

## FORMAT FOR A PRA RECORD (version 3 of the Decision support scheme for PRA for quarantine pests)

10-15986 P IAS Point 11.2

	European and Mediterranean Plant Protection Organisation		
	Organisation Européenne et Méditerranéenne pour la Protection des Plantes		
			10-15986
	<b>Guidelines on Pest Risk Analysis</b>		P IAS Point 11.3
	<b>Lignes directrices pour l'analyse du risque phytosanitaire</b>		
	<b>Decision-support scheme for quarantine pests Version N°4</b>		
	<b>PEST RISK ANALYSIS FOR</b>		<i>Myriophyllum heterophyllum</i> Michaux
<b>Pest risk analyst:</b>			Nicole Ahlburg, Gritta Schrader, Uwe Starfinger
<b>Stage 1: Initiation</b>			
<b>1 What is the reason for performing the PRA?</b>		<p>In North America, <i>M. heterophyllum</i> is considered invasive in much of the northeastern United States (New England region except Vermont) (Invasive.org (2009), <a href="http://www.invasive.org/browse/subject.cfm?sub=12803">http://www.invasive.org/browse/subject.cfm?sub=12803</a>, 23/01/2009).</p> <p>The plant is of limited distribution in Europe but may increase and be a future invader. The species is present in the wild in the EPPO region (EPPO Reporting Service (2007), <a href="http://archives.eppo.org/EPPORreporting/2007/GGTSPU-styx2.bba.de-18588-1733739-DAT/Rse-0701.pdf">http://archives.eppo.org/EPPORreporting/2007/GGTSPU-styx2.bba.de-18588-1733739-DAT/Rse-0701.pdf</a>, 23/01/2009).</p> <p>It is considered a naturalized neophyte in Germany (FloraWeb (2009), its actual distribution and abundance is probably not well documented.</p>	
<b>2 Enter the name of the pest</b>		<i>Myriophyllum heterophyllum</i> Michx.	
<b>2A Indicate the type of the pest</b>		Submerse aquatic plant.	

<b>2B Indicate the taxonomic position</b>		Kingdom Plantae - plants Subkingdom Cormobionta - vascular plants Division Angiospermae - Magnoliophyta Class Dicotyledonae - Magnoliopsida Subclass Rosidae Order Haloragidales Family Haloragaceae Genus <i>Myriophyllum</i> L. – watermilfoil Species <i>Myriophyllum heterophyllum</i> Michaux - variable water milfoil
<b>3 Clearly define the PRA area</b>		Germany
<b>4 Does a relevant earlier PRA exist?</b>	no	An earlier PRA does not exist. But outside the EPPO region there are different reports about <i>M. heterophyllum</i> . In its area of origin, <i>M. heterophyllum</i> has spread to the northeastern United States and is considered invasive there (New England region except Vermont), (Invasive.org (2009), <a href="http://www.invasive.org/browse/subject.cfm?sub=12803">http://www.invasive.org/browse/subject.cfm?sub=12803</a> , 23/01/2009).
<b>5 Is the earlier PRA still entirely valid, or only partly valid (out of date, applied in different circumstances, for a similar but distinct pest, for another area with similar conditions)?</b>		
Stage 2A: Pest Risk Assessment - Pest categorization		
<b>6 Specify all the host plant species (for pests directly affecting plants) or suitable habitats (for non parasitic plants). Indicate the ones which are present in the PRA area.</b>		<i>M. heterophyllum</i> colonizes still or slow-moving freshwater bodies, e.g. channels, lakes, ponds, ditches, spring-fed swamps and sloughs.
<b>7. Specify the pest distribution</b>		In North America, <i>M. heterophyllum</i> is native to the southern United States and ranges throughout the eastern region westwards to North Dakota (ENSR International (2005), Rapid Response Plan for Variable Watermilfoil in Massachusetts). The species is

		<p>considered invasive in much of the northeast (New England region except Vermont) (Invasive.org (2009), <a href="http://www.invasive.org/browse/subject.cfm?sub=12803">http://www.invasive.org/browse/subject.cfm?sub=12803</a>, 23/01/2009).</p> <p>New infestations in lakes have been discovered in the western United States (Washington and Oregon), (Howard, V. (2009), "<i>Myriophyllum heterophyllum</i>", USGS Nonindigenous Aquatic Species Database, Gainesville, FL. <a href="http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=236">http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=236</a>, 23/01/2009).</p> <p>In Europe <i>M. heterophyllum</i> is established in Austria, Spain, Great Britain, Switzerland, the Netherlands and Germany. (<a href="http://www.europe-aliens.org">www.europe-aliens.org</a>; <a href="http://www.aquatischeneophyten.org">www.aquatischeneophyten.org</a>;</p>
<b>8. Is the organism clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?</b>	Yes	There are several species in the genus <i>Myriophyllum</i> . Some are difficult to distinguish in the vegetative state.
<b>9. Even if the causal agent of particular symptoms has not yet been fully identified, has it been shown to produce consistent symptoms and to be transmissible?</b>	/	n/a
<b>10. Is the organism in its area of current distribution a known pest (or vector of a pest) of plants or plant products?</b>	yes	In North America <i>M. heterophyllum</i> is a known pest in the New England region (except Vermont) where the species is considered invasive and has negative effects on the aquatic ecosystem by generating dense mats.
<b>11. Does the organism have intrinsic attributes that indicate that it could cause significant harm to plants?</b>	yes	Ability to form dense stands that can outshade other plants.
<b>12 Does the pest occur in the PRA area?</b>	yes	
<b>13. Is the pest widely distributed in the PRA area?</b>	no	A distribution map of the German Flora Mapping project ( <a href="http://www.floraweb.de">www.floraweb.de</a> ) shows scattered occurrence in several Federal States.

<b>14. Does at least one host-plant species (for pests directly affecting plants) or one suitable habitat (for non parasitic plants) occur in the PRA area (outdoors, in protected cultivation or both)?</b>	yes	Suitable habitats for the plant are still or slow-moving freshwater bodies and ecosystems. They are common in Germany
<b>15. If a vector is the only means by which the pest can spread, is a vector present in the PRA area? (if a vector is not needed or is not the only means by which the pest can spread go to 16)</b>	/	n/a
<b>16. Does the known area of current distribution of the pest include ecoclimatic conditions comparable with those of the PRA area or sufficiently similar for the pest to survive and thrive (consider also protected conditions)?</b>	yes	<i>M. heterophyllum</i> occurs in the eastern United States and in south-eastern Canada. The ecoclimatic conditions are largely similar to Germany.
<b>17. With specific reference to the plant(s) or habitats which occur(s) in the PRA area, and the damage or loss caused by the pest in its area of current distribution, could the pest by itself, or acting as a vector, cause significant damage or loss to plants or other negative economic impacts (on the environment, on society, on export markets) through the effect on plant health in the PRA area?</b>	yes or uncertain	<p>Leaf canopies on the water surface can shadow plants below and could replace native plants and reduce species diversity. A formation of dense populations can affect water quality (oxygen, pH, organic content). Oxygen levels can be reduced underneath large mats or by decomposing plants.</p> <p>Reduced oxygen levels can result in fish avoidance or fish kills.</p> <p>The decay of large plant masses puts elevated levels of dissolved and suspended organic matter into the water column. Large mats of the plant increase sedimentation.</p> <p>Monospecific populations can negatively affect wildlife (predator/prey relationship among fish, impedes predation, shelters prey fish, covers spawning areas). All this can lead to a change of the aquatic ecosystem.</p> <p>Also human uses of water body will be limited. The plant chokes channels, clogs water intakes, restricts aquatic activities as fishing, swimming, boating.</p> <p>(ENSR International (2005), Rapid Response Plan for Variable Watermilfoil in Massachusetts).</p>
<b>18. This pest could present a phytosanitary risk to the PRA area.</b>	yes	<i>M. heterophyllum</i> may present a risk and may cause economic as well as ecological and social impacts.

<b>19. The pest does not qualify as a quarantine pest for the PRA area and the assessment for this pest can stop.</b>		
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## Section 2B: Pest Risk Assessment - Probability of introduction/spread and of potential economic consequences

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
		<b>Note: If the most important pathway is intentional import, do not consider entry, but go directly to establishment. Spread from the intended habitat to the unintended habitat, which is an important judgement for intentionally imported organisms, is covered by questions 1.33 and 1.35.</b>
<b>1.1. Consider all relevant pathways and list them</b>		Intentional import as an ornamental plant for use in aquaria plant or plant for use outdoors in garden ponds. Actual figures for import not known; also potential misidentifications in trade make estimate difficult. No other pathways identified.
<b>1.2. Select from the relevant pathways, using expert judgement, those which appear most important. If these pathways involve different origins and end uses, it is sufficient to consider only the realistic worst-case pathways. The following group of questions on pathways is then considered for each relevant pathway in turn, as appropriate, starting with the most important.</b>		
<b>Pathway n°: This pathway analysis should be conducted for all relevant pathways</b>	<b>1</b>	Intentional import as an ornamental plant
<b>1.3. How likely is the pest to be associated with the pathway at origin taking into account factors such as the occurrence of suitable life stages of the pest, the period of the year?</b>		
<b>1.4. How likely is the concentration of the pest on the pathway at origin to be high, taking into account factors like cultivation</b>		

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
<b>practices, treatment of consignments?</b>		
<b>1.5. How large is the volume of the movement along the pathway?</b>	moderate/ medium uncertainty	The species is available in garden centres, aquarium stores and pet shops. It is also traded on internet, e.g.: <a href="http://www.aquabotanicstore.com/Red_Foxtail_p/p124.htm">http://www.aquabotanicstore.com/Red_Foxtail_p/p124.htm</a> <a href="http://www.aquariumplants.com/Myrio_Red_Myriophyllum_heterophyllum_p/bp025.htm">http://www.aquariumplants.com/Myrio_Red_Myriophyllum_heterophyllum_p/bp025.htm</a> <a href="http://www.liveaquaria.com/product/prod_display.cfm?c=768+2546&amp;pcatid=2546">http://www.liveaquaria.com/product/prod_display.cfm?c=768+2546&amp;pcatid=2546</a> There are several species in the genus <i>Myriophyllum</i> . Some are difficult to distinguish vegetatively. There is the possibility that <i>M. heterophyllum</i> is traded under a false name.
<b>1.6. How frequent is the movement along the pathway?</b>	often/low uncertainty	The movement along the pathway is throughout the year.
<b>1.7. How likely is the pest to survive during transport/storage?</b>	very likely/low uncertainty	Intentional introduction of the plant.
<b>1.8. How likely is the pest to multiply/increase in prevalence during transport /storage?</b>		
<b>1.9. How likely is the pest to survive or remain undetected during existing management procedures (including phytosanitary measures)?</b>		
<b>1.10. In the case of a commodity pathway, how widely is the commodity to be distributed throughout the PRA area?</b>	widely/low uncertainty	The species is available in aquarium trade throughout the PRA area.
<b>1.11. In the case of a commodity pathway, do consignments arrive at a suitable time of year for pest establishment?</b>	yes /low uncertainty	Intentional import of the plant in aquarium trade occurs throughout the year. As the plant is usually used indoors, time is always suitable.

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
<b>1.12. How likely is the pest to be able to transfer from the pathway to a suitable host or habitat?</b>	moderately likely/low uncertainty	Dumping of aquaria and cleaning of ponds is a possibility to release the species into unintended habitats like ponds or rivers and brooks in the wild.
<b>1.13. In the case of a commodity pathway, how likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) to aid transfer to a suitable host or habitat?</b>	moderately likely	
<b>1.14. Do other pathways need to be considered?</b>	no	
<b>Conclusion on the probability of entry. Risks presented by different pathways.</b>	probability of entry is high/low uncertainty	<i>M. heterophyllum</i> has already entered Germany. The plant is traded as an aquarium plant. Import from other countries is very likely going on.
<b>1.15. Estimate the number of host plant species or suitable habitats in the PRA area (see question 6).</b>	many/low uncertainty	Ideal habitats for <i>M. heterophyllum</i> are still or slow-moving freshwater bodies and ecosystems.
<b>1.16. How widespread are the host plants or suitable habitats in the PRA area? (specify)</b>	widely/low uncertainty	Freshwater bodies and ecosystems abound in Germany.
<b>1.17. If an alternate host or another species is needed to complete the life cycle or for a critical stage of the life cycle such as transmission (e.g. vectors), growth (e.g. root symbionts), reproduction (e.g. pollinators) or spread (e.g. seed dispersers), how likely is the pest to come in contact with such species?</b>	n/a	

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
<b>1.18. How similar are the climatic conditions that would affect pest establishment, in the PRA area and in the current area of distribution?</b>	largely similar/medium uncertainty	The climatic conditions are largely similar. The plant's current area of distribution, North America and Europe, is within the temperate zone. The north-eastern part of the United States and Central Europe are summarized as a warm temperate climate as it is classified by Köppen. The warm temperate climate is defined by the coldest month between +18°C and -3°C. The affected areas in Canada are classified as snow climate with the coldest month below -3°C and the warmest month above +10°C. (Forkel, M. (2009), <a href="http://www.m-forkel.de/klima/koeppen.html">http://www.m-forkel.de/klima/koeppen.html</a> , 29/01/2009). Within the main climates there are subclimates which are defined by humidity/aridity in dependence on precipitation and temperature.
<b>1.19. How similar are other abiotic factors that would affect pest establishment, in the PRA area and in the current area of distribution?</b>	largely similar/low uncertainty	<i>M. heterophyllum</i> is able to thrive in a wide variety of environmental conditions. It grows well in still and slow flowing waters, and can survive under ice with the ability to overwinter. The plant grows in acidic and alkaline water, can tolerate a wide range of calcium concentrations and prefers fine textured sediments with high ammonium nitrogen levels (Crow and Hellquist (1983) in ENSR International (2005), Rapid Response Plan for Variable Watermilfoil in Massachusetts). In general it grows on various substrates including organic muck, silt, sand and gravel (Maine Center for Invasive Aquatic Plants (2009), <a href="http://www.mciap.org/herbarium/VariableWaterMilfoil.php">http://www.mciap.org/herbarium/VariableWaterMilfoil.php</a> , 29/01/2009).
<b>1.20. If protected cultivation is important in the PRA area, how often has the pest been recorded on crops in protected cultivation elsewhere?</b>	N/A	Not relevant.
<b>1.21. How likely is it that establishment will occur despite competition from existing species in the PRA area, and/or despite natural enemies present in the PRA area ?</b>	likely/medium uncertainty	<i>M. heterophyllum</i> is a freshwater macrophyte and can generate monospecific populations and dense mats. <i>M. heterophyllum</i> often co-occurs and competes with <i>Cabomba caroliniana</i> (ENSR International (2005), Rapid Response Plan for Variable Watermilfoil in Massachusetts). But a co-occurrence of both does not inhibit the establishment of <i>M. heterophyllum</i> . Competitive effects of other aquatic plants are not sufficiently studied. <i>Eubrychius velutus</i> Beck is an aquatic weevil which is distributed throughout Europe and Asia. The species is a <i>Myriophyllum</i> specialist. Native hosts are <i>M. verticillatum</i> and <i>M. spicatum</i> . It has expanded its host range to include the non-native <i>M. heterophyllum</i> . The weevil can complete all life stages submersed on the plant (Newman <i>et. al</i> (2006)).

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
<b>1.22. To what extent is the managed environment in the PRA area favourable for establishment?</b>	favourable/medium uncertainty	River regulation leads to the existence of oxbow lakes with standing or slow-flowing water favourable for the plant. In addition, measures to reconstruct natural water courses create shallow and slow flowing sections, e.g. on riverbanks.
<b>1.23. How likely is it that existing pest management practice will fail to prevent establishment of the pest?</b>	likely/medium uncertainty	<p>In some countries, water bodies are managed by using herbicides to control aquatic weeds. However, measures like the application of systemic herbicides can be a danger for the water body or aquatic ecosystem, because they don't only have an effect on the primary objective but also on other species. Furthermore the groundwater/drinking water can be affected, too. Therefore in Germany an application of herbicides in aquatic systems is prohibited.</p> <p>In Germany a mechanical removal of unwelcome water plants by "harvesting" them via mowing/collecting boats is common. This measure is unlikely to prevent establishment.</p>
<b>1.24. Based on its biological characteristics, how likely is it that the pest could survive eradication programmes in the PRA area?</b>	likely/medium uncertainty	Hand or suction harvesting may not have a long lasting success, because plants can re-sprout from stem fragments and the population can appear again. An application of herbicides is prohibited in Germany. Small populations may be eradicated by stricter measures, e.g. excavation of lakes or river sections, blanketing vegetation with black plastic sheets etc.
<b>1.25. How likely is the reproductive strategy of the pest and the duration of its life cycle to aid establishment?</b>	very likely/low uncertainty	<i>M. heterophyllum</i> is a submersed, rooted macrophyte. Reproduction is vegetative. Short stem fragments are able to generate new shoots.

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
<b>1.26 How likely are relatively small populations to become established?</b>	likely/medium uncertainty	In spring populations grow stronger and build new shoots. The blooming period is from June to August whereas in autumn and winter populations thin out (Hussner, A. (2006). But populations are quite capable to overwinter. Reproduction is vegetative. Short stem fragments are able to generate new shoots and build a new population.
<b>1.27 How adaptable is the pest?</b>	no information	
<b>1.28. How often has the pest been introduced into new areas outside its original area of distribution? (specify the instances, if possible)</b>	occasionally	<i>M. heterophyllum</i> was introduced into Europe. The species is present in the wild in several countries.
<b>1.29. If establishment of the pest is very unlikely, how likely are transient populations to occur in the PRA area through natural migration or entry through man's activities (including intentional release into the environment)?</b>	N/A	
<b>Conclusion on the probability of establishment</b>	Probability of establishment: high/medium uncertainty	The plant is considered as a naturalized neophyte in Germany. Establishment in new habitats is likely.
<b>1.30. How likely is the pest to spread rapidly in the PRA area by natural means?</b>	moderately likely/medium uncertainty	Reproduction is vegetative. Stem fragments can generate new shoots. The distribution is primarily bound to water bodies. Fragments can be transported by flowing water. Also waterfowl can aid dispersal by eating fruits, but this is less likely.
<b>1.31. How likely is the pest to spread rapidly in the PRA area by human assistance?</b>	likely/medium uncertainty	Dumping of aquaria by pouring the content into ponds or rivers. Human recreational uses as boating, fishing and swimming can spread the reproducible fragments. Distribution and establishment is bound to water bodies, but stem fragments can also be transported by human assistance without a direct connection to water bodies by uncleaned

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
		fishing gear, diver's equipment and boat propellers. But this is bound to a short period of time because the reproducible fragments do not tolerate drying out.
<b>1.32. Based on biological characteristics, how likely is it that the pest will not be contained within the PRA area?</b>	moderately likely/medium uncertainty	The distribution is bound to water bodies. Aquatic habitats have to be available. Fragments can be transported by water courses, human assistance and waterfowl.
<b>Conclusion on the probability of spread</b>	Probability of spread is medium /medium uncertainty	<i>M. heterophyllum</i> is quite capable to spread by reproducible stem fragments. It is a popular plant in aquarium trade. It is either imported or already cultivated in-country. Dumping of aquaria by pouring the content into ponds or rivers is another possibility of spread. Fragments are transported by boats, trailers, fishing gear, wind, animals and currents (Aiken <i>et al.</i> (1979) in ENSR International (2005), Rapid Response Plan for Variable Watermilfoil in Massachusetts).
<b>Conclusion on the probability of introduction and spread</b> <b>The overall probability of introduction and spread should be described. The probability of introduction and spread may be expressed by comparison with PRAs on other pests.</b>	The overall probability of introduction and spread is medium to high/medium uncertainty	The plant has already entered Germany and is traded as an aquarium plant. The plant is quite capable to spread by reproducible stem fragments. Spreading by humans and also birds (less likely). Fragments are transported by boats, trailers, fishing gear and currents.
<b>Conclusion regarding endangered areas</b> <b>1.33. Based on the answers to questions 1.15 to 1.32 identify the part of the PRA area where presence of host plants or suitable habitats and ecological factors favour the establishment and spread of the pest to define the endangered area.</b>		Suitable habitats are still and slow-flowing waters. They are widely distributed over much of the area of Germany.
<b>2. In any case, providing replies for all hosts (or all habitats) and all situations may be laborious, and it is desirable to</b>		

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
<p><b>focus the assessment as much as possible. The study of a single worst-case may be sufficient. Alternatively, it may be appropriate to consider all hosts/habitats together in answering the questions once. If a selection is made, it should be justified. Only in certain circumstances will it be necessary to answer the questions separately for specific hosts/habitats.</b></p>		
<p><b>2.1. How great a negative effect does the pest have on crop yield and/or quality to cultivated plants or on control costs within its current area of distribution?</b></p>	minimal/low uncertainty	No reports.
<p><b>2.2. How great a negative effect is the pest likely to have on crop yield and/or quality in the PRA area without any control measures?</b></p>	minimal/low uncertainty	

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
<p><b>2.3. How easily can the pest be controlled in the PRA area without phytosanitary measures?</b></p>	<p>with some difficulty/medium uncertainty</p>	<p>In the New England region in the northeastern United States the following measures against water plant infestations are applied:</p> <ul style="list-style-type: none"> <li>• hand harvesting</li> <li>• suction harvesting</li> <li>• benthic barriers</li> <li>• water level drawdown</li> <li>• application of systemic herbicides (2,4-D, Triclopyr, Fluridone)</li> </ul> <p>(ENSR International (2005), Rapid Response Plan for Variable Watermilfoil in Massachusetts)</p> <p>Hand or suction harvesting may not have a long-lasting success, because an infestation can appear again.</p> <p>Laying out benthic barriers is another effective method to destroy invasive water plant infestations. They cover the sediment like a blanket and compress water plants while blocking light.</p> <p>But if plant populations get out of control, phytosanitary measures, e.g. selling and import prohibitions, may be necessary.</p>
<p><b>2.4. How great an increase in production costs (including control costs) is likely to be caused by the pest in the PRA area?</b></p>	<p>minimal</p>	<p>Not relevant.</p>
<p><b>2.5. How great a reduction in consumer demand is the pest likely to cause in the PRA area?</b></p>	<p>minimal</p>	<p>Not relevant.</p>

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
<b>2.6. How important is environmental damage caused by the pest within its current area of distribution?</b>	major	Dense mats of <i>M. heterophyllum</i> reduce light to other submerged plants and can affect water quality by reducing oxygen levels. Reduced oxygen levels can result fish avoidance or fish kills. The decay of large plant masses puts elevated levels of dissolved and suspended organic matter into the water column. Furthermore large mats of plants increase sedimentation. Monospecific populations can negatively affect wildlife (predator/prey relationship among fish, impedes predation, shelters prey fish, covers spawning areas). All this can lead to a change of the aquatic ecosystem. (ENSR International (2005), Rapid Response Plan for Variable Watermilfoil in Massachusetts).
<b>2.7. How important is the environmental damage likely to be in the PRA area (see note for question 2.6)?</b>	major/medium uncertainty	Where <i>M. heterophyllum</i> is able to establish dense mats the negative effect on the aquatic ecosystem will occur (see above).
<b>2.8. How important is social damage caused by the pest within its current area of distribution?</b>	moderate	Human use Aquatic activities like fishing, swimming, boating will be restricted by dense mats of <i>M. heterophyllum</i> .  Water quality Eutrophication by dense plant growth increases nutrient levels and leads to an increased plant dying. Decay of large plant mats results in a reduction in oxygenation and can produce ammonia, hydrogen sulfide and methane. These substances are toxic and also produce a bad smell and taste.
<b>2.9. How important is the social damage likely to be in the PRA area?</b>	moderate/medium uncertainty	See above
<b>2.10. How likely is the presence of the pest in the PRA area to cause losses in export markets?</b>	Impossible	Not relevant.

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
<p>As noted in the introduction to section 2, the evaluation of the following questions may not be necessary if the responses to question 2.2 is "major" or "massive" and the answer to 2.3 is "with much difficulty" or "impossible" or any of the responses to questions 2.4, 2.5, 2.7, 2.9 and 2.10 is "major" or "massive" or "very likely" or "certain". You may go directly to point 2.16 unless a detailed study of impacts is required or the answers given to these questions have a high level of uncertainty.</p>		
<p><b>2.11. How likely is it that natural enemies, already present in the PRA area, will not reduce populations of the pest below the economic threshold?</b></p>	<p>moderately likely/high uncertainty</p>	<p>The aquatic weevil <i>Eubrychius velutus</i> which is distributed throughout Europe and Asia is a <i>Myriophyllum</i> specialist. Native hosts are <i>M. verticillatum</i> and <i>M. spicatum</i>. It has expanded its host range to include the non-native <i>M. heterophyllum</i>. The weevil can complete all life stages submersed on the plant. It develops in the meristem and outer portions of the plant and pupates in a cocoon on the top 5 cm of the plant (Newman <i>et. al</i> (2006)).</p> <p>There is little information about the exact distribution of <i>E. velutus</i> within the PRA area. In some Federal States of Germany such as Bavaria, Lower Saxony and Saxony-Anhalt the species is recorded. In Saxony-Anhalt and Bavaria it is listed as endangered or even critically endangered on the Red List of endangered weevils. Furthermore there is little research about the effect on <i>M. heterophyllum</i> populations.</p>
<p><b>2.12. How likely are control measures to disrupt existing biological or integrated systems for control of other pests or to have negative effects on the environment?</b></p>	<p>impossible</p>	<p>In some countries an application of systemic herbicides on aquatic systems is allowed, but in Germany it is prohibited.</p>
<p><b>2.13. How important would other costs resulting from introduction be?</b></p>	<p>minimal</p>	<p>Not relevant.</p>

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
<p><b>2.14. How likely is it that genetic traits can be carried to other species, modifying their genetic nature and making them more serious plant pests?</b></p>	<p>moderately likely/high uncertainty</p>	<p>The plant is able to hybridize with other (native) <i>Myriophyllum</i> species, e.g. <i>M. heterophyllum x pinnatum</i> (found in the New England region (USA)). <i>M. heterophyllum</i> and especially its hybrid can out-compete native vegetation and can displace other aquatic species. Native species in the PRA area are <i>M. spicatum</i>, <i>M. verticillatum</i> and <i>M. alterniflorum</i>. (<a href="http://www.mainevolunteerlakemonitors.org/mciap/herbarium/VariableWatermilfoil.php">http://www.mainevolunteerlakemonitors.org/mciap/herbarium/VariableWatermilfoil.php</a>)</p>
<p><b>2.15. How likely is the pest to cause a significant increase in the economic impact of other pests by acting as a vector or host for these pests?</b></p>		<p>Not relevant.</p>
<p><b>2.16. Referring back to the conclusion on endangered area (1.33), identify the parts of the PRA area where the pest can establish and which are economically most at risk.</b></p>		<p>Any still or slow-moving freshwater body or aquatic ecosystem in Germany.</p>
<p><b>Degree of uncertainty</b>  <b>Estimation of the probability of introduction of a pest and of its economic consequences involves many uncertainties. In particular, this estimation is an extrapolation from the situation where the pest occurs to the hypothetical situation in the PRA area. It is important to document the areas of uncertainty (including identifying and prioritizing of additional data to be collected and research to be conducted) and the degree of uncertainty in the assessment, and to indicate where expert judgement has been used. This is</b></p>		

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
<p>necessary for transparency and may also be useful for identifying and prioritizing research needs.</p> <p>It should be noted that the assessment of the probability and consequences of environmental hazards of pests of uncultivated plants often involves greater uncertainty than for pests of cultivated plants. This is due to the lack of information, additional complexity associated with ecosystems, and variability associated with pests, hosts or habitats.</p>		
<p>Evaluate the probability of entry and indicate the elements which make entry most likely or those that make it least likely. Identify the pathways in order of risk and compare their importance in practice.</p>		<ul style="list-style-type: none"> <li>• Difficulty to distinguish the <i>Myriophyllum</i> species, trade under a false name.</li> <li>• No declaration about the origin of the traded plant in shops/on internet (imported/cultivated in-country).</li> <li>• Location and time of dumping of aquaria is impossible to ascertain.</li> <li>• The number of natural enemies is unknown. A potential control agent would be the aquatic weevil <i>Eubrychius velutus</i> which has expanded its host range to include <i>M. heterophyllum</i>. The weevil lives and feeds on the plant. But there is little information about the effect on <i>M. heterophyllum</i> populations. A further research is necessary.</li> <li>• <i>M. heterophyllum</i> is already present in the wild and even naturalized in the PRA area, but has not shown an invasive behaviour yet. This could be possibly caused by a time lag between introduction and invasion. Könnte dabei auch <i>Eubrychius velutus</i> eine Rolle spielen?</li> </ul>
<p>Evaluate the probability of establishment, and indicate the elements which make establishment most likely or those that make it least likely. Specify which part of the PRA area presents the greatest risk of establishment.</p>		

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
<p><b>List the most important potential economic impacts, and estimate how likely they are to arise in the PRA area. Specify which part of the PRA area is economically most at risk.</b></p>		
<p><b>The risk assessor should give an overall conclusion on the pest risk assessment and an opinion as to whether the pest or pathway assessed is an appropriate candidate for stage 3 of the PRA: the selection of risk management options, and an estimation of the associated pest risk.</b></p>		<p><i>M. heterophyllum</i> has already entered and is traded in Germany. The most important pathway is the intentional import and selling as an aquarium plant. By dumping of aquaria and cleaning of ponds the plant is released into unintended habitats. The plant is quite capable to spread by reproducible stem fragments. Spreading is caused by humans and also birds (less likely). Fragments are transported by boats, trailers, fishing gear and currents. Suitable habitats are any still or slow-moving freshwater body or aquatic ecosystem. A dense and extensive growth of the plant will modify the aquatic habitat and is described as follows:</p> <ul style="list-style-type: none"> <li>• degradation of water quality (oxygen, pH, organic content)</li> <li>• loss of biodiversity (extrusion/avoidance)</li> <li>• limitation of recreational use (swimming, fishing)</li> </ul> <p><i>M. heterophyllum</i> is present in the wild and is already established in Germany, but not widely distributed (see stage 2: pest categorization, question 12 (figure 2.)).</p>

This is the end of the Pest risk assessment	
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**Stage 3: Pest risk Management**

Question	Y/N	Explanatory text
<b>3.1. Is the risk identified in the Pest Risk Assessment stage for all pest/pathway combinations an acceptable risk?</b>	no	
<b>Pathway 1</b>		Intentional import as an aquarium plant or plant for use outdoors in garden ponds.
<b>3.2. Is the pathway that is being considered a commodity of plants and plant products?</b>  If yes, go to 3.11, If no, go to 3.3	yes	
<b>3.3. Is the pathway that is being considered the natural spread of the pest? (see answer to question 1.30)</b>  If yes, go to 3.4, If no, go to 3.9	no	
<b>3.4. Is the pest already entering the PRA area by natural spread or likely to enter in the immediate future? (see answer to question 1.30)</b>	no	

<p><b>3.5. Is natural spread the major pathway?</b></p> <p>If yes, go to 3.29, If no, go to 3.6</p>	no	
<p><b>3.6. Could entry by natural spread be reduced or eliminated by control measures applied in the area of origin?</b></p> <p>If yes, possible measures: control measures in the area of origin, go to 3.7</p>	no	
<p><b>3.7. Could the pest be effectively contained or eradicated after entry? (see answer to question 1.24, 1.32)</b></p> <p>If yes, possible measures: internal containment and/or eradication campaign, Go to 3.8</p>		
<p><b>3.8. Was the answer "yes" to either question 3.6 or question 3.7?</b></p> <p>If yes, go to 3.38, If no, go to 3.44</p>		
<p><b>3.9. Is the pathway that is being considered the entry with human travellers?</b></p> <p>If yes, possible measures: inspection of human travellers, their luggage, publicity to enhance public awareness on pest risks, fines or incentives. Treatments may also be possible, Go to 3.29 If no, go to 3.10</p>		

<p><b>3.10. Is the pathway being considered contaminated machinery or means of transport?</b></p> <p><b>If yes, possible measures: cleaning or disinfection of machinery/vehicles</b></p>		
<p><b>3.11. If the pest is a plant, is it the commodity itself?</b></p> <p><b>If yes, go to 3.29, If no (the pest is not a plant or the pest is a plant but is not the commodity itself), go to 3.12</b></p>	yes	
<p><b>3.12. Are there any existing phytosanitary measures applied on the pathway that could prevent the introduction of the pest?</b></p> <p><b>if appropriate, list the measures and identify their efficacy against the pest of concern, Go to 3.13</b></p>		
<p><b>3.13. Can the pest be reliably detected by a visual inspection of a consignment at the time of export, during transport/storage or at import?</b></p> <p><b>If yes, possible measure: visual inspection, go to 3.14</b></p>		

<p><b>3.14. Can the pest be reliably detected by testing (e.g. for pest plant, seeds in a consignment)?</b></p> <p><b>If yes, possible measure: specified testing, go to 3.15</b></p>		
<p><b>3.15. Can the pest be reliably detected during post-entry quarantine?</b></p> <p><b>If yes, possible measure: import under special licence/permit and post-entry quarantine, go to 3.16</b></p>		
<p><b>3.16. Can the pest be effectively destroyed in the consignment by treatment (chemical, thermal, irradiation, physical)?</b></p> <p><b>If yes, possible measure: specified treatment, go to 3.17</b></p>		
<p><b>3.17. Does the pest occur only on certain parts of the plant or plant products (e.g. bark, flowers), which can be removed without reducing the value of the consignment? (This question is not relevant for pest plants)</b></p> <p><b>If yes, possible measure: removal of parts of plants from the consignment, go to 3.18</b></p>		
<p><b>3.18. Can infestation of the consignment be reliably prevented by handling and packing methods?</b></p> <p><b>If yes, possible measure: specific handling/packing methods, go to 3.19</b></p>		
<p><b>3.19. Could consignments that may be infested be accepted without risk for certain end uses, limited distribution in the PRA area, or limited periods of entry, and can such limitations be applied in practice?</b></p> <p><b>If yes, possible measure: import under special licence/permit and specified restrictions, go to 3.20</b></p>		

<p><b>3.20. Can infestation of the commodity be reliably prevented by treatment of the crop?</b></p> <p><b>If yes, possible measure: specified treatment and/or period of treatment, go to 3.21</b></p>		
<p><b>3.21. Can infestation of the commodity be reliably prevented by growing resistant cultivars? (This question is not relevant for pest plants)</b></p> <p><b>If yes, possible measure: consignment should be composed of specified cultivars, go to 3.22</b></p>		
<p><b>3.22. Can infestation of the commodity be reliably prevented by growing the crop in specified conditions (e.g. protected conditions such as screened greenhouses, physical isolation, sterilized growing medium, exclusion of running water, etc.)?</b></p> <p><b>If yes, possible measure: specified growing conditions, go to 3.23</b></p>		
<p><b>3.23. Can infestation of the commodity be reliably prevented by harvesting only at certain times of the year, at specific crop ages or growth stages?</b></p> <p><b>If yes, possible measure: specified age of plant, growth stage or time of year of harvest, go to 3.24</b></p>		
<p><b>3.24. Can infestation of the commodity be reliably prevented by production in a certification scheme (i.e. official scheme for the production of healthy plants for planting)?</b></p> <p><b>If yes, possible measure: certification scheme, go to 3.25</b></p>		

<p><b>3.25. Is the pest of very low capacity for natural spread?</b></p> <p><b>If yes, possible measures: pest freedom of the crop, or pest-free place of production or pest-free area, Go to 3.28</b></p> <p><b>If no, go to 3.26</b></p>		
<p><b>3.26. Is the pest of low to medium capacity for natural spread?</b></p> <p><b>If yes, possible measures: pest-free place of production or pest free area, Go to 3.28</b></p> <p><b>If no, go to 3.27</b></p>		
<p><b>3.27. The pest is of medium to high capacity for natural spread</b></p> <p><b>Possible measure: pest-free area, go to 3.28</b></p>		
<p><b>3.28. Can pest freedom of the crop, place of production or an area be reliably guaranteed?</b></p> <p><b>If no, possible measure identified in questions 3.25-3.27 would not be suitable, go to 3.29</b></p>		
<p><b>3.29. Are there effective measures that could be taken in the importing country (surveillance, eradication) to prevent establishment and/or economic or other impacts?</b></p> <p><b>If yes, possible measures: internal surveillance and/or eradication campaign, go to 3.30</b></p>	yes?	<p>Management measures in case of invasion are:</p> <ul style="list-style-type: none"> <li>• Construction of a control plan for existing infestations.</li> <li>• A rapid response plan for new infestations.</li> <li>• Monitoring and surveillance to early detect the plant.</li> <li>• Control measures are: a mechanical and periodically repeated removal of the plant, placement of benthic barriers and an application with herbicides. However, herbicides are usually prohibited in aquatic ecosystems, especially in Germany.</li> </ul> <p>If control costs are high prohibitions of import/cultivating in-country, selling, planting and holding of the plant could be necessary.</p>

<p><b>3.30. Have any measures been identified during the present analysis that will reduce the risk of introduction of the pest? List them.</b></p> <p><b>If yes, go to 3.31</b> <b>If no, go to 3.38</b></p>	yes	prohibitions of import/cultivating in-country, selling, planting and holding of the plant
<p><b>3.31. Does each of the individual measures identified reduce the risk to an acceptable level?</b></p> <p><b>If yes, go to 3.34</b> <b>If no, go to 3.32</b></p>	yes	An early detection and repeated harvesting may keep the plant's annual growth to a minimum and therefore may reduce the risk to an acceptable level. Eradication measures may not have a long lasting success because a re-introduction is likely. A prohibition of selling and import to prevent a re-introduction could be necessary. If control costs are high a prohibition should be also considered.
<p><b>3.32. For those measures that do not reduce the risk to an acceptable level, can two or more measures be combined to reduce the risk to an acceptable level?</b></p> <p><b>If yes, go to 3.34</b> <b>If no, go to 3.33</b></p>		
<p><b>3.33. If the only measures available reduce the risk but not down to an acceptable level, such measures may still be applied, as they may at least delay the introduction or spread of the pest. In this case, a combination of phytosanitary measures at or before export and internal measures (see question 3.29) should be considered.</b></p> <p><b>Go to 3.34</b></p>		
<p><b>3.34. Estimate to what extent the measures (or combination of measures) being considered interfere with trade.</b></p> <p><b>Go to 3.35</b></p>		The plant is popular in aquarium trade. A prohibition of import, selling, transport and possession interferes with trade.

<p><b>3.35. Estimate to what extent the measures (or combination of measures) being considered are cost-effective, or have undesirable social or environmental consequences.</b></p> <p><b>Go to 3.36</b></p>		<p>Aquarists and sellers of aquatic plants may not agree with a prohibition. But there is the possibility to switch to non invasive substitution plants.</p>
<p><b>3.36. Have measures (or combination of measures) been identified that reduce the risk for this pathway, and do not unduly interfere with international trade, are cost-effective and have no undesirable social or environmental consequences?</b></p> <p><b>If yes, For pathway-initiated analysis, go to 3.39</b>  <b>For pest-initiated analysis, go to 3.38</b>  <b>If no, go to 3.37</b></p>	yes	<p>Prohibition of import/cultivating in-country, selling, planting and holding of the plant.</p>
<p><b>3.37. Envisage prohibiting the pathway</b></p> <p><b>For pathway-initiated analysis, go to 3.43 (or 3.39),</b>  <b>For pest-initiated analysis go to 3.38</b></p>		
<p><b>3.38. Have all major pathways been analyzed (for a pest-initiated analysis)?</b></p> <p><b>If yes, go to 3.41,</b>  <b>If no, Go to 3.1 to analyze the next major pathway</b></p>	yes	
<p><b>3.39. Have all the pests been analyzed (for a pathway-initiated analysis)?</b></p> <p><b>If yes, go to 3.40,</b>  <b>If no, go to 3.1 (to analyze next pest)</b></p>		

<p><b>3.40. For a pathway-initiated analysis, compare the measures appropriate for all the pests identified for the pathway that would qualify as quarantine pests, and select only those that provide phytosanitary security against all the pests.</b></p> <p><b>Go to 3.41</b></p>		
<p><b>3.41. Consider the relative importance of the pathways identified in the conclusion to the entry section of the pest risk assessment</b></p> <p><b>Go to 3.42</b></p>		??
<p><b>3.42. All the measures or combination of measures identified as being appropriate for each pathway or for the commodity can be considered for inclusion in phytosanitary regulations in order to offer a choice of different measures to trading partners.</b></p> <p><b>Go to 3.43</b></p>		??
<p><b>3.43. In addition to the measure(s) selected to be applied by the exporting country, a phytosanitary certificate (PC) may be required for certain commodities. The PC is an attestation by the exporting country that the requirements of the importing country have been fulfilled. In certain circumstances, an additional declaration on the PC may be needed (see EPPO Standard PM 1/1(2): Use of phytosanitary certificates)</b></p> <p><b>Go to 3.44</b></p>		??

<p><b>3.44. If there are no measures that reduce the risk for a pathway, or if the only effective measures unduly interfere with international trade (e.g. prohibition), are not cost-effective or have undesirable social or environmental consequences, the conclusion of the pest risk management stage may be that introduction cannot be prevented. In the case of pest with a high natural spread capacity, regional communication and collaboration is important.</b></p>		
<p><b>Conclusion of Pest Risk Management. Summarize the conclusions of the Pest Risk Management stage. List all potential management options and indicate their effectiveness. Uncertainties should be identified.</b></p>		<p>Prohibition of import/cultivating in-country, selling, planting and holding of the plant. Potentially very effective if strictly adhered to. Uncertainty comes from: existing plants in private ownership and in the wild.</p>

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