium species (CABI, 2020)	Low
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Myriophyllum heterophyllum is present as an alien species in nine European countries: Hungary (Jasprica, N., Lasić, A., Hafner, D., & Bratoš Cetinić, A. (2017). Myriophyllum heterophyllum Michx.(Haloragaceae) u Hrvatskoj. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 26(1), 99-103).	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Myriophyllum heterophyllum is present as an alien species in nine European countries: Austria, Belgium, France, Germany, Hungary, the Netherlands, Spain, Switzerland and the United Kingdom (Jasprica, N., Lasić, A., Hafner, D., & Bratoš Cetinić, A. (2017). Myriophyllum heterophyllum Michx.(Haloragaceae) u Hrvatskoj. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici,	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Thick mats often out-competing native vegetation (Global Invasive Species Database (2021) Species profile: Myriophyllum heterophyllum.) Dense mono-specific growth of any aquatic plant species can incur impacts on native plant communities and other aquatic organisms such as invertebrates and fish.	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No evidence	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	M. heterophyllum is highly competitive and able to outcompete other aquatic plants. It forms dense mats of submergent vegetative material throughout the water column and at the water surface, which can prevent water flow, reduce sunlight and reduce oxygen availability. The resulting low oxygen conditions can harm or kill aquatic organisms (CABI, 2020)	Very high
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	M. heterophyllum forms dense stands in water bodies, which have negative effects on boating, swimming and aesthetics. (CABI,	Very high
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Global Invasive Species Database (2021) Species profile: Myriophyllum heterophyllum.	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No evidence	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No evidence	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	It can tolerate high summer temperatures as well as cold winter temperatures where it can be covered by ice during the winter months.	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	M. heterophyllum is highly competitive and able to outcompete other aquatic plants. It forms dense mats of submergent vegetative material throughout the water column and at the water surface, which can prevent water flow, reduce sunlight and reduce oxygen availability. The resulting low oxygen conditions can harm or kill aquatic organisms (CABI, 2020)	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	M. heterophyllum forms dense stands in water bodies, which have negative effects on boating, swimming and aesthetics. (CABI,	Low

20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	No	No evidence (Global Invasive Species Database (2021) Species profile: Myriophyllum heterophyllum.) EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.ht	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No evidence (Global Invasive Species Database (2021) Species profile: Myriophyllum heterophyllum). EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.ht	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Global Invasive Species Database (2021) Species profile: Myriophyllum heterophyllum. EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.ht	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Suitable habitats for this species include freshwater ponds, lakes, ditches, standing and slow flowing waters (Global Invasive Species Database (2021) Species profile: Myriophyllum	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Dense mats of M. heterophyllum reduce light to other submerged plants and can affect water quality by reducing oxygen levels resulting in fish avoiding the infested area (EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.ht)	Very high
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Jasprica, N., Lasić, A., Hafner, D., & Bratoš Cetinić, A. (2017). Myriophyllum heterophyllum Michx.(Haloragaceae) u Hrvatskoj. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 26(1), 99-103.	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	Not applicable	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No data available	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	Not applicable	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Jasprica, N., Lasić, A., Hafner, D., & Bratoš Cetinić, A. (2017). Myriophyllum heterophyllum Michx.(Haloragaceae) u Hrvatskoj. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici, 26(1), 99-103.	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	M. heterophyllum x M. laxum (Tavalire, H. F., Bugbee, G. E., LaRue, E. A., & Thum, R. A. (2012). Hybridization, cryptic diversity, and invasiveness in introduced variable-leaf watermilfoil. Evolutionary Applications, 5(8), 892-900).	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	Reproduction may occur through asexual vegetative propagation and also sexual reproduction (seed production). Asexual vegetative propagation is thought to be the dominant mode of reproduction in introduced populations (CABI, 2020)	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.ht	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable habitats nearby)?	>1	the aquatic plant trade, Ship hull fouling, Floating vegetation and debris (EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm)	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Ship hull fouling (EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm)	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	Yes	May be commonly transported among water bodies on boats and boat trailers (CABI, 2020)	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	Seeds may also be dispersed by animal vectors. (CABI, 2020)	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	M. heterophyllum is capable of spreading through vegetative fragments (CABI, 2020)	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Not applicable	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	Seeds may also be dispersed by animal vectors. (CABI, 2020)	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	It can be moved around by any number of water and animal vectors and may be commonly transported among water bodies on boats and boat trailers. Seeds may also be dispersed by animal vectors. (CABI, 2020).	High

43	7.09	Is dispersal of the taxon density dependent?	No	EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	No evidence	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	Yes	Myriophyllum heterophyllum can grow in a wide range of physical and chemical conditions (EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm)	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	Triclopyr may be another option. Results from Getsinger et al. (2003) suggest that triclopyr may be efficacious against M. heterophyllum in the field over a wide range of concentrations and exposure times. (Global Invasive Species Database (2021) Species profile: Myriophyllum heterophyllum).	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	(EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm)	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	No evidence; Freshwater species	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Insects (CABI, 2020)	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	M. heterophyllum is present in RA area. Only human impact (Jasprica, N., Lasić, A., Hafner, D., & Bratoš Cetinić, A. (2017). Myriophyllum heterophyllum Michx.(Haloragaceae) u Hrvatskoj. Natura Croatica: Periodicum Musei Historiae Naturalis Croatici,	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	The risk of establishment may potentially increase with temperature increases. Those areas which are currently unsuitable for the occurrence of M. heterophyllum may become more suitable with increased number of day degrees. Extreme weather events, flooding etc., may increase the occurrence and potential areas of establishment for the plant. (EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm)	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	The risk of spread is likely to increase as established populations build and become more invasive. An increase in extreme natural events, such as increased flooding may act to facilitate movement of the species between isolated populations. M. heterophyllum has been shown to increase in growth and vigour at elevated C02 levels. (EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm)	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	With increased temperature, C02 levels and nitrogen deposition, the impacts of M. heterophyllum may be more profound within native plant communities. M. heterophyllum has high phenotypic plasticity which will enable the species to persist and outcompete species with restricted habitat requirements. (EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.h	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	EPPO (2015) Pest risk analysis for Myriophyllum heterophyllum. EPPO, Paris. Available at http://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm	Medium

Statistics	
Scores	
BRA	**24.0**
BRA Outcome	**High**
BRA+CCA	**34.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**9.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*7.0*
B. Biology/Ecology	**15.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*0.0*
6. Reproduction	*6.0*
7. Dispersal mechanisms	*6.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**10.0**
9. Climate change	*10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**

1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**11**
Environmental	**10**
Species or population nuisance traits	**16**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.53**
BRA	**0.52**
CCA	**0.58**

Date and Time
06/12/2021 21:08:14

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Najas graminea*
Common name	ricefield waternymph
Assessor	Tena Radočaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	This plant is also commercialized in the aquarium trade. (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	This plant is also commercialized in the aquarium trade. (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No evidence	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	The similarity of climatic conditions between native areas and the RA area is medium (Climatch)	Medium
5	2.02	What is the quality of the climate matching data?	Medium	I used climatch and distribution map of CABI	Low
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	N. graminea is present in the RA area. (Lansdown, R. V., Anastasiu, P., Barina, Z., Bazos, I., Çakan, H., Caković, D., ... & Király, G. (2016). Review of alien freshwater vascular plants in South-east Europe. ESENIAS Scientific Reports, 1, 137-154).	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	None	N. graminea is present in the RA area. (Lansdown, R. V., Anastasiu, P., Barina, Z., Bazos, I., Çakan, H., Caković, D., ... & Király, G. (2016). Review of alien freshwater vascular plants in South-east Europe. ESENIAS Scientific Reports, 1, 137-154).	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	No	N. graminea is present in the RA area. (Lansdown, R. V., Anastasiu, P., Barina, Z., Bazos, I., Çakan, H., Caković, D., ... & Király, G. (2016). Review of alien freshwater vascular plants in South-east Europe. ESENIAS Scientific Reports, 1, 137-154).	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	It has become naturalised in Spain, Italy, Bulgaria, the Crimea (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	No records of impacts from the introductions were found. With known established populations, but a lack of information on impacts, the history of invasiveness for this species	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021	Very high
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	No records of impacts from the introductions were found. With known established populations, but a lack of information on impacts, the history of invasiveness for this species	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No records of impacts from the introductions were found. With known established populations, but a lack of information on impacts, the history of invasiveness for this species	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	No information on threats to humans was found for Najas graminea. (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No records of impacts from the introductions were found. With known established populations, but a lack of information on impacts, the history of invasiveness for this species	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No records of impacts from the introductions were found. With known established populations, but a lack of information on impacts, the history of invasiveness for this species	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	This species is wide-spread in tropical and subtropical regions, in the RA area climate is temperate.	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No records of impacts from the introductions were found. This species is wide-spread in tropical and subtropical regions, in the RA area climate is temperate.	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No records of impacts from the introductions were found. This species is wide-spread in tropical and subtropical regions, in the RA area climate is temperate.	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No records of diseases were found for Najas graminea. (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No records of diseases were found for Najas graminea. (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Stems up to 60 cm high (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Medium

23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	This aquatic plant grows in ponds, river, streams, lakes and paddy fields, usually in still or slow-moving water. (Zhuang X. 2017. Najas graminea. The IUCN Red List of Threatened Species 2017: e.T164296A67788915. Available: https://www.iucnredlist.org/species/164296/67788915)	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	(Zhuang X. 2017. Najas graminea. The IUCN Red List of Threatened Species 2017: e.T164296A67788915. Available: https://www.iucnredlist.org/species/164296/67788915)	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	(Zhuang X. 2017. Najas graminea. The IUCN Red List of Threatened Species 2017: e.T164296A67788915. Available: https://www.iucnredlist.org/species/164296/67788915)	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	Not applicable	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No data available	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	Not applicable	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	No evidence..	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No evidence (Zhuang X. 2017. Najas graminea. The IUCN Red List of Threatened Species 2017: e.T164296A67788915. Available: https://www.iucnredlist.org/species/164296/67788915)	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No evidence (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	(U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	(U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	escape from pond gardens (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Interconnected waterways (Personal opinion, no information)	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No evidence (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	No evidence (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Not applicable	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No evidence (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Floods (Personal opinion)	Low
43	7.09	Is dispersal of the taxon density dependent?	No	No evidence	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	No evidence	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	Silprasit K, Ngamniyom A, Kerksakul P, Thumajitsakul S. 2016. Using morphology and genomic template stability (GTS) to track herbicide effect on some submersed aquatic plants. Applied Environmental Research 38:75–85	Low
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	resistance to aquatic pesticides water (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	This species resistance to aquatic pesticides; were found to be remained alive in glyphosate-contaminated water (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	This species can tolerate high salinity waters (U.S. Fish & Wildlife Service, August 2020 Revised, January 2021 Web Version, 3/26/2021)	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Probably some insects (Presonal opinion, no information)	Low
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	The risks of entry into the RA area by the taxon are likely to no change, only by human impact..	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	The risks of dispersal is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.	Medium

Statistics	
Scores	
BRA	**11.5**
BRA Outcome	**Medium**
BRA+CCA	**11.5**
BRA+CCA Outcome	**Medium**
Score partition	
A. Biogeography/Historical	**3.5**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*1.5*
B. Biology/Ecology	**8.0**
4. Undesirable (or persistence) traits	*1.0*
5. Resource exploitation	*0.0*
6. Reproduction	*3.0*
7. Dispersal mechanisms	*-1.0*
8. Tolerance attributes	*5.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**4**
Environmental	**1**
Species or population nuisance traits	**9**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.42**
BRA	**0.41**
CCA	**0.50**

Date and Time
06/12/2021 21:33:00

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Najas guadalupensis*
Common name	southern waternymph
Assessor	Mihaela Britvec
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	No	no reference	Low
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	used in aquaria	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	for example Najas graminea, Najas gracillima and Najas orientalis	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	no reference	Medium
5	2.02	What is the quality of the climate matching data?	Medium	no reference	Low
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Hussner, A. (2012). Alien aquatic plant species in European countries. Weed Research, 52 (4), 297-306.	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	It produces a large amount of seed.	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	Hussner, A. (2012). Alien aquatic plant species in European countries. Weed Research, 52 (4), 297-306.	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Hussner, A. (2012). Alien aquatic plant species in European countries. Weed Research, 52 (4), 297-306.	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	no reference	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	no reference	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	no reference	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	no reference	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	no reference	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	sometimes forming mats	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	no reference	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	no reference	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	Forms dense weed beds in shallow water.	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Forms dense weed beds in shallow water interfering with recreational activities.	Very high
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	no reference	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	no reference	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Not applicable	no reference	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	may be found in springs, fresh and brackish lakes, ponds, and canals	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Forms dense weed beds.	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Species has dorminant form - seed.	Low

5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	is not carnivore species	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	The impacts of the plant are not well documented but they are theorized to compete with native species by shading.	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	no reference	Low
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	no reference	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	no reference	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	no reference	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	no reference	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Najas guadalupensis is a fast-growing aquatic plant species that produces a large amount of seed.	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	6	6 months	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	seeds may be spread by waterfowl	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	no reference	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no reference of acitively attaching	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	seeds may be spread by waterfowl	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	as seeds and fragments	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	has not active dispersal mechanisms	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	pkants can be dispersed by animals between water bodies	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Species is a fast growing plant.	High
43	7.09	Is dispersal of the taxon density dependent?	Yes	when its population density increases - increases the number of	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	no reference	Medium
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Species is little tolerant on a few factors: light, temperature, and pH.	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	https://www.doc.govt.nz/documents/science-and-technical/sfc141.pdf	Medium
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Seasonal flooding can also result in the spread of the organism locally.	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	no reference	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	no reference	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	professional judgement	Medium

54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	professional judgement	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	professional judgement	Low

Statistics	
Scores	
BRA	**17.0**
BRA Outcome	**Medium**
BRA+CCA	**29.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**5.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**12.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*2.0*
6. Reproduction	*-1.0*
7. Dispersal mechanisms	*4.0*
8. Tolerance attributes	*0.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**5**
Environmental	**8**
Species or population nuisance traits	**19**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.48**
BRA	**0.48**
CCA	**0.50**

Date and Time
12/12/2021 13:05:11

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Nelumbo nucifera*
Common name	sacred lotus
Assessor	Mihaela Britvec
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Nelumbo nucifera has been in cultivation in China for more than 3,000 years, and has been grown not only for its cultural and ornamental value, but also for medicinal uses and for its edible 'seeds' and rhizomes. In China, Japan and India, for example, the rhizomes are roasted, pickled, candied or sliced and fried as chips. A paste made from the nutlets is used as a filling in 'mooncakes', traditional Chinese pastries. The young leaves, leaf stalks and flowers are eaten as vegetables in India. https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:6054	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Although abundant in cultivation, with many different cultivars having been bred over the centuries, local wild populations of sacred lotus in central mainland China have been greatly reduced due to the rapid development of the aquaculture industry. https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:6054	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Nelumbo lutea, according https://invazivnevrste.haop.hr/katalog	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Low	N. nucifera prefers warm-temperate to tropical climates.	Medium
5	2.02	What is the quality of the climate matching data?	Low	lack of information	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	doi: 10.1111/j.1365-3180.2012.00926.x	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	via human translocations (https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf)	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	Hussner, A. (2012). Alien aquatic plant species in European countries. Weed Research, 52 (4), 297-306.	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Hussner, A. (2012). Alien aquatic plant species in European countries. Weed Research, 52 (4), 297-306.	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	No records were found of documented impacts from introductions. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No records were found of documented impacts from introductions. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	No records were found of documented impacts from introductions. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No records were found of documented impacts from introductions. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	No information on threat to humans was found. (https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf)	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	The impacts of the plant are not well documented but they are theorized to compete with native species by shading. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	no reference	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Nelumbo nucifera is a species native to Japan, India, Australia, India and the surrounding areas. The species has been introduced to areas in Europe, North Africa, North America, and Europe. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	It is expected that sooner or later the physiognomy of the pond will become monotypic and be represented mainly by the tall and large surface covering plant, Nelumbo. (https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf)	High

20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	no reference	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	no reference	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Not applicable	no reference	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	N. nucifera are adapted to grow in the flood plains of slow-moving rivers, delta areas, wetland habitats, including flood plains, ponds, lakes, pools, lagoons, marshes, swamps and the backwaters of reservoirs.	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Nelumbo, which develops leaves on and above the pond's surface, has the most advantage in the pond and the shade-intolerant species under cover are compelled to be eliminated. It is expected that sooner or later the physiognomy of the pond will become monotypic and be represented mainly by the tall and large surface covering plant, Nelumbo. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	N. nucifera have remarkable power of dormancy and indeed the proved longevity of its seeds exceeds that of any known species of flowering plant. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	N. nucifera is not carnivore species.	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	The impacts of the plant are not well documented but they are theorized to compete with native species by shading. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Medium
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	no reference	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	https://www.sciencedirect.com/science/article/abs/pii/S0031942296008801	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	no reference	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	no reference	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	no reference	Medium
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Stands of lotus drop hundreds of thousands of seeds every year to the bottom of the pond. https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	6	6 months	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	via human translocations	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	no reference	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no reference of acitively attaching	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	This species propagates by seeds and rhizomes.	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	This species propagates by seeds and rhizomes.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	has not active dispersal mechanisms	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	pkants can be dispersed by animals between water bodies	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	High
43	7.09	Is dispersal of the taxon density dependent?	Yes	when its population density increases - increases the number of	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	seeds can remain dormant for an extensive period of time as the pond silts in and dries out https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf	Low

46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	https://www.icid.org/weed_report.pdf	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Seasonal flooding can also result in the spread of the organism locally.	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	no reference	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	https://www.cabi.org/isc/datasheet/68490#tohostPlants	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement (https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf)	Low
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement (https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf)	Low
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	professional judgement (https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf)	Low
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	professional judgement	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	professional judgement (https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf)	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	professional judgement (https://www.fws.gov/fisheries/ANS/erss/uncertainrisk/Nelumbo-nucifera-FINAL-November2020.pdf)	Low

Statistics	
Scores	
BRA	**19.0**
BRA Outcome	**Medium**
BRA+CCA	**31.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**7.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**12.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*2.0*
6. Reproduction	*0.0*
7. Dispersal mechanisms	*4.0*
8. Tolerance attributes	*0.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**7**
Environmental	**8**
Species or population nuisance traits	**19**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.54**
BRA	**0.57**
CCA	**0.29**

Date and Time
11/12/2021 17:17:23

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Nymphaea candida*
Common name	-
Assessor	Tena Radočaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	ornamental value (Nierbauer, K. U., Kanz, B., & Zizka, G. (2014). The widespread naturalisation of Nymphaea hybrids is masking the decline of wild-type Nymphaea alba in Hesse, Germany. Flora-Morphology, Distribution, Functional Ecology of Plants, 209(2),	Medium
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	ornamental value (Nierbauer, K. U., Kanz, B., & Zizka, G. (2014). The widespread naturalisation of Nymphaea hybrids is masking the decline of wild-type Nymphaea alba in Hesse, Germany. Flora-Morphology, Distribution, Functional Ecology of Plants, 209(2),	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No evidence	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	The similarity of climatic conditions between native areas and the RA area is medium (Climatch)	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Nowak, A., Nobis, M., Dajdok, Z., Zalewska-Galosz, J., Nowak, S., Nobis, A., ... & Krawczyk, R. (2010). Revision of Nymphaea candida range-new data on the distribution and habitat preferences of the species in southern Poland. Acta Societatis Botanicorum Poloniae, 79(4).	Low
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	N. candida is present in the RA area. (Boršić I, Kutleša P, Desnica S, Bošnjak D, Slivar S, Wong L J, Pagad S (2021). Global Register of Introduced and Invasive Species- Croatia. Version 2.8. Invasive Species Specialist Group ISSG. Checklist dataset https://doi.org/10.15468/rhmen3 accessed via GBIF.org.)	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	None	(Dabrowska, M. A., Rola, K., Volkova, P., Suda, J., & Zalewska-Galosz, J. (2015). Genome size and phenotypic variation of Nymphaea (Nymphaeaceae) species from Eastern Europe and temperate Asia. Acta Societatis Botanicorum Poloniae, 84(2).	Low
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	No	Hungary (Nowak, A., Nobis, M., Dajdok, Z., Zalewska-Galosz, J., Nowak, S., Nobis, A., ... & Krawczyk, R. (2010). Revision of Nymphaea candida range-new data on the distribution and habitat preferences of the species in southern Poland. Acta Societatis Botanicorum Poloniae, 79(4).	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Czech Republic, Southern regions of Germany, eastern France, Switzerland, south-western Romania, Austria, Hungary (Nowak, A., Nobis, M., Dajdok, Z., Zalewska-Galosz, J., Nowak, S., Nobis, A., ... & Krawczyk, R. (2010). Revision of Nymphaea candida range-new data on the distribution and habitat preferences of the species in southern Poland. Acta Societatis Botanicorum Poloniae,	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	No evidence (Bilz, M., Kell, S.P., Maxted, N. and Lansdown, R.V. 2011. European Red List of Vascular Plants. Luxembourg: Publications Office of the European Union)	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No evidence (Bilz, M., Kell, S.P., Maxted, N. and Lansdown, R.V. 2011. European Red List of Vascular Plants. Luxembourg: Publications Office of the European Union)	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	No evidence (Bilz, M., Kell, S.P., Maxted, N. and Lansdown, R.V. 2011. European Red List of Vascular Plants. Luxembourg: Publications Office of the European Union)	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No evidence (Bilz, M., Kell, S.P., Maxted, N. and Lansdown, R.V. 2011. European Red List of Vascular Plants. Luxembourg: Publications Office of the European Union)	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Bilz, M., Kell, S.P., Maxted, N. and Lansdown, R.V. 2011. European Red List of Vascular Plants. Luxembourg: Publications Office of the European Union)	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No information	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No information	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Boršić I, Kutleša P, Desnica S, Bošnjak D, Slivar S, Wong L J, Pagad S (2021). Global Register of Introduced and Invasive Species- Croatia. Version 2.8. Invasive Species Specialist Group ISSG. Checklist dataset https://doi.org/10.15468/rhmen3	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No evidence	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No evidence	Low

20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No information	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No information	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	Spread 60cm flower up to size 20 cm. (https://www.naturescape.co.uk/product/dwarf-white-water-lily-bareroot/)	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	The plant grows only in water, as it is an aquatic plant, mainly in ponds, lakes, and slow flowing streams (https://inaturalist.ca/taxa/196966-Nymphaea-candida)	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	No evidence (Bilz, M., Kell, S.P., Maxted, N. and Lansdown, R.V. 2011. European Red List of Vascular Plants. Luxembourg: Publications Office of the European Union)	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Nowak, A., Nobis, M., Dajdok, Z., Zalewska-Galosz, J., Nowak, S., Nobis, A., ... & Krawczyk, R. (2010). Revision of Nymphaea candida range-new data on the distribution and habitat preferences of the species in southern Poland. Acta Societatis Botanicorum Poloniae, 79(4).	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	Not applicable	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	Not applicable	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	(Boršić I, Kutleša P, Desnica S, Bošnjak D, Slivar S, Wong L J, Pagad S (2021). Global Register of Introduced and Invasive Species- Croatia. Version 2.8. Invasive Species Specialist Group ISSG. Checklist dataset https://doi.org/10.15468/rhmen3	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Nymphaea alba – N. candida (Vít, P. (2017). Evolutionary and conservation consequences of interspecific hybridization in rare plant species.)	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 795-	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Nowak, A., Nobis, M., Dajdok, Z., Zalewska-Galosz, J., Nowak, S., Nobis, A., ... & Krawczyk, R. (2010). Revision of Nymphaea candida range-new data on the distribution and habitat preferences of the species in southern Poland. Acta Societatis Botanicorum Poloniae, 79(4).	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 795-804.	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 795-804.	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	the aquatic plant trade	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	No information	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No information	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 795-804.	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 795-804.	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Not applicable	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No evidence (Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 795-804).	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	No	Low
43	7.09	Is dispersal of the taxon density dependent?	No	Wiersema, J. H. (1988). Reproductive biology of Nymphaea (Nymphaeaceae). Annals of the Missouri Botanical Garden, 795-	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Nowak, A., Nobis, M., Dajdok, Z., Zalewska-Galosz, J., Nowak, S., Nobis, A., ... & Krawczyk, R. (2010). Revision of Nymphaea candida range-new data on the distribution and habitat preferences of the species in southern Poland. Acta Societatis Botanicorum Poloniae, 79(4).	Medium

45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	No	Nowak, A., Nobis, M., Dajdok, Z., Zalewska-Galosz, J., Nowak, S., Nobis, A., ... & Krawczyk, R. (2010). Revision of Nymphaea candida range-new data on the distribution and habitat preferences of the species in southern Poland. Acta Societatis Botanicorum Poloniae, 79(4).	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No information	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	SKLIAR, I., SKLIAR, V., KLYMENKO, A., SHERSTIUK, M., & ZUBTSOVA, I. (2020). GROWTH SIGNS OF Nymphaea candida IN VARIOUS ECOLOGICAL AND CENOTIC CONDITIONS OF DESNA BASIN (UKRAINE). AgroLife Scientific Journal, 9(1), 316-323.	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Freshwater species	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	No evidence	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	N. candida is present in the RA area. (Boršić I, Kutleša P, Desnica S, Bošnjak D, Slivar S, Wong L J, Pagad S (2021). Global Register of Introduced and Invasive Species- Croatia. Version 2.8. Invasive Species Specialist Group ISSG. Checklist dataset https://doi.org/10.15468/rhmen3 accessed via GBIF.org.)	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	The risks of dispersal is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.	Medium

Statistics	
Scores	
BRA	**5.5**
BRA Outcome	**Medium**
BRA+CCA	**5.5**
BRA+CCA Outcome	**Medium**
Score partition	
A. Biogeography/Historical	**3.5**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*1.5*
B. Biology/Ecology	**2.0**
4. Undesirable (or persistence) traits	*1.0*
5. Resource exploitation	*0.0*
6. Reproduction	*6.0*
7. Dispersal mechanisms	*-3.0*
8. Tolerance attributes	*-2.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**3**
Environmental	**0**
Species or population nuisance traits	**3**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.40**
BRA	**0.38**
CCA	**0.58**

Date and Time
06/12/2021 22:19:04

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Nymphaea lotus*
Common name	white Egyptian lotus
Assessor	Marina Piria
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	The leaves, petioles, roots and seeds are all used in medicine in Nigeria (Lim, 2014)	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Pet/aquarium trade https://www.cabi.org/isc/datasheet/115821#touses	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Nymphaea odorata http://www.columbia.edu/itc/cerc/danoff-burg/invasion_bio/inv_spp_summ/Nymphaea_odorata.html	Medium
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	N. lotus is widespread in Africa and parts of temperate and tropical Asia to which it is native (Plant Gene Resources of Canada, 2016) but tolerate Bs climate	Low
5	2.02	What is the quality of the climate matching data?	Medium	Climatch	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	Horizon species, found in Hungary	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	water, floating vegetation https://www.cabi.org/isc/datasheet/115821#topathwayVectors	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	in Hungary, Hussner et al 2012	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Costarika, Salvador https://www.cabi.org/isc/datasheet/115821#todistribution	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	having moderate negative impacts on wildlife or natural communities in Louisiana, but of limited concern and/or extent	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	The plant has also been reported as a weed of fish ponds in Nigeria (Adesina et al., 2015).	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	Negatively impacts livelihoods	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	. lotus has many uses as a human food; th	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	N. lotus produces a dense mat-like canopy that is heavy enough to break tillers of rice during vegetative growth periods and can reduce crop yield, particularly in direct seeded rice (Mohamed and Serag, 2003). H	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	it is not parasite	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	n Louisiana, USA, the plant is listed as a Tier II invasive species, (having moderate negative impacts on wildlife or natural communities in Louisiana, but of limited concern and/or extent),	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	no evidences but potentially can affect fishery	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	no evidence	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	In Ghana, Annang and Addo-Boadu (2012) recorded twenty-eight genera of algae belonging to five phyla in association with N. lotus.	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	it is large plant	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	require calm, shallow (<2 m) water, full sunlight and neutral to slightly alkaline pH	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	N. lotus could possibly be used for the removal of heavy metals from polluted water sources (Mohamed and Serag, 2003).	High

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Species of Nymphaea reproduce sexually though show variability between species e.g. flower opening times, flower colour and function of the various flower parts. Agamospermous reproduction is not seen in species of Nymphaea, however several modes are exhibited e.g. detachable tubers and stolon formation.	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	no	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Probably	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	no.	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Species of Nymphaea reproduce sexually though show variability between species e.g. flower opening times, flower colour and function of the various flower parts. Agamospermous reproduction is not seen in species of Nymphaea, however several modes are exhibited e.g. detachable tubers and stolon formation.	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No evidence but other Nymphea species can hybridize https://pbsociety.org.pl/journals/index.php/asbp/article/view/asbp.2015.016/0	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Species of Nymphaea reproduce sexually though show variability between species e.g. flower opening times, flower colour and function of the various flower parts. Agamospermous reproduction is not seen in species of Nymphaea, however several modes are exhibited e.g. detachable tubers and stolon formation.	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	No	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	debris, water, birds	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	birds https://www.cabi.org/isc/datasheet/115821#toimpactSummary	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no data https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	not yet present	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	not yet present	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	na	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Medium
43	7.09	Is dispersal of the taxon density dependent?	No	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Very high
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	Herbicides if allowed	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	https://www.cabi.org/isc/datasheet/115821#toimpactSummary	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	no	Very high
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	preferring warm temperatures	High

51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	prefer warm temperatures	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	watercourses are connected	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	if introduced with increase temp. have better chance fully establish	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	if there is better chance to establish and distribute than can have higher impact	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	probably will affect fisheries	Medium

Statistics	
Scores	
BRA	**14.5**
BRA Outcome	**Medium**
BRA+CCA	**26.5**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**15.5**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*10.5*
B. Biology/Ecology	**-1.0**
4. Undesirable (or persistence) traits	*3.0*
5. Resource exploitation	*2.0*
6. Reproduction	*-1.0*
7. Dispersal mechanisms	*-1.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**13**
Environmental	**10**
Species or population nuisance traits	**7**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.68**
BRA	**0.69**
CCA	**0.58**

Date and Time
23/11/2021 17:07:57

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Pistia stratiotes*
Common name	water lettuce
Assessor	Tena Radočaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	P. stratiotes is a popular ornamental plant, used in ponds and aquariums. (Global Invasive Species Database (2021) Species profile: Pistia stratiotes).	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	P. stratiotes is a popular ornamental plant, used in ponds and aquariums. (Global Invasive Species Database (2021) Species profile: Pistia stratiotes).	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No evidence	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Low	The similarity of climatic conditions between native areas and the RA area is low (Climatch)	Medium
5	2.02	What is the quality of the climate matching data?	Medium	I used climatch and distribution map of CABI	Low
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	P. stratiotes is present in RA area (Boršić, I., Rubinić, T., 2018: First record of Pistia stratiotes L. (Araceae) in Croatia, with the consideration of possible introduction pathways. In: Jelaska, S.D. (ed.), Zbornik sažetaka 3. Hrvatskog simpozija o invazivnim vrstama, 96. Hrvatsko ekološko društvo, Zagreb)	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	None	P. stratiotes is present in RA area (Boršić, I., Rubinić, T., 2018: First record of Pistia stratiotes L. (Araceae) in Croatia, with the consideration of possible introduction pathways. In: Jelaska, S.D. (ed.), Zbornik sažetaka 3. Hrvatskog simpozija o invazivnim vrstama, 96. Hrvatsko ekološko društvo, Zagreb)	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	No	P. stratiotes is present in RA area (Boršić, I., Rubinić, T., 2018: First record of Pistia stratiotes L. (Araceae) in Croatia, with the consideration of possible introduction pathways. In: Jelaska, S.D. (ed.), Zbornik sažetaka 3. Hrvatskog simpozija o invazivnim vrstama, 96. Hrvatsko ekološko društvo, Zagreb)	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	It was introduced into Europe in the 20th century and has since spread to 15 European countries (Živković, M. M., Anđelković, A. A., Cvijanović, D. L., Novković, M. Z., Vukov, D. M., Šipoš, Š. Š., ... & Radulović, S. B. (2019). The beginnings of Pistia stratiotes L. invasion in the lower Danube delta: the first record for the Province of Vojvodina (Serbia). BioInvasions Record, 8(2))	Medium
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Its growth habit can make it a weed in waterways, where it can kill native submerged plants and reduce biodiversity. (CABI, 2020)	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No evidence	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	Mats of P. stratiotes can also disrupt natural ecosystems. They can lead to a lower concentration of oxygen in covered waters and sediments by blocking air-water interface and root respiration. (Global Invasive Species Database (2021) Species profile: Pistia stratiotes.)	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	P. stratiotes can inflict a severe impact on the environment and economy of infested areas. The dense mats created by connected rosettes of the plant lead to the majority of problems encountered with water lettuce. These mats can have a negative economic effect by blocking waterways, thus increasing the difficulty of navigation and hindering flood control efforts. (Global Invasive Species Database (2021) Species profile: Pistia stratiotes.)	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Global Invasive Species Database (2021) Species profile: Pistia stratiotes.)	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Such rigorous growth often leads to drastic reductions in the diversity of native aquatic plant and animal communities (Živković, M. M., Anđelković, A. A., Cvijanović, D. L., Novković, M. Z., Vukov, D. M., Šipoš, Š. Š., ... & Radulović, S. B. (2019). The beginnings of Pistia stratiotes L. invasion in the lower Danube delta: the first record for the Province of Vojvodina (Serbia).	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No evidence (Global Invasive Species Database (2021) Species profile: Pistia stratiotes.	Low

17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Its temperature tolerance limits are 15°C (59°F) and 35°C (95°F); the optimal growth temperature range for the plant is 22-30°C. In the RA area is temperate climate. Over the years it has been introduced to a number of European countries, e.g. Czech Republic, Spain and Russia but without forming self-replacing populations. (Živković, M. M., Anđelković, A. A., Cvijanović, D. L., Novković, M. Z., Vukov, D. M., Šipoš, Š. Š., ... & Radulović, S. B. (2019). The beginnings of Pistia stratiotes L. invasion in the lower Danube delta: the first record for the Province of Vojvodina	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	In the RA area it cannot survive the winter, but it can probably have a adverse impact on the ecosystem in the short period when it is present. Ecological impacts of P. stratiotes and note that they include increased rates of siltation, slowing of water velocities, degradation of fish nesting sites, increased nutrient loading, thermal stratification, increase in alkalinity and fish and macroinvertebrate mortality. (CABI, 2020)	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Consequently, such dense stands of Pistia may have serious negative effects on the multifunctional human use of waterbodies. These harmful effects include impediment of the transport of irrigation and drainage water, interference with hydro-electric schemes from artificial lakes, hindering navigation and fishing and the creation of habitats favourable for the transmittance of water-borne diseases (CABI, 2020)	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No evidence (Global Invasive Species Database (2021) Species profile: Pistia stratiotes).	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No evidence (Global Invasive Species Database (2021) Species profile: Pistia stratiotes).	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Živković, M. M., Anđelković, A. A., Cvijanović, D. L., Novković, M. Z., Vukov, D. M., Šipoš, Š. Š., ... & Radulović, S. B. (2019). The beginnings of Pistia stratiotes L. invasion in the lower Danube delta: the first record for the Province of Vojvodina (Serbia). BioInvasions Record, 8(2).	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	Pistia stratiotes grows in slow-moving rivers and reservoirs, irrigation channels, ponds, lakes, canals and ditches (Živković, M. M., Anđelković, A. A., Cvijanović, D. L., Novković, M. Z., Vukov, D. M., Šipoš, Š. Š., ... & Radulović, S. B. (2019). The beginnings of Pistia stratiotes L. invasion in the lower Danube delta: the first record for the Province of Vojvodina (Serbia). BioInvasions	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Ecological impacts of P. stratiotes and note that they include increased rates of siltation, slowing of water velocities, degradation of fish nesting sites, increased nutrient loading, thermal stratification, increase in alkalinity and fish and	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Živković, M. M., Anđelković, A. A., Cvijanović, D. L., Novković, M. Z., Vukov, D. M., Šipoš, Š. Š., ... & Radulović, S. B. (2019). The beginnings of Pistia stratiotes L. invasion in the lower Danube delta: the first record for the Province of Vojvodina (Serbia). BioInvasions Record, 8(2).)	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	Not applicable	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No evidence	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	Not applicable	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	No, due to lower temperatures (Global Invasive Species Database (2021) Species profile: Pistia stratiotes).	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No information (CABI, 2020); Global Invasive Species Database (2021) Species profile: Pistia stratiotes.	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	Reproduces asexually (CABI, 2020) ; Global Invasive Species Database (2021) Species profile: Pistia stratiotes.	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Global Invasive Species Database (2021) Species profile: Pistia stratiotes.	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Rapid vegetative reproduction allows water lettuce to cover an entire lake, from shore to shore, with a dense mat of connected rosettes in a short period of time. (Global Invasive Species Database (2021) Species profile: Pistia stratiotes).	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	Global Invasive Species Database (2021) Species profile: Pistia stratiotes.	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Escape from confinement or garden escape, Ornamental purposes, Nursery trade (CABI, 2020)	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Fragments, or whole plants, can be spread via boats or fishing equipment from an infested area to a clean body of water. (Global Invasive Species Database (2021) Species profile: Pistia stratiotes)	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No (CABI, 2020) ; Global Invasive Species Database (2021) Species profile: Pistia stratiotes.	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	P. stratiotes reproduces vegetatively and by seed. (Global Invasive Species Database (2021) Species profile: Pistia stratiotes.)	High

39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Global Invasive Species Database (2021) Species profile: Pistia stratiotes	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Not applicable	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	CABI 2020; Global Invasive Species Database (2021) Species profile: Pistia stratiotes	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Ship ballast water; Floating vegetation and debris (CABI, 2020)	Low
43	7.09	Is dispersal of the taxon density dependent?	No	CABI 2020; Global Invasive Species Database (2021) Species profile: Pistia stratiotes	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	It can survive for extended periods on moist soil. (CABI, 2020)	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	No information (CABI, 2020)	Low
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	Chemical control methods that have been successful in treating P. stratiotes include the herbicide endothall, which can act quickly and kill all plant cells that it contacts. (Global Invasive Species Database (2021) Species profile: Pistia stratiotes).	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Global Invasive Species Database (2021) Species profile: Pistia stratiotes	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	P. stratiotes has a low salinity tolerance; salt concentrations of 1.66% are toxic to the plant (Haller et al., 1974).	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	In the RA area no	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	Not applicable	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	We may assume that predicted climate change causing warmer conditions might create new problems: the species might extend its range. (Šajna, N., Haler, M., Škornik, S., & Kaligarič, M. (2007). Survival and expansion of Pistia stratiotes L. in a thermal stream in Slovenia. Aquatic Botany, 87(1), 75-79.)	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	Its growth habit can make it a weed in waterways, where it can kill native submerged plants and reduce biodiversity. (CABI, 2020)	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	(Šajna, N., Haler, M., Škornik, S., & Kaligarič, M. (2007). Survival and expansion of Pistia stratiotes L. in a thermal stream in Slovenia. Aquatic Botany, 87(1), 75-79.)	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	These mats can have a negative economic effect by blocking waterways, thus increasing the difficulty of navigation and hindering flood control efforts. (CABI, 2020)	Medium

Statistics	
Scores	
BRA	**15.0**
BRA Outcome	**Medium**
BRA+CCA	**23.0**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**9.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*7.0*
B. Biology/Ecology	**6.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*0.0*
6. Reproduction	*3.0*
7. Dispersal mechanisms	*0.0*
8. Tolerance attributes	*-2.0*
C. Climate change	**8.0**
9. Climate change	*8.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*

7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**11**
Environmental	**10**
Species or population nuisance traits	**5**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.53**
BRA	**0.53**
CCA	**0.54**

Date and Time
06/12/2021 22:38:50

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Rotala macrandra*
Common name	-
Assessor	Tena Radočaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Rotala macrandra is popular in the global aquarium trade (Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Rotala macrandra is popular in the global aquarium trade (Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	R. rotundifolia	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Low	The similarity of climatic conditions between native areas and the RA area is low (Climatch)	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala	Low
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	R. macrandra is not present in the RA area.	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	The aquarium trade (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Hungary (Hussner, A. (2012). Alien aquatic plant species in European countries. Weed Research, 52(4), 297-306).	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	It has escaped from cultivation in Hungary, where the plants survive in thermal water bodies. (Hussner, A. (2012). Alien aquatic plant species in European countries. Weed Research,	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	No evidence that R. macrandra has any negative impacts in natural environments, urban and suburban settings, or production systems. (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No evidence that R. macrandra has any negative impacts in natural environments, urban and suburban settings, or production systems. (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	No evidence that R. macrandra has any negative impacts in natural environments, urban and suburban settings, or production systems. (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No evidence that R. macrandra has any negative impacts in natural environments, urban and suburban settings, or production systems. (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No evidence that R. macrandra has any negative impacts in natural environments, urban and suburban settings, or production systems. (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No evidence	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Native area is India, and in Hungary survive in thermal water bodies. (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No evidence	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No evidence	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	The shoots of R. macrandra can grow 60 cm in length (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala).	Medium

23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	R. macrandra occurs in streams, temporary ponds, and flooded paddy fields. (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala).	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	No evidence that R. macrandra has any negative impacts in natural environments, urban and suburban settings, or production systems. (Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala)	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Botond, M., and B.-D. Zoltan (eds.). 2004. Biologiai Invaziok Magyarorszagon: Ozonnovenyek [Biological Invasions in Hungary: Invasive Plants]. TermészetBÚVÁR Alapítvány Kiadó, Budapest. 409 pp.	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	Not applicable	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	Not applicable	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	No information- I think not, because of low temperatures in the RA area.	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No evidence	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	Botond, M., and B.-D. Zoltan (eds.). 2004. Biologiai Invaziok Magyarorszagon: Ozonnovenyek [Biological Invasions in Hungary: Invasive Plants]. TermészetBÚVÁR Alapítvány Kiadó, Budapest. 409 pp.	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No evidence	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Botond, M., and B.-D. Zoltan (eds.). 2004. Biologiai Invaziok Magyarorszagon: Ozonnovenyek [Biological Invasions in Hungary: Invasive Plants]. TermészetBÚVÁR Alapítvány Kiadó, Budapest. 409 pp.	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	Botond, M., and B.-D. Zoltan (eds.). 2004. Biologiai Invaziok Magyarorszagon: Ozonnovenyek [Biological Invasions in Hungary: Invasive Plants]. TermészetBÚVÁR Alapítvány Kiadó, Budapest. 409 pp.	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Escape from garden	Low
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Personal opinion- flood or boat	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No evidence	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	No evidence	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	No evidence	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Not applicable	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	(Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala).	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Floods	Low
43	7.09	Is dispersal of the taxon density dependent?	No	(Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala).	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	(Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala).	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	(Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala).	Low
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No evidence	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	(Climatch and Weed Risk Assessment for Rotala macrandra Koehne (Lythraceae) – Giant red Rotala).	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Freshwater species	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	No	Low
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	The risks of entry into the RA area by the taxon are likely to no change, only by human impact.	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	The risks of dispersal is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium

Statistics	
Scores	
BRA	**8.0**
BRA Outcome	**Medium**
BRA+CCA	**8.0**
BRA+CCA Outcome	**Medium**
Score partition	
A. Biogeography/Historical	**5.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*1.0*
B. Biology/Ecology	**3.0**
4. Undesirable (or persistence) traits	*1.0*
5. Resource exploitation	*0.0*
6. Reproduction	*3.0*
7. Dispersal mechanisms	*-3.0*
8. Tolerance attributes	*2.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**4**
Environmental	**1**
Species or population nuisance traits	**5**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.41**
BRA	**0.40**
CCA	**0.50**

Date and Time
06/12/2021 13:48:01

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Rotala rotundifolia*
Common name	dwarf rotala
Assessor	Tena Radočaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	It is widely grown as an aquarium plant (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	It is widely grown as an aquarium plant (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	R.macrandra	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Low	Rotala rotundifolia is native to South and Southeast Asia from Japan to India. (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup) The similarity of climatic conditions between native areas and the RA area is low (Climatch)	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climatch and Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	R. rotundifolia is not present in the RA area.	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Pet trade (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Rotala rotundifolia has become naturalized iin thermal water bodies in Hungary (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Rotala rotundifolia has become naturalized in Australia in Queensland and New South Wales and in thermal water bodies in Hungary (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	that shades out native vegetation (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No evidence	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	Rotala rotundifolia is targeted for control in natural systems because this species forms a dense layer on the water surface and restricts water flow. It is prohibited in Western Australia, Tasmania and Honduras. Rotala rotundifolia is also controlled in residential areas because dense populations interfere with drainage, preventing water control canals from working properly. (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No evidence (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No evidence	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No evidence	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Native area to South and Southeast Asia from Japan to India, and in Hungary survive in thermal water bodies (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No evidence	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No evidence	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	(Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	(Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Its stems can be creeping or floating and can grow to 70 cm long (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Medium

23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	R. rotundifolia grows in marshes, swamps, and shallow ponds at high altitudes. (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	changes habitat light regime and slows water flow (Zlatković, B. K., & Bogosavljević, S. S. (2020). Risk analysis of alien plants recorded in thermal waters of Serbia. Weed Research, 60(1), 85-95).	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No evidence	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	Not applicable	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	Not applicable	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	In the RA area is low temperatures	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No information	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No evidence	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	(Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	R. rotundifolia is known to disperse by water (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	By water (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No information	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	reproduce by seed (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Fragments also can be dispersed easily in water bodies, providing rapid distribution purely by vegetative means. (Ervin, G. N., & White, R. A. Assessing vegetative growth potential of exotic Rotala rotundifolia (Roxb.) Koehne (roundleaf toothcup), in comparison with Alternanthera philoxeroides (Mart.) Griseb.(alligator weed), a known successful invader.)	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Not applicable	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Ervin, G. N., & White, R. A. Assessing vegetative growth potential of exotic Rotala rotundifolia (Roxb.) Koehne (roundleaf toothcup), in comparison with Alternanthera philoxeroides (Mart.) Griseb.(alligator weed), a known successful invader.	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Water (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Low
43	7.09	Is dispersal of the taxon density dependent?	No	No information	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	Rotala rotundifolia is a water-loving plant that can grow fully submerged, as an emerged aquatic plant, and as a terrestrial plant in dry gravel. (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	Yes	This species has the potential to grow in a broad range of conditions (Ervin, G. N., & White, R. A. Assessing vegetative growth potential of exotic Rotala rotundifolia (Roxb.) Koehne (roundleaf toothcup), in comparison with Alternanthera philoxeroides (Mart.) Griseb.(alligator weed), a known successful	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	the contact herbicide diquat and the sys temic herbicides glyphosate, imazapyr, penoxsulam, and triclopyr are likely to provide effective control (Ervin, G. N. Roundleaf toothcup [Rotala rotundifolia (Roxb.) Koehne].)	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	No evidence (Weed Risk Assessment for Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne (Lythraceae) – Roundleaf toothcup)	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Freshwater species	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	No evidence	Low
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Only by humans.	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	The risks of establishment is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany,	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	The risks of dispersal is no change, in the future temperatures will not be high enough to achieve a stable population (Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.	Medium

Statistics	
Scores	
BRA	**14.0**
BRA Outcome	**Medium**
BRA+CCA	**14.0**
BRA+CCA Outcome	**Medium**
Score partition	
A. Biogeography/Historical	**9.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*5.0*
B. Biology/Ecology	**5.0**
4. Undesirable (or persistence) traits	*1.0*
5. Resource exploitation	*0.0*
6. Reproduction	*3.0*
7. Dispersal mechanisms	*1.0*
8. Tolerance attributes	*0.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**6**
Environmental	**4**
Species or population nuisance traits	**6**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.50**
BRA	**0.51**
CCA	**0.50**

Date and Time
06/12/2021 14:41:05

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Sagittaria subulata*
Common name	awl-leaf arrowhead
Assessor	Tena Radočaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Garden ponds (http://freshwateraquariumplants.com/plantprofiles/narrowsag.html)	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Garden ponds (http://freshwateraquariumplants.com/plantprofiles/narrowsag.ht	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No evidence	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Low	The similarity of climatic conditions between native areas and the RA area is low (Climatch)	Low
5	2.02	What is the quality of the climate matching data?	Low	https://tropica.com/en/plants/plantdetails/Sagittariasubulata(079)/4530	Low
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	S. subulata is not present in the RA area.	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Pet trade	Low
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Hungary (Brunel, S. (2009). Pathway analysis: aquatic plants imported in 10 EPPO countries. EPPO bulletin, 39(2), 201-213).	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Slovakia (Hrivnák, R., Medvecká, J., Baláži, P., Bubíková, K., Oťaheľová, H., & Svitok, M. (2019). Alien aquatic plants in Slovakia over 130 years: historical overview, current distribution and future perspectives. NeoBiota, 49, 37).	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Low risk (Brunel, S. (2009). Pathway analysis: aquatic plants imported in 10 EPPO countries. EPPO bulletin, 39(2), 201-213.)	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Low risk (Brunel, S. (2009). Pathway analysis: aquatic plants imported in 10 EPPO countries. EPPO bulletin, 39(2), 201-213.)	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	Low risk (Brunel, S. (2009). Pathway analysis: aquatic plants imported in 10 EPPO countries. EPPO bulletin, 39(2), 201-213.)	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Low risk (Brunel, S. (2009). Pathway analysis: aquatic plants imported in 10 EPPO countries. EPPO bulletin, 39(2), 201-213.)	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless	Medium
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	Low risk (Brunel, S. (2009). Pathway analysis: aquatic plants imported in 10 EPPO countries. EPPO bulletin, 39(2), 201-213.)	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No evidence	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	South America	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No evidence	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No evidence	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No information	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No information	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Place individual plants 2-4 cm apart. This plant may cause problems because in certain conditions it suddenly grows to a height of 50 cm when it grows older	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	The remaining alien plants were recorded in shallow or even very shallow waters (< 0.4 m, Sagittaria subulata). (Hrivnák, R., Medvecká, J., Baláži, P., Bubíková, K., Oťaheľová, H., & Svitok, M. (2019). Alien aquatic plants in Slovakia over 130 years: historical overview, current distribution and future perspectives. NeoBiota,	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Low risk (Brunel, S. (2009). Pathway analysis: aquatic plants imported in 10 EPPO countries. EPPO bulletin, 39(2), 201-213.)	Low

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No evidence	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	Not applicable	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	Not applicable	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	Sutton, D. L. (1990). Growth of Sagittaria subulata and interaction with hydrilla. Journal of Aquatic Plant Management, 28, 20-22.	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Sutton, D. L. (1990). Growth of Sagittaria subulata and interaction with hydrilla. Journal of Aquatic Plant Management, 28, 20-22.	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	Sutton, D. L. (1990). Growth of Sagittaria subulata and interaction with hydrilla. Journal of Aquatic Plant Management, 28, 20-22.	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No evidence	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	No	No evidence	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	Sutton, D. L. (1990). Growth of Sagittaria subulata and interaction with hydrilla. Journal of Aquatic Plant Management, 28, 20-22.	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Pet trade	Low
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	No evidence	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No evidence	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	No evidence	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	No evidence	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	Not applicable	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Adair, R. J., Keener, B. R., Kwong, R. M., Sagliocco, J. L., & Flower, G. E. (2012). The Biology of Australian weeds 60.'Sagittaria platyphylla'(Engelmann) JG Smith and'Sagittaria calycina'Engelmann. Plant Protection Quarterly, 27(2), 47-58.	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	Adair, R. J., Keener, B. R., Kwong, R. M., Sagliocco, J. L., & Flower, G. E. (2012). The Biology of Australian weeds 60.'Sagittaria platyphylla'(Engelmann) JG Smith and'Sagittaria calycina'Engelmann. Plant Protection Quarterly, 27(2), 47-58.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	Adair, R. J., Keener, B. R., Kwong, R. M., Sagliocco, J. L., & Flower, G. E. (2012). The Biology of Australian weeds 60.'Sagittaria platyphylla'(Engelmann) JG Smith and'Sagittaria calycina'Engelmann. Plant Protection Quarterly, 27(2), 47-58.	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Adair, R. J., Keener, B. R., Kwong, R. M., Sagliocco, J. L., & Flower, G. E. (2012). The Biology of Australian weeds 60.'Sagittaria platyphylla'(Engelmann) JG Smith and'Sagittaria calycina'Engelmann. Plant Protection Quarterly, 27(2), 47-58.	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Adair, R. J., Keener, B. R., Kwong, R. M., Sagliocco, J. L., & Flower, G. E. (2012). The Biology of Australian weeds 60.'Sagittaria platyphylla'(Engelmann) JG Smith and'Sagittaria calycina'Engelmann. Plant Protection Quarterly, 27(2), 47-58.	Low
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	Adair, R. J., Keener, B. R., Kwong, R. M., Sagliocco, J. L., & Flower, G. E. (2012). The Biology of Australian weeds 60.'Sagittaria platyphylla'(Engelmann) JG Smith and'Sagittaria calycina'Engelmann. Plant Protection Quarterly, 27(2), 47-58.	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	No evidence	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Humphreys, A., Gorsky, A. L., Bilkovic, D. M., & Chambers, R. M. (2021). Changes in plant communities of low-salinity tidal marshes in response to sea-level rise. Ecosphere, 12(7), e03630.	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	No evidence	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Only by humans	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium

52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	(Parmesan, C., & Hanley, M. E. (2015). Plants and climate change: complexities and surprises. Annals of botany, 116(6), 849-864.)	Medium

Statistics	
Scores	
BRA	**6.0**
BRA Outcome	**Medium**
BRA+CCA	**6.0**
BRA+CCA Outcome	**Medium**
Score partition	
A. Biogeography/Historical	**8.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*6.0*
B. Biology/Ecology	**-2.0**
4. Undesirable (or persistence) traits	*0.0*
5. Resource exploitation	*0.0*
6. Reproduction	*2.0*
7. Dispersal mechanisms	*-5.0*
8. Tolerance attributes	*1.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**7**
Environmental	**0**
Species or population nuisance traits	**-1**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.37**
BRA	**0.36**
CCA	**0.50**

Date and Time
07/12/2021 09:02:34

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Utricularia gibba*
Common name	humped bladderwort
Assessor	Marina Piria
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	U. gibba is commonly cultivated as an ornamental plant (Biosecurity New Zealand, 2008); it may have been introduced originally as an aquarium plant (Webb et al., 1988). I	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	U. gibba is commonly cultivated as an ornamental plant (Biosecurity New Zealand, 2008); it may have been introduced originally as an aquarium plant (Webb et al., 1988). I	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Utricularia aurea	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	prefer Cs - Warm temperate climate with dry summer	Low
5	2.02	What is the quality of the climate matching data?	Medium	Cs - Warm temperate climate with dry summer; Climatch	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	https://www.cabi.org/isc/datasheet/117747	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	machinery, water,pet trade	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Hungary; Husner 2012	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Nwe Zealand	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Impact on wild native species https://www.cabi.org/isc/datasheet/117747	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	Has high reproductive potential, U. gibba forms mats over the water surface; in New Zealand it has been reported that this could be a problem for irrigation and drainage (Champion and Clayton, 2000; Biosecurity New Zealand, 2008).	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	Damaged ecosystem services	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	. gibba is reported as a weed in botanic gardens throughout the world; it poses no known harm to human health (Biosecurity New Zealand, 2008).	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	. gibba is reported as a weed in botanic gardens throughout the world; it poses no known harm to human health (Biosecurity New Zealand, 2008).	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Competition - monopolizing resources Competition - shading Rapid growth	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	it is not parasitic spec	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	U. gibba is specially adapted to low-nutrient environments such as bogs and swamps (Biosecurity New Zeland, 2008), and increases in abundance when the conditions change from oligotrophic to mesotropic; however, with further change in that direction it decreases in abundance (Preston and Croft, 1997)	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	yes	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	if introduced, yes	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	no data	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	no data	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	it has high growth potential	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	U. gibba prefers slow-moving, warm water and has moderate shade tolerance (NZPCN, 2010). These factors best explain the occurrence of U. gibba in New Zealand (Compton et al., 2012).	Very high

24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	no data	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	The flowers are hermaphrodite and pollinated either by insects or by self-pollination (Salmon, 2001). U. gibba regenerates naturally from seeds (Champion and Clayton, 2000; Compton, et al., 2012). The vegetative reproduction is by re-sprouts from stem fragments or from rhizomes (NZPCN, 2010). U. gibba differs from all these species in that it has no winter buds in its leaf axils, which are the most common propagation method for other species of Utricularia (Zhenyu and Cheek, 2011).	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	specialized carnivorous plant	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Competition - monopolizing resources	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	https://www.cabi.org/isc/datasheet/117747	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	yes, similar conditions as part of New Zealand	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	no evidences	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	The flowers are hermaphrodite and pollinated either by insects or by self-pollination (Salmon, 2001). U. gibba regenerates naturally from seeds (Champion and Clayton, 2000; Compton, et al., 2012). The vegetative reproduction is by re-sprouts from stem fragments or from rhizomes (NZPCN, 2010). U. gibba differs from all these species in that it has no winter buds in its leaf axils, which are the most common propagation method for other species of Utricularia (Zhenyu and Cheek, 2011).	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	no.	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	The flowers are hermaphrodite and pollinated either by insects or by self-pollination (Salmon, 2001). U. gibba regenerates naturally from seeds (Champion and Clayton, 2000; Compton, et al., 2012). The vegetative reproduction is by re-sprouts from stem fragments or from rhizomes (NZPCN, 2010). U. gibba differs from all these species in that it has no winter buds in its leaf axils, which are the most common propagation method for other species of Utricularia (Zhenyu and Cheek, 2011).	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	The flowers are hermaphrodite and pollinated either by insects or by self-pollination (Salmon, 2001). U. gibba regenerates naturally from seeds (Champion and Clayton, 2000; Compton, et al., 2012). The vegetative reproduction is by re-sprouts from stem fragments or from rhizomes (NZPCN, 2010). U. gibba differs from all these species in that it has no winter buds in its leaf axils, which are the most common propagation method for other species of Utricularia (Zhenyu and Cheek, 2011).	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	vector organisms, machinery, water	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	can be transferred by birds	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	passive yes, active no	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	The flowers are hermaphrodite and pollinated either by insects or by self-pollination (Salmon, 2001). U. gibba regenerates naturally from seeds (Champion and Clayton, 2000; Compton, et al., 2012). The vegetative reproduction is by re-sprouts from stem fragments or from rhizomes (NZPCN, 2010). U. gibba differs from all these species in that it has no winter buds in its leaf axils, which are the most common propagation method for other species of Utricularia (Zhenyu and Cheek, 2011).	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	The flowers are hermaphrodite and pollinated either by insects or by self-pollination (Salmon, 2001). U. gibba regenerates naturally from seeds (Champion and Clayton, 2000; Compton, et al., 2012). The vegetative reproduction is by re-sprouts from stem fragments or from rhizomes (NZPCN, 2010). U. gibba differs from all these species in that it has no winter buds in its leaf axils, which are the most common propagation method for other species of Utricularia (Zhenyu and Cheek, 2011).	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	no.	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	Yes	yes	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	probably not	Medium

43	7.09	Is dispersal of the taxon density dependent?	No	The flowers are hermaphrodite and pollinated either by insects or by self-pollination (Salmon, 2001). U. gibba regenerates naturally from seeds (Champion and Clayton, 2000; Compton, et al., 2012). The vegetative reproduction is by re-sprouts from stem fragments or from rhizomes (NZPCN, 2010). U. gibba differs from all these species in that it has no winter buds in its leaf axils, which are the most common propagation method for other species of Utricularia (Zhenyu and Cheek, 2011).	Very high
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	Yes	Has propagules that can remain viable for more than one year	Medium
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	mezortophic cinditions, eutrophic cant stand	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No information is available on any chemical control methods attempted on this species. Only mechanical removal	Medium
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	probably not	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	No data	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Rook (2004) reports that in America, U. gibba is occasionally eaten by muskrats, ducks and other waterfowl.	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	preferred warm climates	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	preferred warm climates	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	connected waterbodies	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	U. gibba has been identified as outcompeting and threatening native, endangered bladderworts including U. dichotoma and U. delicatula, and sundews including Drosera auriculata, D. peltata and the forked sundew D. binate	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	probably higher	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	on fishing activities	Medium

Statistics	
Scores	
BRA	**28.5**
BRA Outcome	**High**
BRA+CCA	**40.5**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**16.5**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*10.5*
B. Biology/Ecology	**12.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*2.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*3.0*
8. Tolerance attributes	*-2.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**14**
Environmental	**10**
Species or population nuisance traits	**21**

Thresholds	
BRA	22.75
BRA+CCA	22.75
Confidence	
BRA+CCA	0.65
BRA	0.66
CCA	0.54

Date and Time
23/11/2021 17:08:35

AS-ISK v2

Taxon and Assessor details	
Category	Plantae (freshwater)
Taxon name	*Vallisneria australis*
Common name	-
Assessor	Marina Piria
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Pannonian region
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	For aquaria https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	for aquaria https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	Low
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Valisneria neotropicalis https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	climatch	Medium
5	2.02	What is the quality of the climate matching data?	Medium	climatch	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Hungary, Germany but previously was misidentified as V. nana or V. americana https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	Medium
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	accidental, release from aquaria https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Hungary https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	no data https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	probably displace other species of submerged hydrophytes)similarly as other Valisneria species <https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	probably Damage ecosystem services as other Valisneria sp. https://www.cabi.org/isc/datasheet/56573#toimpactSummary	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	V. spiralis can impede water flow in irrigation canals and storage dams, affect drainage, choke hydro turbines, and impact on navigational, recreational and agricultural use of water bodies. Probably has similar effect	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y	High

15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No data https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y; According to our experience in Hungarian populations, this species is a very strong competitor and can replace other submerged invasive species (Hydrilla verticillata (L.f.) Royle, Cabomba caroliniana A. Gray) in thermal water canals.	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	it is not parasitic https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	even tropical species, found survived populations on -15 C https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	Other Valisneria spec disrupts - Ecosystem change/ habitat alteration https://www.cabi.org/isc/datasheet/56573#tohabitat ; According to our experience in Hungarian populations, this species is a very strong competitor and can replace other submerged invasive species (Hydrilla verticillata (L.f.) Royle, Cabomba caroliniana A. Gray) in thermal water canals.	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Other valisneria - Damaged ecosystem services https://www.cabi.org/isc/datasheet/56573#tohabitat	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	No	no data https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	no data https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	High
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	V. spiralis was found in stagnant, slow and fast running (up to 0.8 m/s) water to depths of 1 m, and on muddy, sandy or gravelly sediment (Hussner and Lösch, 2005). Probably is for V americana similar.	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	probably yes but no data for this species https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Probably yes because of releseas from aquaria usually occur in low densities https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Not applicable	https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	probably yes as other Valisneria	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Not applicable	https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y#bib0090	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	found in Japan https://www.sciencedirect.com/science/article/abs/pii/S0304377015300176	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	in Russia Valisneria sp. Flowering plants were observed only with female inflorescences (author's observation in 2016) suggesting that reproduction was only vegetative; he most common form of propagation for Vallisneria is through runners. These will grow all over the aquarium and each new plant will quickly start sending out runners of its own. They can very quickly take over the entire tank this way. https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8YFlowering plants were https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609gvYRKlq6w0ASqKq6x8Y	High

32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y#bib0090	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	he pistillate flowers, attached to submerged plants by long, flexuous peduncles, orient their opening at the water surface and pollination occurs when anthers of the floating staminate flowers contact the stigmas of the pistillate flowers. After fertilization the peduncle coils into a spiral, thus drawing the developing fruit underwater where it matures; he most common form of propagation for Vallisneria is through runners. These will grow all over the aquarium and each new plant will quickly start sending out runners of its own. They can very quickly take over the entire	Medium
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	he pistillate flowers, attached to submerged plants by long, flexuous peduncles, orient their opening at the water surface and pollination occurs when anthers of the floating staminate flowers contact the stigmas of the pistillate flowers. After fertilization the peduncle coils into a spiral, thus drawing the developing fruit underwater where it matures	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	release from aquaria	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	not yet present	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	based on reproduction, no	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	by plant remains; All known populations probably resulted from plant remains released in drainage water from aquariums. https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y#bib0090	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	V. spiralis spreads asexually by means of runners, https://www.sciencedirect.com/science/article/pii/S0304377021000802?casa_token=hhN6-6tAlIAAAAAA:qkJRMlOnYOEWxWhnFhFnVb4HaZxGlJTZTEKUZUhdmq0xhr0Oz609qvYRKlq6w0ASqKq6x8Y#bib0090	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Not applicable	n.a.	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	not known for V.australis	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	distributed locally elsewhere, Adriatic area with disconnected waterbodies	Very high
43	7.09	Is dispersal of the taxon density dependent?	No	he most common form of propagation for Vallisneria is through runners. These will grow all over the aquarium and each new plant will quickly start sending out runners of its own. They can very quickly take over the entire tank this way.	Very high
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	yes in other valisneria	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	Yes	All populations were detected in artificial or strongly modified water bodies; no plants were found so far in unregulated water systems. As these plants have been observed across multiple growing seasons, these can be considered as self-sustaining populations. However, the survival of these plants in all known populations, pointing at. While, at least at present, continental cold winters are posing a barrier for the "giant" alien Vallisneria species, these may become invasive species in western Europe in	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	In New Zealand, the species is considered virtually impossible to eliminate once established, but small infestations can be controlled by divers hand-pulling plants (Auckland Regional Council, 2010a). Also generalist herbivoreous fishes can maybe	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	All populations were detected in artificial or strongly modified water bodies; no plants were found so far in unregulated water systems. As these plants have been observed across multiple growing seasons, these can be considered as self-sustaining populations. However, the survival of these plants in all known populations, pointing at. While, at least at present, continental cold winters are posing a barrier for the "giant" alien Vallisneria species, these may become invasive species in western Europe in	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	V. spiralis known to tolerate low salinity.	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	locally grass carp	High
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	Our study confirms that V. australis has become established in some parts of Europe. Firstly, this species naturalised in Hungary although in this country it only occurs in thermally heated canals. Later, this species was also recorded from Italy, Belgium and Germany where it occurs in strongly modified water bodies (rice fields, canals, gravel pits), but these are not thermally heated. This means that this species can adapt to the Atlantic climate and potentially may become an invasive species in the near future.	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	Our study confirms that V. australis has become established in some parts of Europe. Firstly, this species naturalised in Hungary although in this country it only occurs in thermally heated canals. Later, this species was also recorded from Italy, Belgium and Germany where it occurs in strongly modified water bodies (rice fields, canals, gravel pits), but these are not thermally heated. This means that this species can adapt to the Atlantic climate and potentially may become an invasive species in the near future.	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	connected waterbodies	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	Our study confirms that V. australis has become established in some parts of Europe. Firstly, this species naturalised in Hungary although in this country it only occurs in thermally heated canals. Later, this species was also recorded from Italy, Belgium and Germany where it occurs in strongly modified water bodies (rice fields, canals, gravel pits), but these are not thermally heated. This means that this species can adapt to the Atlantic climate and potentially may become an invasive species in the near future.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	Our study confirms that V. australis has become established in some parts of Europe. Firstly, this species naturalised in Hungary although in this country it only occurs in thermally heated canals. Later, this species was also recorded from Italy, Belgium and Germany where it occurs in strongly modified water bodies (rice fields, canals, gravel pits), but these are not thermally heated. This means that this species can adapt to the Atlantic climate and potentially may become an invasive species in the near future.	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	Our study confirms that V. australis has become established in some parts of Europe. Firstly, this species naturalised in Hungary although in this country it only occurs in thermally heated canals. Later, this species was also recorded from Italy, Belgium and Germany where it occurs in strongly modified water bodies (rice fields, canals, gravel pits), but these are not thermally heated. This means that this species can adapt to the Atlantic climate and potentially may become an invasive species in the near future.	Medium

Statistics	
Scores	
BRA	**22.5**
BRA Outcome	**Medium**
BRA+CCA	**34.5**
BRA+CCA Outcome	**High**
Score partition	
A. Biogeography/Historical	**6.5**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*1.5*
B. Biology/Ecology	**16.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*2.0*
6. Reproduction	*6.0*
7. Dispersal mechanisms	*-1.0*
8. Tolerance attributes	*4.0*
C. Climate change	**12.0**
9. Climate change	*12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**6**
Environmental	**6**
Species or population nuisance traits	**24**

Thresholds	
BRA	**22.75**
BRA+CCA	**22.75**
Confidence	
BRA+CCA	**0.61**
BRA	**0.61**
CCA	**0.63**

Date and Time
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