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, Pathway, Receptor or	**Floating Pennywort - *Hydrocotyle ranunculoides***	
	Objectives:	Assess the risks associated with this species in GB	
	Authors, Date, Draft:		
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?	YES (Go to 4)	PRA made by EPPO (2005), and has been updated and revised in 2009 in the view of the EFSA comments.
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)	Partly valid, because EPPO region covers UK as well.
	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?	NO (Go to 6)	Kingdom: Plantae, Class: Magnoliopsida (Dicotyledons), Family: Apiaceae. Chromosome number: 2n=24. There is a wide range of polyploids within the genus Hydrocotyle, with up to 15-ploidy (Moore 1971, Federov 1974). There is uncertainty about distinction of *H. ranunculoides* from other members of the genus also available as ornamental plants. There are approximately 75 species in the genus worldwide (Cook 1970) mostly originating in the southern hemisphere, of which some such as *H. novae-zeelandiae* and *H. elongata* may not be readily distinguishable (Allan 1982).
6	If not a single taxonomic entity, can it be redefined?	YES (Go to 7)	It is a single taxonomic entity, but a number of other taxa could be confused with it and some of these are being replaced in sale by garden centres.
7	Is the organism in its present range known to be invasive, i.e. to threaten species, habitats or ecosystems?	YES (Go to 9)	In its native range, *H. ranunculoides* is not considered to be a pest (M. Dubrule Reed pers. comm.) and in the U.S. federal states of Illinois, New Jersey and New York it is listed as an endangered species and protected (New York Environmental Regulations 2000 and USDA 2004 in EPPO 2005); outside this range it can cause major problems in nature reserves and recreation areas (Baas & Duistermaat, 1999). It can damage waterworks by blocking pipes and pumps or flow, especially after mechanical control when the floating mass is taken by the current and blocks the outlet. *H. ranunculoides* can displace native flora through competition, and fauna by habitat modification (Krabben and Rotteveel 2003 in EPPO 2005). Dense mats reduce penetration of light to the water below and oxygen shortage may induce high fish mortality (Kelly, 2006). Strongly invaded waters lose their attractiveness and safety for recreation. Flooding may be caused by heavy infestations choking drainage systems and sluices. Plants can accumulate heavy metals (Pinochet *et al.*, 2002), making disposal of plant material problematic.
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)	
9	Does the organism occur outside effective containment in the Risk Assessment area?	YES (Go to 10)	It is widely naturalised in the UK (Preston *et al*. 2002, NBN Gateway).
10	Is the organism widely distributed in the Risk Assessment area?	YES & Future conditions/management procedures/policies are being considered (Go to 19)	It was first recorded in Essex in 1990 and is now widely established around and to the north-west of London, at a number of sites on the south coast, the Gwent Levels and in the north-west Midlands, in a total of more than 50 10 km squares (Preston, Pearman and Dines 2002, NBN gateway).
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?		
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)?		
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?		
15	Could the organism establish under protected conditions (e.g. glasshouses, aquaculture facilities, terraria, zoological gardens) in the Risk Assessment area?		
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?		
17	Can the organism spread rapidly by natural means or by human assistance?		
18	Could the organism as such, or acting as a vector, cause economic, environmental or social harm in the Risk Assessment area?		
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	Detailed Risk Assessment completed below.
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?	many - 3	HIGH -2	Known pathways are: (i) intentional introduction as an ornamental plant for garden ponds and aquaria from which there is no barrier to natural habitats, or transfer from artificial ponds to natural sites when growth in the artificial site becomes excessive; (ii) unintentional introduction: hitch-hiking with other plants. Plant fragments may also spread with birds or other animals, but there are no quantitative data available; (iii) unintentional introduction: carried downstream along waterways and possibly upstream attached to boats (EPPO 2005, invasivespeciesireland.com).
1.2	Choose one pathway from the list of pathways selected in 1.1 to begin the pathway assessments.			(i) Intentional introduction as an ornamental plant for garden ponds and aquaria: plants escape from there into unintended habitats. Deliberate sale.
1.3	How likely is the organism to be associated with the pathway at origin?	likely - 3	LOW - 0	If the area of origin is taken to refer to sale in garden centres and other areas of the trade, then any garden centre with a section selling aquatic plants would normally include *H. ranunculoides*. More recently, it seems that most garden centres have replaced this species with material labelled *H. novae-zeelandiae.* This species is also available on the web, e.g. eBay.
1.4	Is the concentration of the organism on the pathway at origin likely to be high?	likely - 3	LOW - 0	Awareness campaigns run by the Horticultural Development Council and the Ornamental Aquatic Trades Association have reduced the quantity on sale to virtually zero. This has led to a reduction in the rate of new observations, but not in expansion in invaded habitats in the UK.
1.5	How likely is the organism to survive existing cultivation or commercial practices?	very likely - 4	LOW - 0	It is deliberately grown in cultivation for sale.
1.6	How likely is the organism to survive or remain undetected by existing measures?	very unlikely - 0	LOW - 0	It has been shown to survive existing control measures. It is only likely to remain undetected during vegetation surveys when surveyors are relatively unskilled.
1.7	How likely is the organism to survive during transport /storage?	very likely - 4	LOW - 0	It is a traded commodity so will survive in transport.
1.8	How likely is the organism to multiply/increase in prevalence during transport /storage?	likely - 3	MEDIUM -1	Growth is rapid under ideal conditions, and if light, nutrients and adequate temperatures are maintained in transport, the plant will grow.
1.9	What is the volume of movement along the pathway?	minor - 1	HIGH -2	In UK and NL it is no longer sold commercially as *H. ranunculoides*, but it may still be sold in the UK as *H. vulgaris* or *H. novae-zeelandiae* and labelling is unreliable. The UK Royal Horticultural Society banned this plant from its shows and gardens (Shaw 2003). It was last listed in the Royal Horticultural Society Plant Finder in 2002 (Royal Horticultural Society 2005). In January 2001, the Dutch Ministry "van Landbouw, Natuurbeheer en Voedselkwaliteit" prohibited the sale and possession of this plant (Staatsblad van het Koninkrijk der Nederlanden 2000). Due to inadequate knowledge of the traded volume of this species, the uncertainty is high. It is likely to be very seasonal in sale and local distribution.
1.10	How frequent is movement along the pathway?	occasionally - 2	MEDIUM -1	Trade in aquatic plants is restricted seasonally (see 1.9).
1.11	How widely could the organism be distributed throughout the Risk Assessment area?	widely - 3	LOW - 0	Distribution maps (e.g. Preston *et al*. 2002, NBN gateway) show that *H. ranunculoides* is concentrated in an area around and to the north of London, with a few records along the south coast, the Gwent Levels and the West Midlands, from Cheshire northwards. There has been a suggestion that its range may be limited by drought (EPPO 2005), but given its native occurrence in Texas and California, this seems unlikely. Equally there has been some experimental study of its tolerance of salinity and whilst it clearly has only a limited tolerance (CAPM in EPPO 2005) any attempt to use salt to control it would have a devastating effect on native aquatic vegetation. The native range of the species suggests that it may be limited by winter minimum temperatures, although no published evidence to support this could be found. If this is the case, then its capacity to spread northwards may be limited.
1.12	How likely is the organism to arrive during the months of the year most appropriate for establishment ?	very likely - 4	LOW - 0	Given that the plant is widely established, this response can probably be taken as accurate.
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?	very likely - 4	HIGH -2	Plants used in confined waterbodies could spread to unintended habitats very easily through human activities as well as through natural spread by floods downstream, and eventually over large distances via sediments containing seeds stuck to the feet and water birds.
1.14	How likely is the organism to be able to transfer from the pathway to a suitable habitat?	very likely - 4	LOW - 0	The degree to which the species is established suggests that that it is able to transfer to a suitable habitat.

	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?	similar - 3	LOW - 0	Climatic conditions in the area of origin vary widely but include conditions similar to those in the assessment area (authors obs.). Again, it can be seen from the current extent of establishment that whilst elements of climate could be limiting, they will not preclude establishment.
1.16	How similar are other abiotic factors that would affect establishment in the Risk Assessment area and in the area of present distribution?	very similar - 4	MEDIUM -1	There is only limited information readily available, although an extensive and detailed desk study could probably provide more information. However, again the fact that the species is widely established and spreading suggests that abiotic factors are compatible with its establishment. The optimal habitat of *H. ranunculoides* are slow-flowing and nutrient-rich waterways. Two factors contribute therefore to the establishment of *H. ranunculoides*: - increased nutrient status through agricultural, urban and industrial run-offs; - and impoundment of waters by creating dams, thus altering hydrological regimes.
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	Suitable habitats clearly exist because the species is established. These are primarily standing water (canals and ponds), and running water (ditches and a few streams and slow-flowing rivers). There appears to be no information on the dependence of this taxon on other species.
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	Suitable habitats occur more or less throughout the Risk Assessment area and habitat availability is unlikely to exert a controlling influence on establishment. It is possible that winter minimum temperatures could be a limiting influence on expansion (see 1.11). There appears to be no information on the dependence of this taxon on other species.
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	There is no evidence to suggest that the species requires any other for critical stages in its life cycle.
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	The species is widely established and spreading, it therefore seems unlikely that establishment will be prevented by competition.
1.21	How likely is it that establishment will not be prevented by natural enemies already present in the Risk Assessment area?	very likely - 4	LOW - 0	The species is widely established and spreading, it therefore seems unlikely that establishment will be prevented by natural enemies.
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)	unlikely - 1	MEDIUM -1	Whilst there are certainly differences in man's management of habitats in the native and non-native ranges of the species, there is no evidence that these have implications for success or failure of establishment.
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 control and husbandry measures have clearly failed to prevent establishment. The more recent cessation of sale is more likely to lead to a decline in both deliberate and accidental introductions, but transmission from existing populations is unlikely to decline. It is apparently illegal to posses or sell *H. ranunculoides* in the Netherlands (www.habitas.org.uk/invasive/species.asp?item=432375), however such legislation is ineffective unless supported by identification guidance and training.
1.24	How often has the organism been recorded in protected conditions, e.g. glasshouses, elsewhere?	N/A		There is no information available on this, however it is known that it reached the Risk Assessment area via trade in ornamental plants and has spread into the wild without needing to occur in protected habitats. In the past it has been on sale in most garden centres; there is no information on current availability.
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 the main reproductive strategy is vegetative (Preston *et al*. 2002). Like many aquatic plants, it is likely that very small fragments are able to root, thus aiding establishment.
1.26	How likely is it that the organism's capacity to spread will aid establishment?	very likely - 4	LOW - 0	Its widespread and increasing establishment suggests that this may be aided by its capacity to spread.
1.27	How adaptable is the organism?	moderately adaptable - 2	MEDIUM -1	Adaptability is probably irrelevant as the plant is able to exploit a wide variety of existing habitats.
1.28	How likely is it that low genetic diversity in the founder population of the organism will not prevent establishment?	very likely - 4	MEDIUM -1	Like many native aquatic plants that are capable of reproduction through vegetative fragmentation, single clones of *H. ranunculoides* may be capable of colonising wide areas. Low genetic diversity will therefore almost certainly not be a controlling factor.
1.29	How often has the organism entered and established in new areas outside its original range as a result of man's activities?	very many - 4	MEDIUM -1	The evidence suggests that it has become established in Australia (Ruiz Avila and Klemm 1996, invasivespeciesireland.com), South America (Holm *et al*. 1979), Africa (CABI 2004), Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands and Portugal (Hegi 1975 and Pignatti 1982 in EPPO 2005). The EPPO assessment states that "Up to now [2005], it is spreading significantly only in the UK and the Netherlands (Newman 2003, Krabben and Rotteveel 2003). It is known to be invasive in Belgium (Pot 2000). In France it has become naturalised in Corsica and around Paris (Kerguélen 1999), according to many participants in the aquatic weed symposium in Landes, France 2002 it is well established in much of southern France. First infestations have been found in Germany in 2004 and seem to spread (Hussner pers. comm., publication in preparation)"
1.30	How likely is it that the organism could survive eradication campaigns in the Risk Assessment area?	very likely - 4	LOW - 0	It has already survived eradication attempts in the Risk Assessment area. Cutting may suppress growth, but without extremely thorough collection and controlled disposal of fragments, is likely to exacerbate spread and colonisation (CEH 2006). Chemical control using Glyphosate may apparently be effective if repeated at 6 - 8 weekly intervals through the growing season (CEH 2006); this seems likely to eradicate native plants from waterways which would usually be unacceptable. The addition of the adjuvants topFilm and Codacide Oil have improved control with lyphosate although repeated applications are still necessary due to the very rapid growth of untreated fragments (Newman pers. comm., 2009) Shade through tree planting has been suggested (CEH 2006) although not only is this an extremely slow-acting method, but any gaps in the canopy would allow survival of plants which would then serve as reservoirs for re-establishment outside the shaded area and again this method would have adverse impacts on the distribution of native aquatic plants. Biological control through introduction of a weevil (*Listronotus elongatus*) has been considered (CEH 2006) but no further information is available.

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)?	N/A		

	Spread	RESPONSE	UNCERTAINTY	COMMENT
2.1	How rapidly is the organism liable to spread in the Risk Assessment area by natural means?	rapid - 3	LOW - 0	It is known to have spread from its original point of introduction to at least 43 10km squares by 2000 (Preston *et al*. 2002) to 51 10km squares in 2008 (NBN Gateway, http://data.nbn.org.uk/interactive). There is no evident means by which to assess whether the means of spread were natural or assisted. In Australia, it apparently doubles its biomass in 3 days, while in the UK this may take 4-7 days, apparently depending upon the availability of nitrate (CEH 2006). There is a high risk of spread of Hydrocotyle ranunculoides in eutrophic still and slow flowing waterbodies in countries where it is already established, and there is a high risk of introduction where it is not already present.
2.2	How rapidly is the organism liable to spread in the Risk Assessment area by human assistance?	rapid - 3	MEDIUM -1	It is known to have spread from its original point of introduction to at least 43 10km squares by 2000 (Preston *et al*. 2002) to 51 10km squares in 2008 (NBN Gateway, http://data.nbn.org.uk/interactive). There is no evident means by which to assess whether the means of spread were natural or assisted. However, the presence in a number of lakes used for recreational activities, such as sailing, angling and other water sports suggests that human assisted spread is a significant means of distribution to new sites.
2.3	How difficult would it be to contain the organism within the Risk Assessment area?	very difficult - 4	LOW - 0	There is no evidence to suggest that it could be contained without the use of methods such as those used in Australia to prevent ingress of alien taxa.
2.4	Based on the answers to questions on the potential for establishment and spread define the area endangered by the organism.		HIGH -2	May be limited by winter frost, but there appears to be no information on this; distribution in North America supports this conclusion (NatureServe. 2008. NatureServe Explorer: An online encyclopaedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer).

	Impacts	RESPONSE	UNCERTAINTY	COMMENT
2.5	How important is economic loss caused by the organism within its existing geographic range?	major - 3	MEDIUM -1	In its native range, it is not considered a pest (M. Dubrule Reed pers. comm.); outside this range, economic impacts appear to affect tourism (both aesthetics and recreational use of waterbodies), direct exploitation of freshwater systems (e.g. commercial fishing, access and navigation) and the consequences of flooding. In the Canning River in Western Australia H. ranunculoides became a serious problem in 1992. A program costing over AU$ 200,000 in the first year was implemented (Atkins, 1994, Ruiz Avila, Klemm, 1996; Newman, Dawson 1999), and the species is still present in Australia. Control costs: In the Netherlands, some water boards faced a doubling of costs each year during the 1990s, and, in 2000, the total annual control costs were around 1 million Euros (van der Krabben & Rotteveel, 2003). In 2007, in the Netherlands, 11 water boards out of 26 responded to an inquiry stating that they spent an additional 1.8 millions Euros for the management of H. ranunculoides over and above normal operating costs for this plant (van Valkenburg, pers. comm., 2009). In Flanders, the estimated cost for the management of H. ranunculoides is 1.5 million Euros per year (needed during 3 years from 2009) (Triest, pers. comm., 2009). In the UK, the estimate for control of the total area infested by H. ranunculoides by herbicides was between £250,000 and £300,000 per year (Harper, 2002). In 2008, £1.93 million were spent for the management and disposal of H. ranunculoides (Newman, pers. comm., 2009). In 6 years, the costs were multiplied 7 times. Flooding caused by the plant may also have an economic impact due to loss of crops (Newman, pers. comm., 2009)
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	MEDIUM -1	There appear to be no useful assessments of the economic impact of this species, although recommendations for such assessment exist (www.invasivespeciesireland.com). In the Netherlands, some waterboards faced a doubling of costs each year during the 1990s, and in 2000, the total annual control costs were around 1 Million Euro (= £788373.25 calculated 3rd August 2008) (van der Krabben and Rotteveel 2003 in EPPO 2005). In the Canning River in Western Australia *H. ranunculoides* became a serious problem in 1992. A program costing over AU$ 200,000 (= £94,230.93 calculated 3rd August 2008) in the first year was implemented (Atkins 1994, Ruiz Avila and Klemm 1996 in EPPO 2005). In the UK, the estimate for control of the total area infested by *H. ranunculoides* by herbicides is between £250,000 and £300,000 per year (Harper 2002 in EPPO 2005). There seems to be no basis for assessment of potential effects on tourism (both aesthetics and recreational use of waterbodies) or fishing.
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	HIGH -2	There appear to be no useful assessments of the economic impact of this species, although recommendations for such assessment exist (www.invasivespeciesireland.com).
2.8	How great a reduction in consumer demand is the organism likely to cause in the Risk Assessment area?	minimal - 0	LOW - 0	See 2.7.
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	See 2.7. Not relevant.
2.10	How important would other economic costs resulting from introduction be? (specify)	minor - 1	LOW - 0	See 2.6. Online and printed advice may be necessary for the horticultural industry. Some funding for research into control methods may also be required. The plant is already established and has economic impacts in terms of direct management costs.
2.11	How important is environmental harm caused by the organism within its existing geographic range?	major - 3	MEDIUM -1	There appear to be no quantified assessments of environmental harm caused by this species within its existing geographic range. There is a high risk of spread of *Hydrocotyle ranunculoides* in eutrophic still and slow flowing waterbodies in countries where it is already established, and there is a high risk of introduction where it is not already present. Dense mats of vegetation can seriously affect species, habitats and ecosystems, but see 2.12 for impacts in other countries that are likely to occur in the UK.
2.12	How important is environmental harm likely to be in the Risk Assessment area?	massive - 4	LOW - 0	The PRA produced by EPPO in 2009 (EPPO, 2009 in press) states on impacts: At most sites, 100% cover is often observed over large distances (25 km), which is detrimental for the ecosystem. The plant is perennial and often present all year long in sheltered habitats in the UK. In Belgium, it has been observed to reduce by more than 50% the number of native aquatic plant species, up to 100% of the submerged species, and to reduce the native cover from 50% to 10 (Nijs *et al.* , 2009). In Sardinia, the species is considered invasive, and although no specific impacts have been studied, the thick coverage of the species at the surface of the water is considered to outcompete other species (G Brundu, pers. comm., 2009). In the UK, *H. ranunculoides* competes with many plant species due to its ability to establish in different habitats. Examples: different *Carex* /sedge and *Juncus* species, *Rorippa amphibia* , *Myosotis palustris* (syn. *M. scorpioides*), *Nasturtium officinale* (A. Hussner, pers. comm., 2009). In Germany, the native *Myriophyllum spicatum* , *Callitriche* spec. and *Potamogeton crispus* were displaced (Hussner, 2008). Nevertheless, these species are not endangered. Due to the high LAI of up to 5.57 +/- 0.2 it seems obvious, that the species is able to outcompete submerged vegetation (Hussner & Lösch, 2007). Many more species can be outcompeted due to *H. ranunculoides* ' capability to build floating carpets that shade out other plants. Data on impacts in dense infestation are rare because of dangerous surveillance conditions underneath dense floating mats. Indirect effects on other biota and food web (phytoplankton, zooplankton, fishes) are caused by its summer biomass and by moments of decay (lowering of oxygen) and alteration of detritus (impact on macroinvertebrates) (Alien impact report, 2009; L Triest, pers. comm., 2009). *H. ranunculoides* causes many significant changes of ecological processes and structures by : - reduction in flow; - increased sedimentation resulting in acceleration of ecological succession; - changes in O2 concentration; - loss of accessible open water at the margins for wildlife (e.g. birds); - loss of light; - increased flood risk.
2.13	How important is social and other harm caused by the organism within its existing geographic range?	moderate - 2	MEDIUM -1	Flooding caused by the presence of this species will have massive impacts on flood plain populations.
2.14	How important is the social harm likely to be in the Risk Assessment area?	major - 3	LOW - 0	Flooding caused by the presence of this species will have massive impacts on flood plain populations.
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	MEDIUM -1	There is no evidence that such genetic exchange is likely to occur, hybridisation has not been proved in the genus, although it has been suspected (Allan 1982).

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	The extent and speed of establishment to-date suggests that natural enemies will have little or no effect.
2.17	How easily can the organism be controlled?	very difficult - 4	LOW - 0	In spite of confident recommendations in some of the standard literature (e.g. CEH 2006) I have been unable to find evidence of long-term successful control. Information from the River Soar in Leicestershire (Bennet 2008), River Can, Essex (Showler 2004), Rivers Chelmer and Lee (Courtman 2003, CEH 2006), Exminster Marshes (Williams 2002, Ackerman 2007), Pevensey Levels (Watson 1999) and Gillingham Marshes, Suffolk (Kelly 2006) suggests that whilst mechanical removal supported by hand removal has been most effective, it has not yet been shown to eradicate the species from a single site (other sources www.environment_agency.gov.uk/commondata/103599/floating_pennywort_899832.doc, www.invasivespeciesireland.com). Mechanical removal has also been identified as a cause of spread (EPPO 2005).
2.18	How likely are control measures to disrupt existing biological or integrated systems for control of other organisms?	unlikely - 1	LOW - 0	Not relevant to this species
2.19	How likely is the organism to act as food, a host, a symbiont or a vector for other damaging organisms?	unlikely - 1	LOW - 0	Unknown
2.20	Highlight those parts of the endangered area where economic, environmental and social impacts are most likely to occur		MEDIUM -1	It is widespread in canals, ditches and slow-flowing rivers and has been recorded from ponds, gravel pits and irrigation channels.

Summarise Entry	very likely - 4	LOW - 0	It has already entered the Risk Assessment area at least once and probably a number of times. Primarily the pathway is through trade in ornamental plants; subsequently it may be discarded by well-meaning members of the public or be distributed accidentally on human, livestock or mechanical vectors from established populations. It moves easily as vegetative fragments in flowing water and through accidental mechanical transport. It seems unlikely that more introductions will derive directly from trade in ornamental plants as it has been replaced in sale by other related taxa.
Summarise Establishment	very likely - 4	MEDIUM -1	It was first recorded in Essex in 1990 and is now widely established around and to the north-west of London, at a number of sites on the south coast, the Gwent Levels and in the north-west Midlands, in a total of more than 50 10 km squares. Establishment is very likely if it reaches a suitable habitat. It is hardy to a certain extent, has a high vegetative reproduction rate and is strongly competitive.
Summarise Spread	rapid - 3	MEDIUM -1	It has spread very rapidly from its first known site in 1990 to at least 51 10km squares in 2008 (NBN gateway). Vegetative spread is very effective, approximately 15m per season. Human activity is principally responsible for long distance spread. With regard to its invasiveness in UK, its presence forms a serious potential threat should it spread from these localities (Environmental Protection Agency, 2004).
Summarise Impacts	major - 3	LOW - 0	The PRA produced by EPPO in 2009 (EPPO, 2009 in press) states on impacts: At most sites, 100% cover is often observed over large distances (25 km), which is detrimental for the ecosystem. The plant is often perennial and present all year long in sheltered habitats the UK. In Belgium, it has been observed to reduce by more than 50% the number of native aquatic plant species, up to 100% of the submerged species, and to reduce the native cover from 50% to 10 (Nijs *et al.* , 2009). In Sardinia, the species is considered invasive, and although no specific impacts have been studied, the thick coverage of the species at the surface of the water is considered to outcompete other species (G Brundu, pers. comm., 2009). In the UK *H. ranunculoides* competes with many plant species due to its ability to establish in different habitats. Examples: different *Carex* /sedge and *Juncus* species, *Rorippa amphibia* , *Myosotis palustris* (syn. *M. scorpioides*), *Nasturtium officinale* (A. Hussner, pers. comm., 2009). In Germany, the native *Myriophyllum spicatum* , *Callitriche* spec. and *Potamogeton crispus* were displaced (Hussner, 2008). Nevertheless, these species are not endangered. Due to the high LAI of up to 5.57 +/- 0.2 it seems obvious, that the species is able to outcompete submerged vegetation (Hussner & Lösch, 2007). Many more species can be outcompeted due to *H. ranunculoides'* capability to build floating carpets that shade out other plants. Data on impacts in dense infestation are rare because of dangerous surveillance conditions underneath dense floating mats. Indirect effects on other biota and food web (phytoplankton, zooplankton, fishes) are caused by its summer biomass and by moments of decay (lowering of oxygen) and alteration of detritus (impact on macroinvertebrates) (Alien impact report, 2009; L Triest, pers. comm., 2009). *H. ranunculoides* causes many significant changes of ecological processes and structures by : - reduction in flow; - increased sedimentation resulting in acceleration of ecological succession; - changes in O2 concentration; - loss of accessible open water at the margins for wildlife (e.g. birds); - loss of light; - increased flood risk. Presence of *H. ranunculoides* may have a negative impact on the ecological quality status under the
Conclusion of the risk assessment	HIGH -2	LOW - 0	*H. ranunculoides* has been introduced into many countries worldwide for ornamental purposes. It is very widely established in the UK, having spread from its first recorded occurrence in the wild in 1990 to more than 50 ten kilometre squares in 2008. It appears likely that repeated introductions will decline as the plant is no longer intentionally sold in garden centres. However inaccurate labelling and mis-identification mean that it may unintentionally continue to be sold, whilst other members of the same genus with as yet unknown invasive potential may preferentially come onto the market. It has a very high capacity for vegetative reproduction through fragmentation and spread through natural and mechanical vectors. There is no reason to believe that any waterbodies in southern Britain are free from the threat of colonisation by this species and the northern limit may be dictated by frost tolerance. The most important potential economic, environmental and social impacts in the Risk Assessment area are to interruption of waterway use, both for commercial and recreational purposes, flood hazard due to build up of vegetative mass, aesthetic problems, obstruction of activities such as fishing, and damage to conservation initiatives and species of conservation concern through competition. No eradication attempts have been truly effective to-date and those with the greatest degree of success have been extremely expensive or extremely damaging to natural habitats or both. There seems to be little that would be gained from extensive eradication programmes unless an effective, cheaper and less environmentally damaging method can be identified. Rather than this, it is imperative that work is undertaken to improve the information available to customs and garden centres and their staff. Only through establishment of a quality standard in competence in such organisations will any attempt to control the introduction of this and other invasive alien species be successful.
Conclusions on Uncertainty		LOW - 0	Adequate data exist on the current extent of invasion by the target species and potential for its further spread. Initiatives for its control have been tested, although none have been shown to have potential to eradicate the species. There is inadequate information on the taxonomy of the genus worldwide to enable sufficient prediction of the risk associated with the sale of alternative species of the same genus. It is necessary to quantify the volume and frequency of the movement of the species along the pathway.

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