Information about GB Non-native Species Risk Assessments

The Convention on Biological Diversity (CBD) emphasises the need for a precautionary approach towards non-native species where there is often a lack of firm scientific evidence. It also strongly promotes the use of good quality risk assessment to help underpin this approach. The GB risk analysis mechanism has been developed to help facilitate such an approach in Great Britain. It complies with the CBD and reflects standards used by other schemes such as the Intergovernmental Panel on Climate Change, European Plant Protection Organisation and European Food Safety Authority to ensure good practice.

Risk assessments, along with other information, are used to help support decision making in Great Britain. They do not in themselves determine government policy.

The Non-native Species Secretariat (NNSS) manages the risk analysis process on behalf of the GB Programme Board for Non-native Species. Risk assessments are carried out by independent experts from a range of organisations. As part of the risk analysis process risk assessments are:

- Completed using a consistent risk assessment template to ensure that the full range of issues recognised in international standards are addressed.
- Drafted by an independent expert on the species and peer reviewed by a different expert.
- Approved by an independent risk analysis panel (known as the Non-native Species Risk Analysis Panel or NNRAP) only when they are satisfied the assessment is fit-for-purpose.
- Approved for publication by the GB Programme Board for Non-native Species.
- Placed on the GB Non-native Species Secretariat (NNSS) website for a three month period of public comment.
- Finalised by the risk assessor to the satisfaction of the NNRAP.

To find out more about the risk analysis mechanism go to: www.nonnativespecies.org

Common misconceptions about risk assessments

To address a number of common misconceptions about non-native species risk assessments, the following points should be noted:

- Risk assessments consider only the risks posed by a species. They do not consider the practicalities, impacts or other issues relating to the management of the species. They therefore cannot on their own be used to determine what, if any, management response should be undertaken.
- Risk assessments are about negative impacts and are not meant to consider positive impacts that may also occur. The positive impacts would be considered as part of an overall policy decision.
- Risk assessments are advisory and therefore part of the suite of information on which policy decisions are based.
- Completed risk assessments are not final and absolute. Substantive new scientific evidence may prompt a re-evaluation of the risks and/or a change of policy.

Period for comment

Draft risk assessments are available for a period of three months from the date of posting on the NNSS website*. During this time stakeholders are invited to comment on the scientific evidence which underpins the assessments or provide information on other relevant evidence or research that may be available. Relevant comments are collated by the NNSS and sent to the risk assessor. The assessor reviews the comments and, if necessary, amends the risk assessment. The final risk assessment is then checked and approved by the NNRAP.

*risk assessments are posted online at:
https://secure.fera.defra.gov.uk/nonnativespecies/index.cfm?sectionid=51
comments should be emailed to nnss@fera.gsi.gov.uk

GB NON-NATIVE ORGANISM RISK ASSESSMENT SCHEME

For more information visit: www.nonnativespecies.org

	Name of Organism:	***Lagarosiphon major* (Ridley) Moss - Curly water Thyme**
	Objectives:	Assess the risks associated with this species in GB
	Version:	FINAL 28/03/11

N	QUESTION	RESPONSE	COMMENT
1	What is the reason for performing the Risk Assessment?		Request made by GB Programme Board
2	What is the Risk Assessment area?	GB	
3	Does a relevant earlier Risk Assessment exist?	NO OR UNKNOWN (Go to 5)	
4	If there is an earlier Risk Assessment is it still entirely valid, or only partly valid?	PARTLY VALID OR NOT VALID (Go to 5)	
A	**Stage 2: Organism Risk Assessment SECTION A: Organism Screening**		
5	Identify the Organism. Is the organism clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	YES (Give the full name & Go to 7)	*Lagarosiphon major* (Ridley) Moss, Curly Water Thyme, Curly Waterweed, Pib-flodyn Crych (Welsh). Often sold as *Elodea crispa* , African *Elodea* , Oxygen Weed
6	If not a single taxonomic entity, can it be redefined?		
7	Is the organism in its present range known to be invasive, i.e. to threaten species, habitats or ecosystems?	YES (Go to 9)	Invasive in the UK (http://www.nerc-wallingford.ac.uk/research/capm/pdf%20files/23%20Lagarosiphon%20major.pdf)
8	Does the organism have intrinsic attributes that indicate that it could be invasive, i.e. threaten species, habitats or ecosystems?	YES or UNCERTAIN (Go to 9)	*Lagarosiphon major* is a rhizomatous, perennial, submerged aquatic plant. It can inhabit freshwater lakes, dams and slow-moving streams. *Lagarosiphon major* can form dense floating mats in deep-water reservoirs and other water bodies and it can block the intakes of hydroelectric systems. Dense growth of *Lagarosiphon major* can block light penetration into waterways, eliminating growth of native water plants and affecting associated populations of aquatic invertebrates. *Lagarosiphon major* can also restrict the passage of boats and limit recreational activities like swimming and angling.
9	Does the organism occur outside effective containment in the Risk Assessment area?	YES (Go to 10)	
10	Is the organism widely distributed in the Risk Assessment area?	YES & Future conditions/management procedures/policies are being considered (Go to 19)	Australia (Csurhes and Edwards, 1998; McGregor and Gourlay, 2002), France (Csurhes and Edwards, 1998), Ireland (Alien Plants in Ireland, 2007), Italy (Airo and Sconfietti, 1995), New Zealand, Reunion (CBNM, 2007), Switzerland (Egloff, 1975) and United Kingdom (Csurhes and Edwards, 1998).
11	Does at least one species (for herbivores, predators and parasites) or suitable habitat vital for the survival, development and multiplication of the organism occur in the Risk Assessment area, in the open, in protected conditions or both?	YES (Go to 12)	The National Heritage Trust (2003) states that, "*L. major* grows best in clear, still or slow-moving fresh water with silty or sandy bottoms. It prefers the cooler waters of the temperate zone, with optimum temperatures of 20-23℃ and a maximum temperature of around 25℃. It can li ve in high and low nutrient levels and grows best under conditions of high light intensity. It also tolerates relatively high pH (i.e. alkaline conditions). Growth of *L. major* is greatest in sheltered areas protected from wind, waves and currents." Csurhes and Edwards (1998) state that, "*L. major* inhabits freshwater lakes, dams and slow-moving streams."
12	Does the organism require another species for critical stages in its life cycle such as growth (e.g. root symbionts), reproduction (e.g. pollinators; egg incubators), spread (e.g. seed dispersers) and transmission, (e.g. vectors)?	NO (Go to 14)	
13	Is the other critical species identified in question 12 (or a similar species that may provide a similar function) present in the Risk Assessment area or likely to be introduced? If in doubt, then a separate assessment of the probability of introduction of this species may be needed.		
14	Does the known geographical distribution of the organism include ecoclimatic zones comparable with those of the Risk Assessment area or sufficiently similar for the organism to survive and thrive?	YES (Go to 16)	Botswana - native and invasive (USDA, ARS, 2005), Lesotho - native and invasive (USDA, ARS, 2005), South Africa (James *et al.* 1999), Zambia - native and invasive (USDA, ARS, 2005), Zimbabwe - native and invasive (Csurhes and Edwards, 1998).
15	Could the organism establish under protected conditions (e.g. glasshouses, aquaculture facilities, terraria, zoological gardens) in the Risk Assessment area?	YES (Go to 16)	
16	Has the organism entered and established viable (reproducing) populations in new areas outside its original range, either as a direct or indirect result of man's activities?	YES (Go to 17)	

17	Can the organism spread rapidly by natural means or by human assistance?	YES (Go to 18)	Spread to new locations is either by large birds, or by deliberate introduction by man. It is widely sold as an aquarium and garden pond plant.
18	Could the organism as such, or acting as a vector, cause economic, environmental or social harm in the Risk Assessment area?	YES OR UNCERTAIN (Go to 19)	In New Zealand, the plant has blocked intakes of hydro-electric systems and has formed dense floating mats in deep-water reservoirs and other water bodies. *L. major* has the potential to become a troublesome weed of lakes and slow-moving streams throughout temperate and sub-tropical regions of Australia. Under favourable conditions, dense growth of the plant can block light penetration into waterways, eliminating growth of native water plants and affecting associated populations of aquatic invertebrates and vertebrates. Once widespread, control would be extremely difficult (as is the case for most submerged aquatics) (Csurhes and Edwards, 1998). James *et al.* (1999) state that, "*L. major* creates progressively stressful conditions of high pH and low CO2 content. *L. major* may be successful in out-competing *Elodea* spp. as a result of its ability to photosynthesize and consequently grow, particularly under very stressful conditions of high pH and low free CO2, perhaps through more efficient bicarbonate utilization than the other species. There is some indication that the competitive success of *L. major* may be a consequence of greater toleration to pH stress". McGregor and Gourlay (2002) state that, "*L. major* replaces native vegetation; dense infestations restrict the passage of boats and limit recreational activities like swimming and angling; storms can tear loose the weed and deposit large masses of rotting vegetation on beaches, spoiling their amenity value". Rattray (1994) states that, "*L. major* has successfully out-competed native species wherever it has colonized." James *et al.* (1999) report that, "*L. major* has been reported to be actively displacing *E. nuttallii* and appears to be competitively superior to *Elodea* spp. in at least some habitats."
19	This organism could present a risk to the Risk Assessment area and a detailed risk assessment is appropriate.	Detailed Risk Assessment Appropriate GO TO SECTION B	
20	This organism is not likely to be a harmful non-native organism in the Risk Assessment area and the assessment can stop.		

B	SECTION B: Detailed assessment of an organism's probability of entry, establishment and spread and the magnitude of the economic, environmental and social consequences			
	Probability of Entry	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1	List the pathways that the organism could be carried on. How many relevant pathways can the organism be carried on?	few - 1	LOW - 0	Horticultural trade, aquarium trade.
1.2	Choose one pathway from the list of pathways selected in 1.1 to begin the pathway assessments.	Horticultural trade		
1.3	How likely is the organism to be associated with the pathway at origin?	very likely - 4	LOW - 0	Deliberate trade.
1.4	Is the concentration of the organism on the pathway at origin likely to be high?	very likely - 4	LOW - 0	Deliberate trade.
1.5	How likely is the organism to survive existing cultivation or commercial practices?	very likely - 4	LOW - 0	Deliberately grown, easy to grow and widely sold.
1.6	How likely is the organism to survive or remain undetected by existing measures?	unlikely - 1	MEDIUM -1	There is a certain amount of confusion as to nomenclature, often sold as *Elodea crispa* or *Egeria densa.*
1.7	How likely is the organism to survive during transport /storage?	very likely - 4	LOW - 0	Deliberate trade.
1.8	How likely is the organism to multiply/increase in prevalence during transport /storage?	unlikely - 1	MEDIUM -1	Some growth may occur during transport. Fragmentation during prolonged storage may encourage spread on release.
1.9	What is the volume of movement along the pathway?	moderate - 2	LOW - 0	As it is easy to grow, most plants are produced by aquatic nurseries in invaded countries.
1.10	How frequent is movement along the pathway?	often - 3	LOW - 0	A common aquarium plant. It is estimated to be imported very frequently.
1.11	How widely could the organism be distributed throughout the Risk Assessment area?	very widely - 4	LOW - 0	It is a common plant at aquatic garden centres and is widely sold as an oxygenating plant. It is often sold as *Elodea densa* or African *elodea* . It is present in 476 10 km squares in the UK already and spread to other areas is inevitable given the association with human recreational activity sites.
1.12	How likely is the organism to arrive during the months of the year most appropriate for establishment ?	very likely - 4	LOW - 0	*L. major* is a perennial species, not dying down significantly over winter. Growth is rapid in spring and early summer when dense canopies are formed. This coincides with the period when gardening activity is at its peak and arrival into new sites will be highest at this time.
1.13	How likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) or other material with which the organism is associated to aid transfer to a suitable habitat?	likely - 3	LOW - 0	Vegetative reproduction and survival of fragments encourage distribution within a country once established.
1.14	How likely is the organism to be able to transfer from the pathway to a suitable habitat?	very likely - 4	LOW - 0	Deliberately planted, transferred on angling equipment and boats and trailers.

	Probability of Establishment	RESPONSE	UNCERTAINTY	COMMENT
1.15	How similar are the climatic conditions that would affect establishment in the Risk Assessment area and in the area of current distribution?	moderately similar - 2	MEDIUM -1	The species is perennial in the UK and winter conditions do not kill the plant. However, the species grows at slightly higher temperatures than other north temperate aquatic macrophytes in its native range. However, it is present in 476 10 km squares in the UK, and environmental conditions are not thought to be limiting anywhere in the UK.
1.16	How similar are other abiotic factors that would affect establishment in the Risk Assessment area and in the area of present distribution?	moderately similar - 2	MEDIUM -1	The species is capable of utilising Dissolved Inorganic Carbon sources with very high efficiency of removal. Light is not limiting, and other geological factors are not though to be limiting. There are probably no abiotic limiting factors present in the Risk Assessment Area.
1.17	How many species (for herbivores, predators and parasites) or suitable habitats vital for the survival, development and multiplication of the organism species are present in the Risk Assessment area? Specify the species or habitats and indicate the number.	very many - 4	LOW - 0	Freshwater bodies and ecosystems abound in the UK, particularly slow-flowing water bodies, ditches, canals, lakes and ponds.
1.18	How widespread are the species (for herbivores, predators and parasites) or suitable habitats vital for the survival, development and multiplication of the organism in the Risk Assessment area?	widespread - 4	LOW - 0	See 1.17
1.19	If the organism requires another species for critical stages in its life cycle then how likely is the organism to become associated with such species in the risk assessment area?	N/A	LOW - 0	
1.20	How likely is it that establishment will not be prevented by competition from existing species in the Risk Assessment area?	very likely - 4	LOW - 0	*L. major* is an aggressive species that replaces similar Elodeid type macrophytes (James *et al.* 1999)
1.21	How likely is it that establishment will not be prevented by natural enemies already present in the Risk Assessment area?	very unlikely - 0	MEDIUM -1	No biological control known in introduced area, although work is underway to find biological control agents from its origin.
1.22	If there are differences in man's management of the environment/habitat in the Risk Assessment area from that in the area of present distribution, are they likely to aid establishment? (specify)	likely - 3	LOW - 0	Mechanical management aids fragmentation which aids dispersal within and between systems.
1.23	How likely is it that existing control or husbandry measures will fail to prevent establishment of the organism?	very likely - 4	LOW - 0	Existing management techniques encourage establishment.
1.24	How often has the organism been recorded in protected conditions, e.g. glasshouses, elsewhere?	occasional - 2	MEDIUM -1	Grown in such conditions in nurseries for distribution into the trade. Not normally considered a pest in such conditions.
1.25	How likely is the reproductive strategy of the organism and duration of its life cycle to aid establishment?	very likely - 4	LOW - 0	It is likely that only female plants occur within the UK; seed production has not been observed. Since the species is dioecious (sexes on different plants) both must be present for sexual reproduction. Only female plants are known outside of the native range of this species. All reproduction in introduced regions is therefore asexual, primarily by fragmentation or local growth by rhizomatous spread (Symoens and Triest 1983). A very successful vegetative strategy, combined with perennation over winter aids establishment in sites where it has been introduced, and presence of large vegetative biomass over winter increases the distribution of viable fragments during the summer growing season.
1.26	How likely is it that the organism's capacity to spread will aid establishment?	very likely - 4	MEDIUM -1	Means of spread are largely unknown, although fragments remain viable.
1.27	How adaptable is the organism?	slightly adaptable - 1	LOW - 0	Native range is high altitude streams and ponds, restricting climatic range to temperate areas, and possibly continental climates in Europe. It is not known elsewhere in Africa, or from South America, indicating only slight adaptability. However, it is probably adaptable to different nutrient status and is not restricted to particular water chemistry variables, except moderate carbonate concentrations are required, (alkalinity above 2 is probably preferred).
1.28	How likely is it that low genetic diversity in the founder population of the organism will not prevent establishment?	unlikely - 1	LOW - 0	The main reproductive strategy is by fragmentation and dispersal. Genetics are not relevant to establishment of this species in its introduced range.
1.29	How often has the organism entered and established in new areas outside its original range as a result of man's activities?	moderate number - 2	LOW - 0	In my opinion this species has entered all non-native areas by being sold as an aquarium plant in trade.
1.30	How likely is it that the organism could survive eradication campaigns in the Risk Assessment area?	likely - 3	LOW - 0	There are no herbicides available for the control of this species. Mechanical control will encourage dispersal, spread and establishment to new areas. Biological control is not yet established. Environmental control is not possible due to adaptability of the species.
1.31	Even if permanent establishment of the organism is unlikely, how likely is it that transient populations will be maintained in the Risk Assessment area through natural migration or entry through man's activities (including intentional release into the outdoor environment)?	likely - 3	LOW - 0	This plant is widely sold and traded in the UK and on the internet.

	Spread	RESPONSE	UNCERTAINTY	COMMENT
2.1	How rapidly is the organism liable to spread in the Risk Assessment area by natural means?	intermediate - 2	LOW - 0	Vegetative spread and perennial overwintering biomass encourage spread.
2.2	How rapidly is the organism liable to spread in the Risk Assessment area by human assistance?	rapid - 3	MEDIUM -1	Deliberate introduction to garden ponds and aquaria is common. Deliberate introduction to sites outside gardens is probably common as the aggressive nature of the plant means that pond clearances will generate large volumes of viable plant material for disposal. The frequency at which this material is disposed of into natural situations is not known.
2.3	How difficult would it be to contain the organism within the Risk Assessment area?	difficult - 3	LOW - 0	The continuity of habitats outside the area makes containment very difficult.
2.4	Based on the answers to questions on the potential for establishment and spread define the area endangered by the organism.		MEDIUM -1	Most lakes, ponds, streams, canals and temperate freshwaters with adequate nutrient status.
	Impacts	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.5	How important is economic loss caused by the organism within its existing geographic range?	moderate - 2	LOW - 0	The cost of control using mechanical means is estimated to be approximately £1000 per hectare. Assuming each 10 km square contains at least 1 hectare of plant, this is equivalent to a minimum management cost of £500,000 per annum. Other intangible or unquantified costs include the consequences of the following characteristics of this species: dense growth of *Lagarosiphon major* can block light penetration into waterways, eliminating growth of native water plants and affecting associated populations of aquatic invertebrates. *Lagarosiphon major* can also restrict the passage of boats and limit recreational activities like swimming and angling.
2.6	Considering the ecological conditions in the Risk Assessment area, how serious is the direct negative economic effect of the organism, e.g. on crop yield and/or quality, livestock health and production, likely to be? (describe) in the Risk Assessment area, how serious is the direct negative economic effect of the organism, e.g. on crop yield and/or quality, likely to be?	moderate - 2	LOW - 0	A value of about 4.3 billion is calculated as the 25 year NPV cost of control and economic loss caused by this species. This is based on the cost of control of £1,000 per hectare and the annualised rate of spread since introduction, assuming a mean population size of 2.5 hectares, which is based on introduction to medium to large gravel pits, and into canal systems where linear spread is rapid.
2.7	How great a loss in producer profits is the organism likely to cause due to changes in production costs, yields, etc., in the Risk Assessment area?	minimal - 0	LOW - 0	Not applicable.
2.8	How great a reduction in consumer demand is the organism likely to cause in the Risk Assessment area?	minimal - 0	LOW - 0	Not applicable.
2.9	How likely is the presence of the organism in the Risk Assessment area to cause losses in export markets?	very unlikely - 0	LOW - 0	Not applicable.
2.10	How important would other economic costs resulting from introduction be? (specify)	minor - 1	LOW - 0	Loss of recreation, primarily sailing and other water sports, fishing restrictions. Flood defence costs of this species have not been estimated.
2.11	How important is environmental harm caused by the organism within its existing geographic range?	minor - 1	LOW - 0	Although invasive, there is substantial competition from other species in the native range which limits nuisance value.
2.12	How important is environmental harm likely to be in the Risk Assessment area?	major - 3	MEDIUM -1	This species is causing and will continue to cause considerable ecological damage to all invaded freshwater habitats (Keenen *et al.* 2009). Most habitats in the introduced range are floristically poor, e.g. gravel pits, and the presence of this dominant species further reduces floristic diversity. Problems caused by this plant include very high pH of 10.4 generated by active transport of bicarbonate ions, which limits productivity by other macrophytes due to carbon shortages. It is not known what effect this has on associated fauna. The ability to change dramatically the chemical status of water bodies, including nutrient and pH changes, means that water quality is also affected by the presence of the species in any volume. Data from an impact assessment carried out for Australia (http://www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/impact_lagarosiphon) states, "The physical properties of the plant are not harmful to humans, however, "it has the ability to accumulate considerable amounts of arsenic from the surrounding medium." Tests conducted on sheep in New Zealand revealed the arsenic does not pose a serious threat to health". Also "can form a light-blocking canopy so dense and thick (3 feet thick) that *Lagarosiphon major* easily out competes even tall non-canopy forming native species." "*Lagarosiphon major* successfully out-competed native species wherever it has colonised New Zealand lakes in the depth zone 2-6 m -- normally occupied by native milfoils (*Myriophyllum* spp.) and pondweeds (*Potamogeton* spp.)." Would have a major impact on the floral strata in aquatic situations. Heavy infestations of *Lagarosiphon* deplete oxygen levels in water, killing fish. Its presence may also impact on waterbirds causing a serious reduction in habitat.
2.13	How important is social and other harm caused by the organism within its existing geographic range?	moderate - 2	LOW - 0	Obermeyer (1964) claims "it is often an obnoxious water pest" in South Africa.
2.14	How important is the social harm likely to be in the Risk Assessment area?	moderate - 2	MEDIUM -1	The use of waterbodies for recreation is much higher in the introduced areas. See 2.10.
2.15	How likely is it that genetic traits can be carried to native species, modifying their genetic nature and making their economic, environmental or social effects more serious?	very unlikely - 0	LOW - 0	Other genera in the Hydrocharitaceae are *Apalanthe, Appertiella, Blyxa, Egeria, Elodea, Enhalus, Halophila, Hydrilla, Hydrocharis, Limnobium, Maidenia, Najas, Nechamandra, Ottelia, Stratiotes, Thalassia* and *Vallisneria*. It is unlikely to cross with any of these.
2.16	How probable is it that natural enemies, already present in the Risk Assessment area, will have no affect on populations of the organism if introduced?	very likely - 4	LOW - 0	There are no natural enemies of this species in the introduced range that will have an affect on this species.

2.17	How easily can the organism be controlled?	difficult - 3	LOW - 0	There are no herbicides for management of this species. Mechanical control and harvesting, combined with Grass Carp may be an appropriate option.
2.18	How likely are control measures to disrupt existing biological or integrated systems for control of other organisms?	likely - 3	LOW - 0	Mechanical control is very disruptive and non-selective.
2.19	How likely is the organism to act as food, a host, a symbiont or a vector for other damaging organisms?	unlikely - 1	MEDIUM -1	None known.
2.20	Highlight those parts of the endangered area where economic, environmental and social impacts are most likely to occur			Freshwater bodies and ecosystems abound in the UK, particularly slow-flowing water bodies, ditches, canals, lakes and ponds.

Summarise Entry	very likely - 4	LOW - 0	The species is already present in the Risk Assessment Area. Continued introductions are likely due to the high frequency of sale in the horticultural trade.
Summarise Establishment	very likely - 4	LOW - 0	The plant is already established and spreading rapidly within the area.
Summarise Spread	very rapid - 4	LOW - 0	Spread between watercourses is likely due to the perennial nature of the species, high fragment viability and dominant physiology. The perennial nature of this species means that spread is possible at all times of the year. This has probably contributed to the rapid colonisation of recreational sites by this species.
Summarise Impacts	major - 3	LOW - 0	The known impacts are restricted to recreational impacts. There is some evidence to suggest that replacement of other Elodeid type species occurs in some cases (James *et al.* 1999), although this will be limited by habitat characteristics. The very dense nature of this species excludes native flora very effectively. Colonisation of Lough Corrib in the west of Ireland has lead to a major loss of fishing income at that site (Caffrey, 2009).
Conclusion of the risk assessment	HIGH -2	LOW - 0	The potential for ecological and recreational damage caused by the presence of this species, combined with the paucity of control methods makes this species a very great threat to native ecosystems and the recreational use of water bodies. The ability to change dramatically the chemical status of water bodies, including nutrient and pH changes, means that water quality is also affected by the presence of the species in any volume. Data from an impact assessment carried out for Australia (http://www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/impact_lagarosiphon) states, "The physical properties of the plant are not harmful to humans, however, “it has the ability to accumulate considerable amounts of arsenic from the surrounding medium.” Tests conducted on sheep in New Zealand revealed the arsenic does not pose a serious threat to health". Also, “can form a light-blocking canopy so dense and thick (3 feet thick) that *Lagarosiphon major* easily out competes even tall non-canopy forming native species.” "*Lagarosiphon major* successfully out-competed native species wherever it has colonised New Zealand lakes in the depth zone 2-6 m -- normally occupied by native milfoils (*Myriophyllum* spp.) and pondweeds (*Potamogeton* spp.)." Would have a major impact on the floral strata in aquatic situations. Heavy infestations of *Lagarosiphon* deplete oxygen levels in water, killing fish. Its presence may also impact on waterbirds causing a serious reduction in habitat.
Conclusions on Uncertainty		LOW - 0	This species has well defined preferences, life cycle and documented impacts in its native and introduced range. It is a high risk species.

References

Airo, S., and R. Sconfietti. 1995. *In situ* experiments on productivity of aquatic macrophytes in a pond. Rivista-di-Idrobiologia. 34(1-3): 147-156.

Alien Plants in Ireland (2007) http://www.biochange.ie/alienplants/result_species.php?species=918&lang=latin&p=i

Caffrey, J. (2009) *Lagarosiphon major* control in a large Irish lake through light exclusion. In: Pieterse, A., Rytkonen, A-M. and Hellsten, S. (Eds) Aquatic Weeds 2009. Proceedings of the 12th European Weed Research Society Symposium, Finland 2009. Reports of the Finnish Environment Institute, 15. 2009.

Caffrey, J.M. (2007a). Lagarosiphon major in Irish watercourses. Proceedings of the 15th International Conference on Aquatic Invasive Species, Nijmegen, Holland. Abstract.

Caffrey, J.M. (2007b). Lagarosiphon major in Lough Corrib – Management Options. 38th Annual Institute of Fisheries Management, Westport, Ireland. Abstract.

CBNM (2007) http://flore.cbnm.org/index2.php?page=taxon&num=9523147e5a6707baf674941812ee5c94

Clayton, J. (2003). The history and principles of managing *Lagarosiphon major* , an invasive aquatic weed in Lake Wanaka. Internal report, NIWA, New Zealand. 6 pp.

Csurhes, S./Edwards, R. 1998. Potential environmental weeds in Australia: Candidate species for preventative control. Canberra, Australia. Biodiversity Group, Environment Australia. 208 pp.

Egloff, F. 1975. New and Noteworthy Species of Swiss Flora. Bulletin de la Societe Botanique Suisse. 1975; 84 (4): 333-342.

Howard-Williams, C. and Davies J. (1988). The invasion of Lake Taupo by the submerged water weed Lagarosiphon major and its impact on the native flora. New Zealand J. Ecol. 11:13-19

James, C. S., J. W. Eaton, and K. Hardwick. 1999. Competition between three submerged macrophytes, Elodea canadensis Michx, Elodea nuttallii (Planch.) St John and Lagarosiphon major (Ridl.) Moss. Hydrobiologia 415: 35-40, 1999

Keenan, E. Baars, J.-R. Caffrey, J.M. (2009) Changes In Littoral Invertebrate Communities In Lough Corrib In Response To An Invasion By Lagarosiphon Major. IN: Aquatic Weeds 2009, Proc., 12th European Weed Res. Soc. Symp., Aug. 24-28, Rep. Finn. Environ. Inst., Jyvaskyla.

McGregor P, Gourlay H 2002. Assessing the prospects for biological control of lagarosiphon (Lagarosiphon major (Hydrocharitaceae)). DOC Science Internal Series 57. Wellington, New Zealand; Department of Conservation. 14p.

National Heritage Trust. 2003. Lagarosiphon - Lagarosiphon major. Weed Management Guide. Cited at http://www.issg.org/database/species/references.asp?si=403&fr=1&sts=&lang=EN

Obermeyer, A.A. (1964). The South African Species of Lagarosiphon. Bothalia 8, 139 – 146.

Symoens and Triest 1983 Monograph of the African genus Lagarosiphon. Bull. Jard. Bot. Nat. Belg. 53:441-488.