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GEHO0307BLZO-E-P

protecting our native wildlife

Guidance for the control of non-native invasive weeds in or near fresh water

We are the Environment Agency. It's our job to look after your environment and make it a better place – for you, and for future generations.

Your environment is the air you breathe, the water you drink and the ground you walk on. Working with business, Government and society as a whole, we are making your environment cleaner and healthier.

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March 2007

Foreword

Our native flora and fauna represent a wealth of diversity within the distinctive character of the wildlife habitats that we all appreciate. Many species have been introduced either deliberately or accidentally since Roman times and some of these have added to the character of the countryside and, more often, our towns and gardens. Victorians were obsessed by the beauty and structure of wild plants and introduced many species from the furthest corners of the British Empire. We live today with the consequences of some of these introductions, which have thrived in our climate and environment.

In more recent times, there has been an unprecedented increase in the rate of new species being brought into the country, many associated with water. Some introductions give considerable cause for concern and action needs to be taken. Environment Agency staff are dealing with more and more requests for advice from members of the public and organisations about how they should deal with such species.

Problems caused by introduced water and waterside plants include blockage of drainage channels, ousting native vegetation, deoxygenation causing fish mortalities, limiting safe access to water and, in some cases, posing significant health risks to the public and livestock.

Important research on how to minimise the impacts of invasive plants is being carried out by the Centre for Aquatic Plant Management. Their experience and technical expertise has been instrumental in compiling this booklet which focuses on those bankside and aquatic species that are causing most concern and generate the most enquiries.

I hope that you will find the information in this booklet useful.

Barbara Young

Barbara Young
Chief Executive, Environment Agency

Contents

What are invasive weeds?

Several types of plant can become invasive weeds. They are either native species that grow well in disturbed or nutrient-enriched conditions, to the detriment of other plant and animal species, or non-native plants that have been introduced to this country by accident or as a consequence of trade or deliberate collection. The latter tend to grow in situations where native plants of similar form do not. Not all non-native species become weeds, but if they do, they become very difficult to control. Native weed species, although troublesome, do not cause as much ecological or physical damage as the non-native variety. This booklet deals with those non-native invasive species that have caused serious problems in the aquatic and riparian environments of Britain.

Invasive non-native species tend to share characteristics that make them successful. These are related to the method of reproduction, growth rate, growth form and persistence, but in particular the absence of pests and diseases and their consequent resistance to control. Species in aquatic plant families are more likely to be both weedy and invaders of natural environments than those of any other plant families. In addition, the frequently disturbed nature of man-made aquatic habitats and artificial nutrient enrichment of aquatic systems makes them more prone to invasion. Successful management of alien invasive species requires an understanding of how they grow and also the ecology of the aquatic systems in which they occur.

The introduction of plant species into new environments carries risks. The danger of species becoming serious weeds in agricultural areas is well controlled, but other potential weeds are not currently recognised and subject to risk assessment and management. The effects of climate change will alter the distribution of weed species in future; already, several aquatic weeds found in Europe originated in sub-tropical areas of the world. The predicted consequences of global warming, including increased temperatures, increased carbon dioxide and stormier weather, make it more likely that additional invasive species will cause problems in future. The huge increase in the distribution of Himalayan balsam since 1962 indicates that conditions are ideally suited for this species. Other species may respond similarly in future if climate change favours their colonisation and rapid growth. Plants that grow in water and on riverbanks

can cause flooding if not managed correctly. All the species described in this booklet create serious flood risks.

The consequences and costs of invasive non-native species are huge. The cost for eradicating Japanese knotweed has been estimated at between £1.5 and 2.6 billion, and that for Himalayan balsam as between £150 and 300 million. This booklet tells you how to identify six problem species and how to reduce their threat to aquatic ecosystems.

Existing legislation

When non-native species become invasive they can transform ecosystems, causing a variety of problems including seriously threatening native and endangered species. These problems are acknowledged in several international treaties, European Union Directives and also in domestic legislation. The problems caused by some invasive non-native species occur worldwide, and international obligations to address them are placed on the United Kingdom through regional and global agreements. These include the Convention on Biological Diversity (CBD), International Plant Protection Convention (IPPC), the Bern Convention on the Conservation of European Wildlife and Natural Habitats, and the EC Habitats and Species Directive. The sixth CBD conference adopted a series of Guiding Principles for States to follow as part of their invasive non-native species policies.

The Wildlife and Countryside Act 1981 provides the primary controls on the release of non-native species into the wild in Great Britain. It is an offence under section 14(2) of the Act to 'plant or otherwise cause to grow in the wild' any plant listed in Schedule 9, Part II. The only flowering plants currently listed in Schedule 9 are Japanese knotweed and giant hogweed. However, Japanese knotweed in particular has continued to spread and has nearly doubled its distribution in the past 20 years.

Stricter enforcement provisions for wildlife offences were introduced under the Countryside and Rights of Way Act 2000. These include increased penalties available to the courts for offences committed under the Wildlife and Countryside Act 1981.

The Weeds Act 1959 provides for the control of five specified weeds. These are non aquatic species, though ragwort, *(Senecio jacobaea)*, can grow in riparian areas. This legislation is directed at clearing weeds that threaten agricultural production.

Other legislation relevant to non-native species control includes:

- Environmental Protection Act 1990
- Environmental Protection (Duty of Care) Regulations 1991
- Town and Country Planning Act 1990
- Highways Act 1980
- Water Resources Act 1991
- The Waste Management Licensing Regulations 1994
- The Landfill (England and Wales) Regulations 2002

The Government has acknowledged the problems that can be caused by non-native invasive species. It has established a programme board to oversee a GB-wide framework strategy which will be implemented later in 2007. This strategy was a key recommendation from the Non-native Species Review Group Report that was published in 2003 and is in line with the guiding principles established by the Convention on Biological Diversity.

Responsibility for invasive weed control

Responsibility for dealing with invasive weeds rests with individual landowners. Strategic, widespread control is currently not the sole responsibility of any statutory organisation. The Environment Agency may seek to control specific invasive weeds on land that it owns or flood defence structures that it maintains.

Control efforts by individuals can help reduce the spread of invasive non-native species and are most successful if carried out as a catchment wide co-ordinated strategy with collaboration of all relevant parties. Control often needs to be repeated year after year.

General methods of control

There are four basic methods of controlling weeds: mechanical, chemical, natural and environmental. Mechanical control includes cultivation, hoeing, pulling, cutting, raking, dredging or other methods to uproot or cut weeds. Chemical control uses specific herbicides. Natural control uses pests and diseases of the target weed to weaken it and prevent it from becoming a nuisance. Environmental control works by

altering the environment to make it less suitable for weed growth, for example by increasing or decreasing water velocity.

Users should follow the instructions on the label. In England and Wales the use of herbicides in or near rivers, canals, lakes and drainage channels requires prior agreement from the Environment Agency.

What to do and what not to do

Do:

- **take immediate action;**
- contact the Centre for Aquatic Plant Management to confirm identification and the location of the plant;
- seek advice on correct management for your specific location;
- obtain approval from the Environment Agency if planning to use herbicides;
- remove all plant debris from the water after cutting operations;
- seek advice from the Environment Agency on the disposal of plant material;
- alert your neighbours to the problem.

Don't:

- **delay in doing something;**
- allow the plant to spread to nearby water bodies;
- dispose of cut material in the nearest water body;
- use invasive non-native species in habitat restoration projects.

Health and safety

Take care when using machinery or herbicides. Environment Agency staff, contractors and others should undertake Control of Substances Hazardous to Health (COSHH) assessments for the activity, and others should be aware of the risks of working near water. There is often a high risk of slipping on banks and other muddy surfaces when carrying equipment or chemicals.

All mixing and application of herbicides must be carried out in accordance with the manufacturer's instructions, which will be found on the product label. All precautions recommended by the manufacturer must be followed.

Although most species in this booklet are not toxic to humans, great care should be taken to avoid contact with the sap of giant hogweed, as this can cause serious skin blistering.

Disposal of non-native weeds

The correct disposal of plant material is vital because there is a high risk of spreading the problem further. Contact the Environment Agency for advice on disposal because there are regulations which cover the composting, burning and burial of plant materials on-site and the transfer and disposal of material, including ash, to licensed or permitted landfill sites.

Householders wishing to dispose of waste from their gardens should either compost or burn it within their gardens, or dispose of the material via their local council. It is important that the waste disposal authority is made aware of the nature of the waste, particularly if the material contains knotweed. Under no circumstances should waste be disposed of by fly-tipping within the countryside. This is a breach of Section 33(1) of the Environmental Protection Act 1990 and an offender may be liable to imprisonment, a large fine, or both.

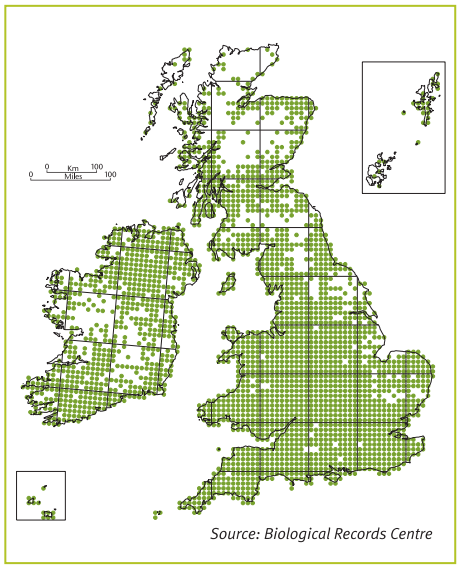
Japanese knotweed is hard to eradicate and will survive composting, so this method of disposal is NOT advisable. For small amounts of material in individual gardens, burning is recommended. It must only be buried or burnt in accordance with Environment Agency advice. You can find 'the knotweed code of practice – Managing Japanese knotweed on development sites' on our website **www.environment-agency.gov.uk**. Failure to ensure safe, legal disposal or obtain an appropriate permit, licence or exemption could result in prosecution. Large volumes, requiring burial on-site may require a licence under the Pollution Prevention and Control Regulations and Landfill Regulations 2002, whilst removal of plant material will need to be carried out by a licensed waste carrier and buried at a licensed or permitted landfill site.

Monitoring

New records of the plants described in this booklet will be helpful in assessing how fast they are spreading and determining local control options. If you see any of these species, please tell the Centre for Aquatic Plant Management, CEH Wallingford, Maclean Building, Crowmarsh Gifford, Wallingford, Oxon, OX10 8BB. Also tell your Local Biological Records Centre; details are available at **www.nbn-nfbr.org.uk/nfbr.php**. Information required is the exact location, with a map grid reference if possible, the extent of the infestation and the kind of water body it is affecting.

Fact file

Japanese knotweed



Distribution map of Japanese knotweed (2003)

Japanese knotweed was first brought to Britain in the mid-nineteenth century as an ornamental garden plant. Since then it has caused serious problems in a range of habitats – particularly roadsides, riverbanks and derelict land – by displacing native flora and even causing structural damage. There are three species of invasive knotweed in the UK: Japanese knotweed (*Fallopia japonica*); giant knotweed (*Fallopia sachalinensis*); and hybrid knotweed (*Fallopia x bohemica*), which is a cross between Japanese and giant knotweed. Japanese knotweed is the most widespread and troublesome bankside species, followed closely by hybrid knotweed, which has a similarly high regeneration capacity.

Only female plants are present in the UK. Japanese knotweed forms dense clumps with fleshy, red/green shoots, 2-3m tall, which have hollow green stems with red/purple flecks. Leaves are green, heart or shield-shaped with a flat base, up to 120mm long. Creamy clusters of flowers are borne on the tips of most stems in late summer. The root system consists of rhizomes which are yellow when cut.

The underground rhizome system can extend at least 7m from the parent plant, and reach a depth of 3m or more. A piece of rhizome the size of a little finger nail can grow into a new plant. The crown, located at the base of the stem, will produce new plants. The stems die back in winter and take up to three years to decompose. Japanese knotweed crowns should neither be composted, nor removed from a site without a waste licence.

Control

Near water **chemical** control can be achieved with herbicides containing glyphosate. Spraying both the top and underside of leaves improves control.

Cutting should be done extremely carefully using a hand scythe to avoid spreading stem fragments. Flail mowing must not be carried out.

Digging out rhizomes and disposing of the spoil is an expensive option and often impracticable. The spoil can be removed from site as special waste, disposed of on-site at least 5m deep, or the material can be sieved through a 20mm mesh and the spoil re-used on site.

A range of herbicides is effective against knotweed, however, only certain formulations of glyphosate and 2,4-D amine are approved for use in or near water (please read the label). Herbicide is most effective when applied to mature canes in early autumn. If it is impractical to treat mature growth, a spring application of herbicide or a spring cut will reduce the subsequent growth to a more manageable size for treatment. A combination of herbicide and mechanical treatment is needed to eradicate knotweed.

Non-chemical control

Cutting
Use a simple scythe method of cutting to prevent stem fragmentation. A brush-cutter may be used carefully, again avoiding the production of fragments.

Continue cutting every 2-4 weeks to reduce both above and below-ground biomass.

Burn cut stems on site or remove to landfill (licence required).

Digging
Great care is needed. Dig out soil around clump for up to 7m. Either sieve soil on site using a 20mm mesh or remove soil to landfill (licence required). Burn rhizome and stem fragments on site, or bury 5m deep, or dispose in landfill (licence required).

Pulling
Uproot stems by pulling from the base – best done from June onwards. Burn rhizome and stem fragments on site, or bury 5m deep, or dispose in landfill (licence required).

Grazing
Grazing of shoots by horses, sheep and goats keeps the plant in check, provided previous dead growth is removed.

Contact the Environment Agency for disposal advice on 08708 506 506, or refer to 'the knotweed code of practice – Managing Japanese knotweed on development sites', which is available from our website.

Chemical control

Near water

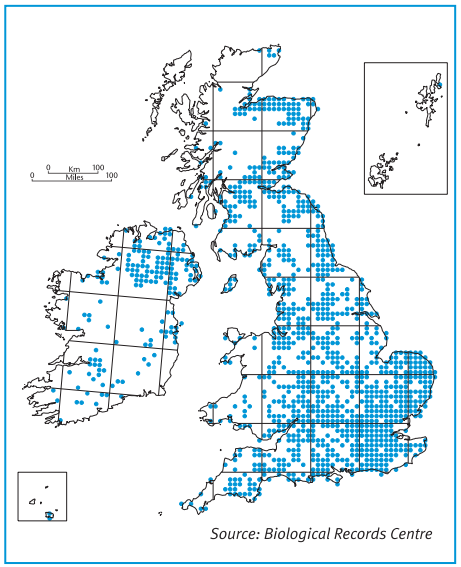
Glyphosate
Apply as soon as shoots appear, but best effects are when shoots are more than 1.5m tall, in August or September. Can be applied by stem injection using a 1 in 10 dilution.

2,4-D amine
Apply in May and then again in August/September for best results.

In general
Treatment is easier if the dead canes from previous years have been removed during the winter. Improved uptake of herbicide is achieved by treating in early autumn, prior to leaf fall. Herbicides can be applied using tractor-mounted, knapsack long-lance, or CDA applicators. Application in sensitive areas is best achieved by stem injection or weed wiper.

Fact file

Giant hogweed



Distribution map of Giant hogweed (2003)

Giant hogweed (*Heracleum mantegazzianum*), is a native of the Caucasus mountains and was introduced to Britain in 1893 as an ornamental plant. It escaped from gardens and now colonises many areas of wasteland and riverbanks. Each flowerhead produces several thousand seeds that are easily dispersed by water, so the plant spreads rapidly along watercourses. It is a perennial plant, taking up to four years to mature and flower, after which it dies. It forms dense colonies that suppress the growth of native plants and grasses, leaving the banks bare of vegetation in winter and increasing the risk of erosion and recolonisation from seeds washed downstream.

Health hazard

Children have been known to use the hollow stems as ‘pea shooters’ and ‘telescopes’. However, the stems, edges and undersides of the leaves bear small hairs containing poisonous sap, and the slightest touch causes painful blistering and severe skin irritation. Unshaded habitats with high soil nitrate levels (for example, riverbanks, roadsides and waste ground) tend to produce greater quantities of toxins in the plant. Contact with the cut material in sunlight produces a skin reaction in almost all cases. Blistering symptoms occur 24-48 hours after exposure, and dense pigmentation is visible after three to five days. This may persist for six years or more. Cut material remains active for several hours after cutting. Protective clothing must be worn when treating this plant because the hairs can penetrate light fabrics.

Growth starts in March and the plants reach 5m in height. The leaves are dark green, and form a rosette. The lobes are deeply cut and spiked at the ends. The stems are green with dark red or purple spots or blotches. Stems are ribbed, with sparse spiky hairs on the ridges. The stems are hollow and up to 100mm across. The flowers are white, forming a large umbel. Each plant produces up to 50,000 seeds, approximately 10mm long by 7mm wide. Seeds may remain viable for up to 15 years.

Control

The aim should be to kill the plant or prevent flowering. Repeated treatment may be necessary during the growing season to prevent flowering.

Chemical control using glyphosate at 6 litres/ha is the most effective method. Spraying can start as soon as the plant is about 1m high, usually in March and continue throughout the summer. More than one application is often necessary and follow-up spraying will be required to kill seedlings in subsequent years.

Cutting down the stems with a sharp scythe or sickle before flowering will help to control this plant. Flail mowing may be carried out, but extreme caution is required to avoid the risk of being sprayed with sap. Strimming is not recommended, unless full protective clothing is worn.

Digging out the crown just below ground prevents regrowth and will provide good control. This can be done with an axe or sharp spade.

Non-chemical control

Cutting

Cut stem below ground using an axe or spade. Wear full protective clothing, especially if strimming. Cut regularly early in the season to prevent flowering. Cutting should be repeated regularly for between 5 and 10 years to eradicate the plant.

Digging

Shallow excavation to about 20cm will remove the growing crown. Spoil should be disposed of at landfill or by piling on site and composting. Any regrowth should be treated chemically.

Grazing

Grazing by cattle, sheep, pigs or goats throughout the growing season will suppress growth, but does not eradicate it.

Contact the Environment Agency for disposal advice on 08708 506 506

Chemical control

Glyphosate

In mixed stands, use a weed wipe when plants are about 1m tall between March and May. When plants are more than 1.5m tall, proceed with extreme caution. Repeat chemical treatment may be required for up to 10 years.

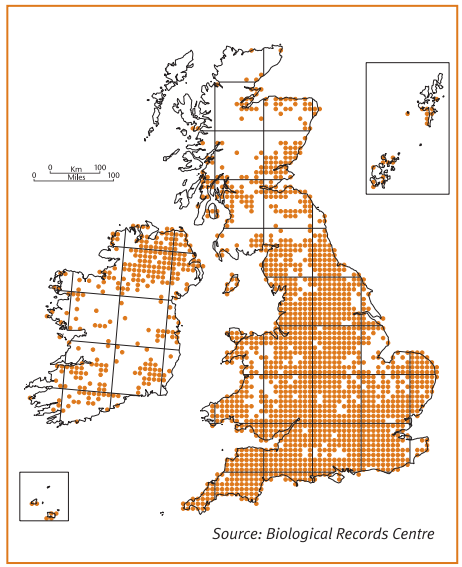
Cutting the stem above ground, followed by injection of 1 in 10 dilution of glyphosate in water below the first node, will give good control. This technique can be used for established plants later in the season.

In general

It is essential to establish vegetation quickly after control measures have been applied. Dense grass sward tends to discourage seed germination. Control should be undertaken on a catchment basis, working from the upstream end to prevent seed recolonisation.

Fact file

Himalayan balsam



Distribution map of Himalayan balsam (2003)

Himalayan or Indian balsam (*Impatiens glandulifera*) is a native of the western Himalayas. Introduced to Britain in 1839, it escaped from gardens and rapidly colonised river banks and areas of damp ground. It is the tallest annual plant in Britain, growing up to 3m high. The characteristic purplish-pink slipper-shaped flowers appear in June. When the seed pods mature, they explode when touched, scattering the seed up to 7m away. Seeds are also spread by water and they may remain viable for up to two years.

Himalayan balsam plants grow in dense stands that suppress the growth of native grasses and other flora. In autumn the plants die back, leaving the banks bare of vegetation, and therefore liable to erosion.

The stems are pinkish-red, hollow and jointed, often with some branching. Leaves and side branches originate from stem joints. The stem is sappy and brittle. The shiny dark green leaves are lance-shaped, have serrated edges, a dark red midrib and can be up to 150mm long. They grow on the stem in whorls of three. Purplish-pink flowers, held on long stalks, appear from June to October.

The white, brown or black seeds are produced from July to October and are 4-7mm in diameter. There are between 4 and 16 seeds per pod.

Control

Control measures should aim to prevent flowering, and are best carried out before June for maximum effectiveness.

Chemical control near water can be carried out with herbicides containing glyphosate or 2,4-D amine. Glyphosate will kill all plants, but 2,4-D amine will kill only broad-leaved weeds; for best effect, use when the plant is small and actively growing, particularly in springtime.

Cutting, mowing or strimming on a regular basis for about three years will be effective and may even eradicate the plant from isolated sites.

Non-chemical control

Cutting

Cut at ground level using a scythe, machete, flail or strimmer before the flowering stage in June. Cutting earlier than this will promote greater seed production from plants that regrow. Cutting should be repeated annually until no more growth occurs.

Pulling

Shallow-rooted plants can be pulled up very easily and disposed of by burning, or composting unless seeds are present.

Grazing

Grazing by cattle and sheep is effective from April throughout the growing season. It should be continued until no new growth occurs.

Contact the Environment Agency for disposal advice on 08708 506 506

Chemical control

Glyphosate

Treatment with a weed wipe in mixed stands, or by foliar spray in dense stands, before flowering. If all plants are controlled, then spraying programmes should only be required for two to three years.

2,4-D amine

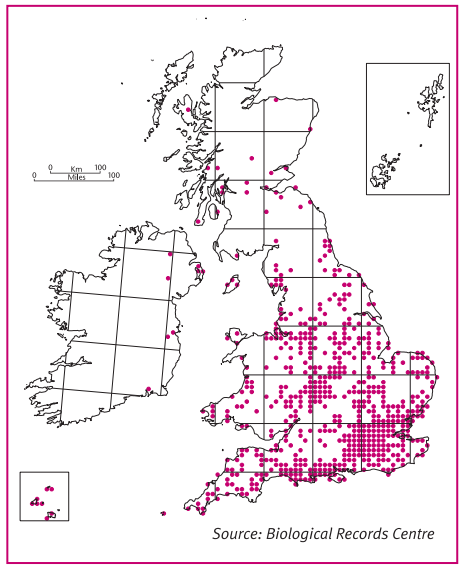
Treat during early spring at the rosette stage for effective control.

In general

It is essential to establish vegetation quickly after control measures have been applied. Dense grass sward tends to discourage seed germination. Control should be undertaken on a catchment basis, working from the upstream end to prevent seed recolonisation.

Fact file

Australian swamp stonecrop



Distribution map of Australian swamp stonecrop (2003)

Australian swamp stonecrop (*Crassula helmsii*) was introduced from Tasmania to Britain in 1911. It was first sold as an 'oxygenating plant' in 1927.

The first occurrence in the wild was reported in Essex in 1956. In recent years, it has spread much more rapidly due to the increased availability of the plant at garden centres and aquatic nurseries. It has been recorded at about 1,500 sites although this is probably an underestimate of the true distribution. It is sometimes referred to as *Tillaea recurva*, *Tillaea helmsii*, or New Zealand pigmy weed.

The plant is easily dispersed and, although not always sold by suppliers, it is often found as a 'contaminant' with other water plants. Introductions to new sites are associated with a wide range of human, water-based activities, and awareness and education programmes can dramatically reduce transport of the plant between sites. Local dispersal is aided by the high viability of small fragments, which can be carried on mud to new sites.

The success of *Crassula* lies mainly in its ability to colonise virtually any suitable static to very-slow-flowing freshwater habitat across a wide range of water chemistry. It has vigorous, year-round growth, and can grow equally well either on damp ground or in water up to 3m deep.

Where *Crassula* invades, it quickly out-competes native vegetation, and maintains its dominance by very rapid growth and uptake of almost all the available nutrients.

There are three typical growth forms: (i) a terrestrial form with creeping stems and aerial, succulent leaves; (ii) an emergent form with densely packed stems, found in water less than 0.6m deep; (iii) and a submerged form that grows from a basal rosette with long, sparsely-leaved stems reaching the surface. The three forms change according to prevailing conditions. The rigid stems have pairs of fleshy leaves that vary in shape from long and narrow in deeper water to slightly elliptical, with sharp or bluntish tips in air. The leaf tip is never notched, which distinguishes it from the native water starwort (*Callitriche* spp.). The leaf bases are joined, forming a distinctive 1mm collar around the stem. In summer, white flowers grow in the axils of the leaves on emergent and terrestrial forms.

Control

This plant is best treated at the early stages of infestation. Delay will make the problem several orders of magnitude worse in each successive year.

Chemical control of emergent material with glyphosate is the best option.

Cutting is not recommended, but dredging out marginal and emergent material can be effective, as the plant is shallow-rooted. The area around any infestation should be fenced to prevent movement of fragments by livestock. Dredged material should be piled in heaps and covered with thick black polythene sheeting or at least 20cm of soil.

Shading of terrestrial or emergent forms with opaque material such as black polythene for about three months may be effective, but is difficult to install and manage, and vandalism can be a problem.

Non-chemical control

Cutting
Not recommended.

Dredging
Dredging of marginal and emergent material throughout the year can be effective, although it is necessary to ensure that plant fragments cannot be transported elsewhere.

Shading
Covering with black polythene or similar for up to 10 weeks during the growing season.

Contact the Environment Agency for disposal advice on 08708 506 506

Chemical control

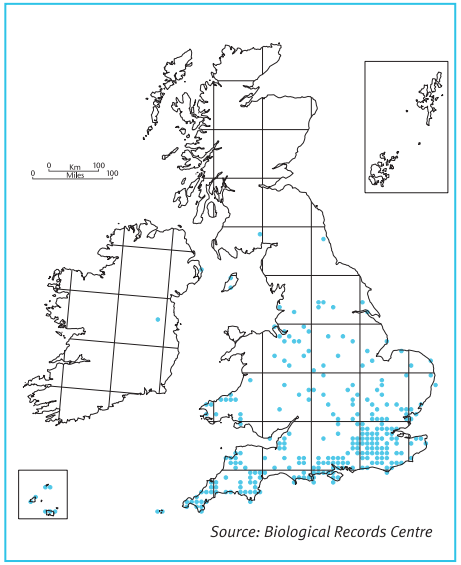
Glyphosate
Application of glyphosate at 6 litres/ha to emergent stands from March to October. Regular treatment is required, and at least two applications may be necessary each year.

Submerged
Submerged material can be treated with dichlobenil in March. Submerged material will also die if connected emergent vegetation has been sprayed with glyphosate.

In general
Regular treatment is necessary. Weed wiping may be appropriate in mixed marginal vegetation. Spot treatment of small patches will prevent complete dominance. Treat early and regularly.

Fact file

Parrot's feather



Distribution map of Parrot's feather (2003)

Parrot's feather (*Myriophyllum aquaticum*) is a native of lowland central South America. It was first found in Britain in 1960 and has now spread extensively, particularly in southern England. It grows in ponds, reservoirs, gravel pits, streams, canals and ditches, particularly where eutrophic water occurs. It can grow as a terrestrial plant when a pond dries out, and has even been found growing on the dry bank of a rubbish tip in Cornwall. It produces emergent shoots in addition to submerged ones, which give it the characteristic feathery appearance, hence its name.

Only female plants are established in the UK and it therefore spreads by vegetative means only. The stems are brittle and the plant propagates by growth from small stem fragments. The species is attractive to look at and is widely grown in garden ponds. Introductions to the wild are usually not deliberate, but fragments can be concealed in the soil of other pot plants sold at aquatic garden centres and nurseries.

Control

Glyphosate is less effective on this species, unless used with an approved wetting agent.

Cutting and dredging can be used very effectively in small areas and gives a reasonable means of control. All fragments should be removed to prevent regrowth and downstream spread.

Non-chemical control

Cutting

Cut material must be removed from the water as soon as possible. Fragmentation must be avoided. Material should be cut as often as necessary and at least every six to nine weeks from March to October to weaken the plant.

Pulling or dredging

Dredging shallow areas will remove this plant very effectively. Carefully pulling out stems by hand after mechanical removal will help to eradicate it.

Grazing

The plant is not palatable to herbivores; cattle and horses will avoid it. There is virtually no insect damage to plants in the UK, but research into biological control agents is under way.

Contact the Environment Agency for disposal advice on 08708 506 506

Chemical control

Emergent

Apply glyphosate at 6 litres/ha to emergent stands from March to October. Regular annual treatment is required, and at least two applications will be necessary each year.

Submerged

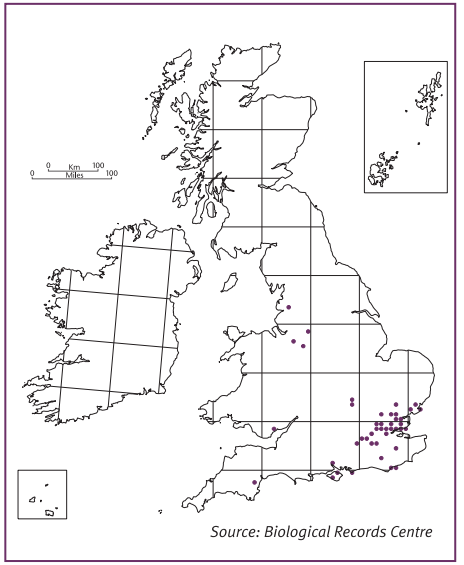
Submerged parts will die if the emergent portion has been regularly sprayed with glyphosate. Treatment usually lasts for three to five years.

In general

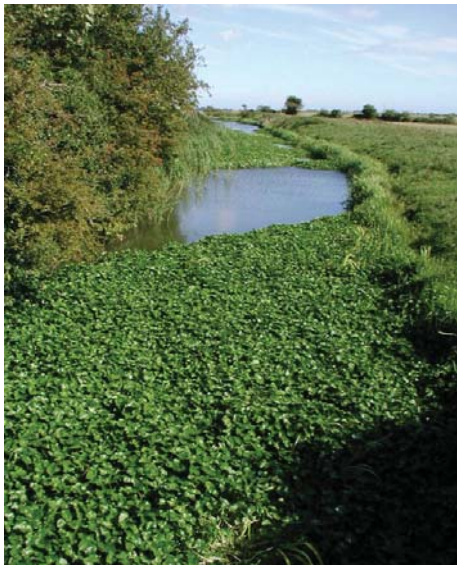
Regular treatment is necessary. Weed wiping with glyphosate may be appropriate in mixed marginal vegetation. Spot treatment of small patches will prevent complete dominance. Treat early and regularly.

Fact file

Floating pennywort



Distribution map of Floating pennywort (2003)



Floating pennywort (*Hydrocotyle ranunculoides*) is a native of North America. It was first brought to Britain in the 1980s as a plant for tropical aquaria and garden ponds, and was first noted in the wild in Essex in 1991.

Floating pennywort grows in the shallow margins of slow-flowing eutrophic water bodies (particularly ditches, slow flowing dykes and lakes), and forms dense interwoven mats of vegetation. These quickly cover the water surface interfering with both the ecology and amenity uses of the water body. These mats grow up to 15m from the bank in a single season, with stem growth rates of up to 20cm per day.

Floating pennywort roots freely from nodes at approximately 40-60mm intervals. The roots are profuse and hair-like. The leaves are emergent, rising on stalks from horizontally growing stems. Both the stem and the petioles are fleshy. The leaf form ranges from circular to kidney-shaped; they are deeply lobed, and up to 180mm across. Leaves are held

above the water surface whilst the interwoven mat of roots and stems sink up to 50cm into the water.

Reproduction in Britain is thought to be principally vegetative, and the plant is capable of forming extensive mats from the smallest shoot fragment. Introduction by seed, however, may also have occurred. Floating pennywort can double its wet weight in as little as three days. The plant exhibits seasonally variable growth in Britain. Maximum growth occurs in the late summer when it typically forms the extensive floating mats of vegetation, whilst it over-winters in the margins and on banks as a much flatter and smaller plant.

The plant is relatively restricted in its distribution, largely in southern England and south Wales. Its appearance at the 90 sites so far reported is likely to have been as a result of escapes from aquaria and garden ponds. Floating pennywort has already proved to be difficult to control because of its rapid growth rates, its ability to re-grow from a single node, and its resistance to chemical control.

Control

Glyphosate, combined with a wetting agent such as 'Topfilm', is effective.

Cutting and removal is a very good method of management, but it will not control or reduce the vigour of the plant. The cut or dredged material should be left on site at the top of the bank, well away from water. Handpulling works well. Eradication is possible using this technique, and has been achieved in Cornwall.

Non-chemical control

Cutting

Regular cutting from May to October will prevent complete dominance of this species. Cut material should be removed from the water immediately. Cutting should be followed by hand pulling or by spot treatment with chemicals to reduce the risk of regrowth.

Pulling or dredging

Hand pulling works very well in small infestations and as a follow-up after major mechanical removal. Eradication is possible using this technique.

Grazing

Cattle grazing has been seen to damage the emergent stems, but it has no long-term effect on the dominance of the plant. There are no known biological control agents in the UK, but research is underway.

Contact the Environment Agency for disposal advice on 08708 506 506

Chemical control

Glyphosate

Applying glyphosate at 6 litres product/ha in 400 litres of water is the most effective treatment with this chemical. Repeat treatments will be necessary throughout the growing season as soon as regrowth occurs. Wetting agents can significantly increase the effectiveness of glyphosate treatment.

In general

The plant does not rot down very quickly after chemical treatment, and treated vegetation in flood-risk areas should be removed after two to three weeks if possible. Follow-up spot treatment after mechanical removal is recommended. Regular treatment is necessary.

Glossary

2,4-D amine – a selective translocated herbicide.

Axil – the angle where the leaf joins the stem.

Biomass – the amount of plant material produced during growth.

Contact – a herbicide that kills the parts of plants to which it is applied, for example leaves.

COSHH – Control of Substances Hazardous to Health.

Eutrophic – water that has an excess of plant nutrients.

Glyphosate – a non-selective, translocated herbicide.

Hybrid – offspring of closely related species that are often more vigorous than either of the parents.

Node – region of attachment of leaves to the stem and of swelling on rhizomes from which roots and shoots arise.

Petiole – the stalk of a leaf.

Riparian – the area at the edge of watercourses.

Selective – term used for a herbicide that kills only one type of plant, for example only grasses or only broad-leaved weeds.

Succulent – fleshy or swollen.

Translocated – absorbed and distributed throughout the plant to the roots and shoots.

Wetting agent – a herbicide additive used to increase absorption of the herbicide through the waxy leaves of aquatic plants.

Whorl – a circular set of leaves arising at the same level on a stem.

Further information

There are many sources of information about invasive plants and methods of controlling them. The Centre for Aquatic Plant Management (CAPM) provides advice on the control of aquatic and riparian invasive species.

The following websites are useful:

GB non-native species secretariat: **www.nonnativespecies.org**

The Centre for Aquatic Plant Management: **www.capm.org.uk**

Invasive Species Project: **www.appliedvegetationdynamics.co.uk**

CABI Bioscience: **www.cabi-bioscience.org**

The Global Invasive Species Programme: **www.gisp.org**

Biological Records Centre **www.nbn-nfbr.org.uk/nfbr.php**

The World Conservation Union: **www.iucn.org**

Centre for Ecology and Hydrology: **www.ceh.ac.uk**

Cornwall Knotweed Forum: **www.cornwall.gov.uk/environment/knotweed**

Publications

CAPM information sheets

Child, L. & Wade, P.M. (2000) *The Japanese knotweed manual*. Packard Publishing, Chichester.

De Waal, L.C., Child, L.E., Wade, P.M. and Brock, J.H. (1994) *Ecology and management of invasive riverside plants*. John Wiley & Sons.

Environment Agency (1995) *The use of herbicides in or near water*.

Environment Agency (2003) *Aquatic weed control operation – Revised best practice guidelines*.

Environment Agency (2006) *The knotweed code of practice – Managing Japanese knotweed on development sites*.

Environment Agency and English Nature (2002) *Crassula helmsii: focus on control – an update*. NERC-CEH.

MAFF (1995) *Guidelines for the use of herbicides on weeds in or near water*. Defra publications.