

Myriophyllum aquaticum (Vell.) Verdcourt

A guide to Identification, Risk Assessment and Management



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Background and Ecology

What is it?

Myriophyllum aquaticum is a bright or glaucous green perennial freshwater herb. It exhibits two different leaf forms (heterophyllous) depending on whether it is growing as a submerged plant or as an emergent. It is characterised by emergent feather-like leaves which are arranged around the stem in whorls of four to six. The submerged leaves are 1.5 to 3.5 cm long and have 20 to 30 divisions per leaf. The emergent leaves are 2 to 5 cm long and have 6 to 18 divisions per leaf. The emergent leaves are stiffer than the submerged leaves. Similar species visually are *Cabomba caroliniana* (when submerged), *Myriophyllum robustum*, *Myriophyllum heterophyllum*, *Myriophyllum verticillatum*, *Hottonia palustris* and *Hippuris vulgaris*. Rhizomes function as a support structure for adventitious roots and provide buoyancy for emergent growth during the summer.

M. aquaticum exhibits a creeping emergent life form (*sensu* Rejmánková 1992). The apical tips are the most physiologically active and productive parts of the plant, but extension of the emergent stem forces older parts underwater where emergent leaves die and adventitious roots and submerged leaves form at the submerged nodes. Dense mats up to 40 cm thick form at the surface of nutrient rich lakes, with stem densities of up to 1500 stems m⁻² (Sytsma & Anderson, 1993a)

Where does it grow?

This species grows rooted in the mud of stagnant to slow flowing water, including, lakes, ponds, canals, and ditches. The species was introduced to natural watercourses in the Netherlands and the UK via discarded or deliberately planted aquarium plants (Brunel, 2009, Van Valkenburg & Pot, 2008).

In Europe naturalised populations comprise exclusively female plants, only vegetative propagation by detached (parts of) rhizomes or stems is possible.

Identification





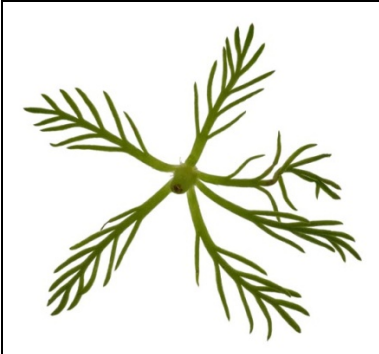


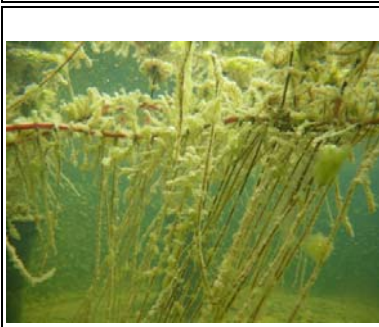

Morphological description:

Q-Bank (www.q-bank.eu) describes *M. aquaticum* as a creeping perennial with stoloniferous submerged stems with weakly trailing, glaucous emergent stems, rooting freely from lower nodes, glabrous. Submerged leaves in whorls of (4-) 5-6, without stipules, flaccid, usually much longer than internodes, oblanceolate in outline, rounded at apex, pectinate, with 25-30 linear pinnae up to 0.7 cm long, the lower leaves usually decaying rapidly. Emergent leaves glaucous and densely covered by translucent hemispherical glands, flaccid, usually much longer than internodes, in whorls of (4-) 5-6, erect near apex, spreading in lower parts,










narrowly oblanceolate in outline, rounded at apex, pectinate, with (18-) 24-36 pinnae in the upper 80% (lower 5-7 mm of rachis naked), pinnae linear to subulate, 4.0-5.5 mm long, 0.3 mm wide, tips very apiculate, slightly in curved. Numerous hydathodes at base of leaves, 0.5-1 mm long.

Plants dioecious, male much less common than female throughout introduced range. In Europe exclusively female flowers (but in Germany there are also plants with male flowers in culture). Inflorescence is an indeterminate spike with white flowers singly borne in axils of upper emergent leaves, subtended by 2 bracteoles subulate, 1.2 - 1.5 mm long with (1-) 2 short teeth in the lower-third. Male flowers tetramerous, sessile at first, with pedicels to 4 mm long usually developing at anthesis; sepals 4, ovate-deltoid, very weakly denticulate, smooth; petals weakly hooded and keeled; stamens 8; styles 0. Female flowers tetramerous, on pedicel 0.2-0.4 mm long; sepals 4, white, deltoid, denticulate with one to several small teeth on each margin, smooth (first persisting, erect, withering at maturity); stamens 0; styles clavate, very short, stigmas sessile, oblong, recurved, persistent.





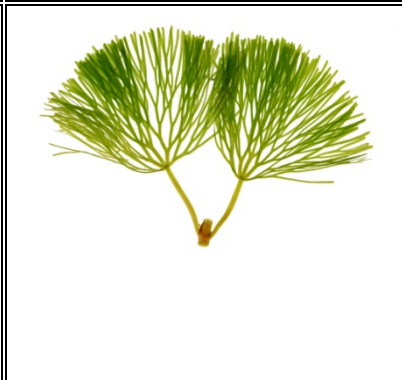





***Myriophyllum aquaticum*: Distinguishing Features**

		
General Appearance	Emergent Leaf Canopy	Flowers in leaf axils
		
Emergent Stem details	Leaflet Detail	Submerged leaf and Stem
		
Submerged red stems in spring	Submerged adventitious roots	Details of flower

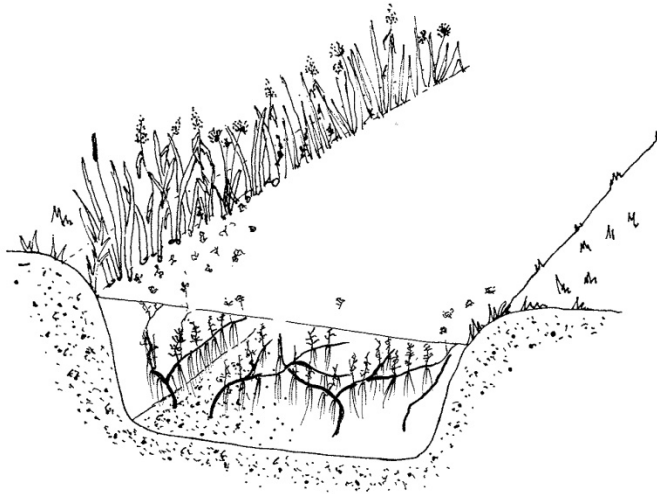
Not to be confused with: other *Myriophyllum* species

<i>Myriophyllum heterophyllum</i>	<i>Myriophyllum robustum</i>	<i>Myriophyllum verticillatum</i>
		
General Appearance	General Appearance	General Appearance
		
Heterophylly	Heterophylly	Produces turions (specialised Leaf Buds)
		
Emergent Leaf Detail	Emergent Leaf Detail	Emergent Leaf and Flower Detail

Not to be confused with: other species

<i>Hippuris vulgaris</i>	<i>Cabomba caroliniana</i>	<i>Hottonia palustris</i>
		
General Appearance	General Appearance	General Appearance
 <p data-bbox="411 678 491 701">A. Mrkvicka</p>		
Heterophylly	Submerged Leaf detail	Submerged Leaf detail
 <p data-bbox="363 1335 499 1357">© Carl Farmer, 2004</p>		
Emergent Leaf Detail	Emergent Leaf Detail and flower	Emergent Leaf Detail
		
		<p data-bbox="986 1720 1265 1742">Pictures Patrizio Ferrari and Andrea Moro</p>

Life cycle



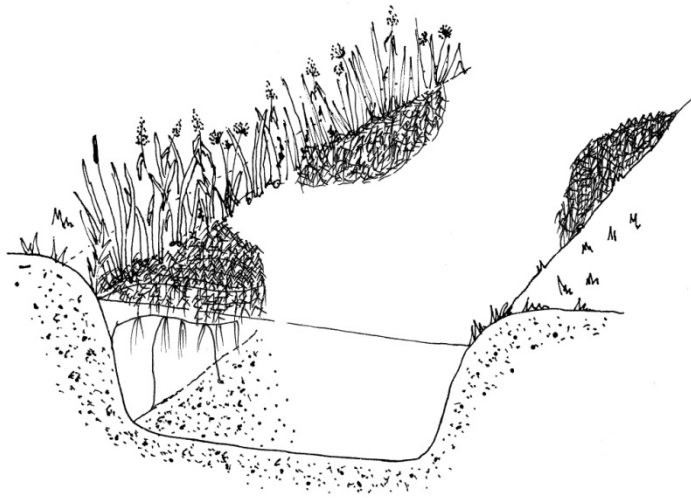
***Myriophyllum* in Spring**

In spring, when water temperatures rise above 10°C, adventitious roots develop at individual stems/stolons usually with two or three roots per node. Submerged shoots develop only after these roots have formed (see below). New submerged type shoots start to develop from nodes on overwintering stolons. The stems and leaves are red in colour due to pigmentation to absorb excessive UV light. There are no obvious signs of emergent material at this time, and emergent leaves start to appear once all signs of frost have past, usually in mid to late May.

Management Restrictions: There are restrictions on mowing, dredging re-profiling and cutting between the middle of March and the end of May, and in addition these activities are not recommended between June and the middle of July.

Action: Cover with opaque floating material, or use dyes in still water.





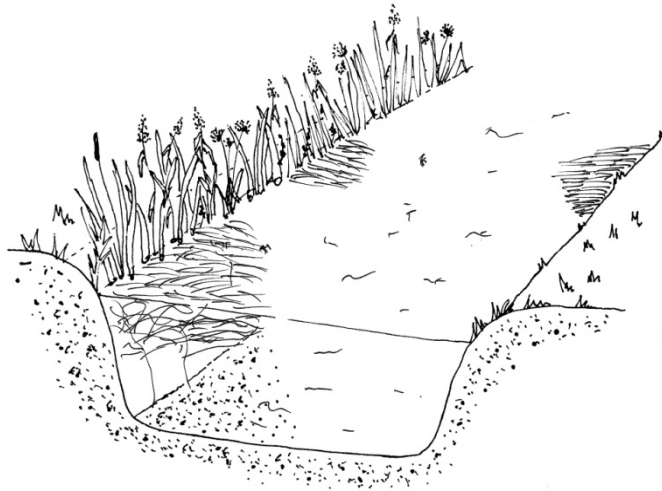
***Myriophyllum* in Summer**

By early June, the emergent leaves have formed and dense carpets of plant material grow close to the bank, with mounds appearing to spread outwards. The most active growth occurs at the apical tips of the plant, so the edges of the mat and the top surface of the mat tend to reach out into the water, followed by submersion of older stems which then grow more adventitious roots and more shoots which eventually become emergent, maintaining the apparent health of the mat.

Management restrictions: There are no restrictions on mowing, dredging re-profiling and cutting should only be undertaken after the middle of July. Please be aware that cutting has no long term effect on this species and may assist spread

Action: Spray with herbicide with the addition of an adjuvant, or remove mechanically to the bank and dispose of by burial or drying and burning.





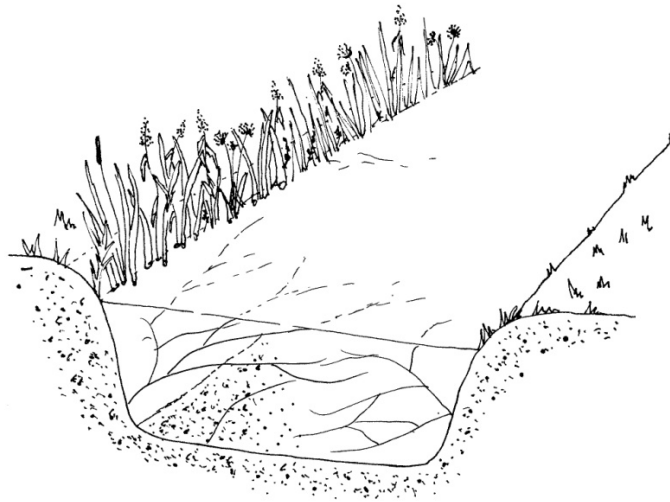
***Myriophyllum* in Autumn**

With shorter days and colder nights, the growth rate declines and mats start to fragment, causing viable propagules to be spread within and between systems. Fragmentation in autumn, when the plant still retains the capacity to regenerate rapidly, is considered to be the most important time for vegetative spread. The underside of the dense mat will become senescent and start to die back, leaving only the stolons intact under the water. These survive through autumn and over winter and form the basis for new growth in the next spring period, when the material above the inactive stolon has rotted away.



Management Restrictions: No applicable

Action: remove mechanically, being careful to restrict the release of fragments. Pull by hand in small infestations.



***Myriophyllum* in Winter**

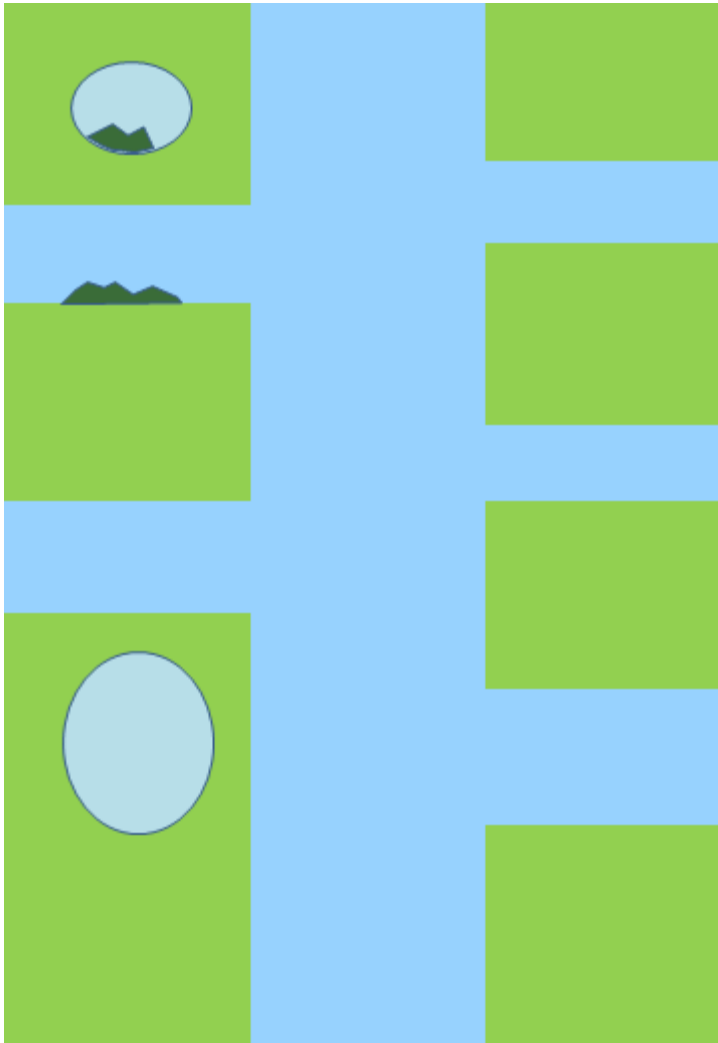
After the first frost, emergent leaves collapse because of damage to cell membranes that cause irreversible loss of turgor. The plant overwinters as submerged stems and stolons. Fragments released in autumn overwinter on the sediment surface and grow again in spring.

Management Restrictions: There are restrictions on re-profiling the wetted channel and on weed cutting.

Action: There is little that can be done to control this species during winter apart from mechanical removal or dredging of the habitat. The best option would be to prepare for spring by covering with opaque floating material, or use dyes in still water.



Risk Assessment



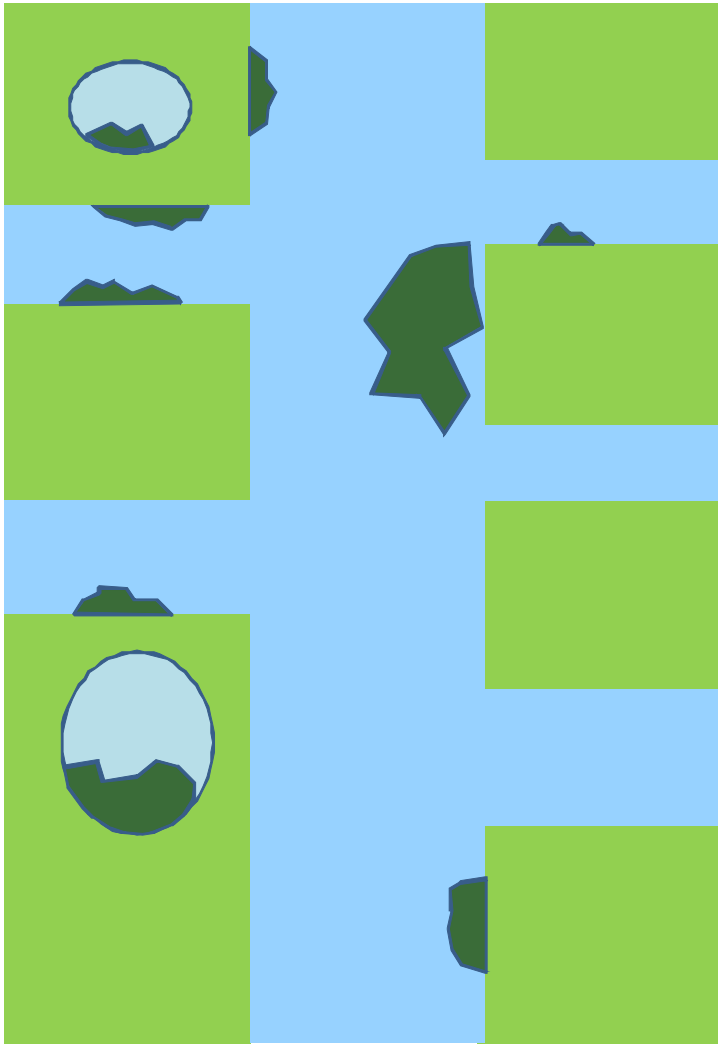
Low Risk High Priority

The occurrence of an invasive species in a new area should always be a case of low risk, because the isolated presence of a small amount of biomass does not present a risk to watercourse function or ecology. However, it should be a high priority to remove or isolate the infested area and to eradicate the species from the area as soon as possible.

In the situation described in the diagram to the left, eradication from the pond would be relatively easy. The patch in the channel should be isolated from the rest of the ditch network and removed as soon as possible. The isolation can take the form of a temporary dam, weighted net or other structure that does not represent a flood risk.

Isolation must take place as soon as possible after the species has been noted and should remain in place until after the plant has been eradicated, and probably

for at least 1 year after no more plants have been observed in the area. This is to ensure that a re-occurrence does not occur, caused either by fragmentation of upstream patches, or by deliberate planting.



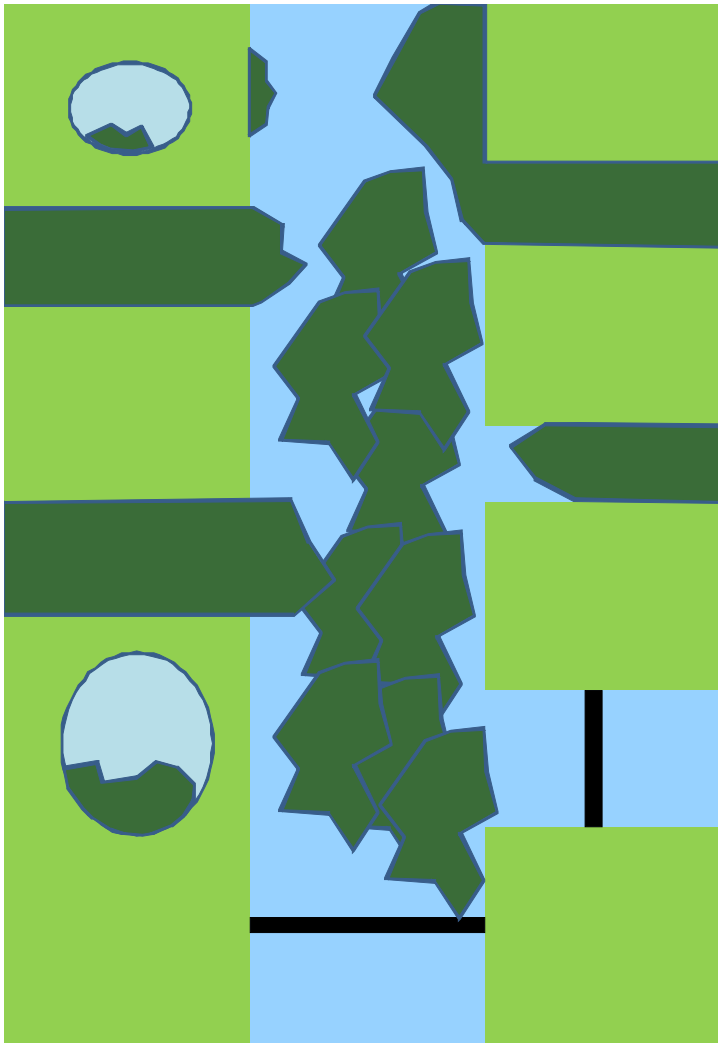
Medium Risk

There are several small patches of less than ten square meters spread within a short distance, but in different parts of the channel and in nearby ponds.

This situation represents a greater risk to watercourse function and to the ecosystem of the ponds. The infestation has probably been present for at least one year and has completed a life cycle. The ability to spread is demonstrated by the occurrence of more than one patch in different parts of the watercourse and action should be taken to remove as much as possible.

Sections of the watercourse that can be isolated must be isolated immediately. Removal of as much as possible of all the patches should be undertaken within 6 months of the first observation. A management plan for removal and eradication of the species could be used to prioritise resources for future

observation and monitoring and immediate removal.



High Risk – Low Priority

There are several large and small patches spread within a drainage system, spread over a large area, in different parts of the channel and in nearby ponds. The sections can be isolated and there are no critical watercourse functions at risk.

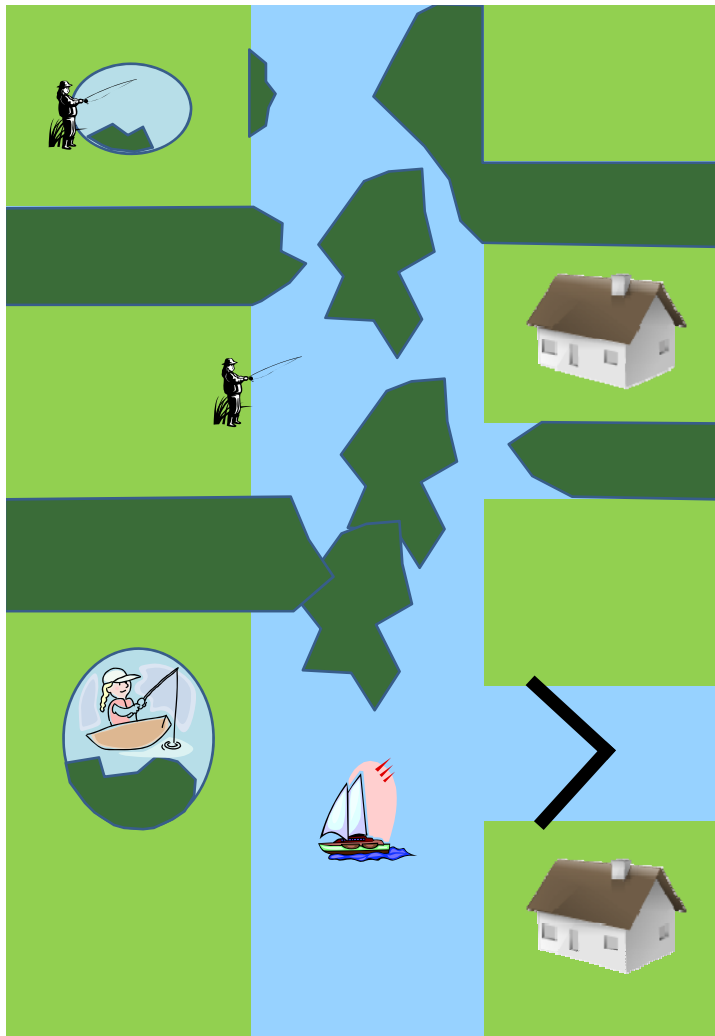
This situation represents perhaps an agricultural drainage network with no pumps, sluices, weirs or risk of flooding to populated areas. The infested section is either contained within an isolated section of watercourse, or can be easily contained.

The spread within this section can be easily monitored and a strategy for eradication or reduction can be implemented as and when resources are available.

Consideration should be given to the impact of the non-native species on the ecology of the drainage network, in terms

of angling, bird and invertebrate populations.

Careful disposal of the biomass removed from the watercourse is required to prevent reinfestation of the cleared channel, or any channels along the transport route to the disposal site.



High Risk and High Priority

There are several large and small patches spread within a drainage system, spread over a large area, in different parts of the channel and in nearby ponds. The sections cannot be isolated and there are critical watercourse functions at risk.

This is a situation that should be rare, and results often from inappropriate management of small infestations, the presence of a very aggressive species, or as a result of favourable environmental conditions resulting in rapid spread within a system in less than one year.

Navigation functions are at risk, both from an inability to navigate and because movement of boats and ships will transport fragments of the species elsewhere in the network.

Fishing may be prevented by excessive growth of the target species.

Sluices, locks, weirs, pumps and other critical watercourse management structures may be at risk.

There is a serious risk of flooding of houses and commercial property as a result of the presence of this species.

Rapid and immediate management should take place to reduce the biomass of the target species. Sections, once cleared should be isolated to prevent further spread, and in the main channel a follow up maintenance operation should be undertaken, usually involving manual removal of fragments. Consideration should be given to educational notices and public awareness campaigns in the local area to encourage reporting of additional sites not normally monitored by the responsible authorities.