

Water hyacinth (*Eichhornia crassipes*)



The distinct water hyacinth flower. Feeding scars from weevil activity can be seen on leaves.
Photo: T Bickel.

Key points

- Water hyacinth is a highly invasive aquatic weed that threatens waterways and wetlands around Australia.
- Infestations are widespread across tropical and subtropical regions on the east coast of Australia but it has large potential for spread within temperate regions and the Murray Darling Basin.
- It spreads mostly through its ongoing use as an ornamental plant for fishponds and water gardens. Public education is an effective tool to help prevent further spread.
- It can be a difficult and expensive plant to control. Large infestations can rarely be eradicated.
- There are a wide range of control methods available however each method must be tailored to the situation.
- Integrated approaches normally provide the most effective solutions.

The problem

Water hyacinth (*Eichhornia crassipes*) is widely regarded as the world's worst aquatic weed due to its ability to form dense and impenetrable floating mats on the waters surface. The floating mats cause considerable biodiversity impacts by displacing

native vegetation, decreasing light penetration and preventing birds and other fauna from accessing the water. Mats also increase the quantity of decaying vegetation and prevent oxygen exchange in the water, which results in unsuitable habitat for fish and other aquatic fauna.

Dense infestations in water storage facilities can cause water losses through transpiration, which can be three times higher than natural evaporation. Infestations can also clog irrigation assets and interfere with recreational activities such as swimming, fishing and boating. Severe infestations are capable of reaching up to 450 tonnes of wet weight per hectare. During flood events heavy floating mats of the weed can dislodge and cause significant damage to downstream infrastructure, such as bridges and fences, and to crops and pastures. Infestations also provide favourable breeding conditions for mosquitoes and reduce the aesthetics of waterways.

The continued spread of water hyacinth threatens aquatic biodiversity throughout its potential range throughout Australia, including the Ramsar listed Gwydir wetlands in New South Wales and other wetlands in the Murray Darling Basin.

The weed

Water hyacinth is a free-floating aquatic plant that grows in ponds or slow moving waterways. It is a perennial monocot that belongs to the Pontederiaceae family.

Native to the Amazon Basin in Brazil and other nearby South American countries, water hyacinth was introduced into Australia as an ornamental plant. It was first recorded naturalised in Australia in 1894 in areas of New South Wales and Queensland.



Water hyacinth with bulbous leaves and a daughter plant attached by the horizontally growing stolon. Photo: A Petroeschovsky.



The ongoing use of water hyacinth for ornamental purposes poses a major risk of creating new infestations. Photo: A Petroeschovsky.

How to identify water hyacinth

Key identification features of water hyacinth include:

- a free-floating plant with spongy leaf petioles
- leaves are glossy, waxy and dark green
- flowers are blue to purple on a large spike, and
- roots are fibrous and feather-like.

Water hyacinth has clusters of leaves with sometimes spongy or inflated petioles that arise from the plants base. The heart-shaped leaves are thick, glossy and dark green in colour. There are two leaf types ranging from plants with swollen and bulbous petioles up to 25 cm long, to plants having slender and non-bulbous petioles up to 60 cm long. These petioles contain variable amounts of air, which provides the plant with the buoyancy it requires to float.

The flowers are bluish purple with a yellow centre, each approximately five centimetres wide with six petals. Flowers are arranged on a single spike consisting of generally eight but ranging from three to 35, flowers. The seed capsules of water hyacinth are one to 1 to 1.5 mm long with each containing up to 300 seeds. The root systems are fibrous and feather like, which can grow to depths of up to one metre in the water column.

How it spreads

Water hyacinth reproduces by both seeds and vegetative means. New plants can flower within three to four weeks. Initial seed dormancy is up to 12 weeks and seeds can remain viable for up to 20 years, even in dry soil. Germination and growth occurs in shallow water or mud.

Vegetative reproduction occurs through the production of daughter plants from horizontally growing stolons. The plant has rapid growth rates with infestations capable of doubling in size in as little as eight to 18 days under optimal growing conditions. Vegetative reproduction is the plants most common mode for reproduction and rapid population expansion, and just one plant can start a new infestation.

Water hyacinth spreads to new catchments through human activities and its use as an ornamental plant poses the greatest risk of creating new infestations. Despite a national ban on its sale, the plant remains a popular ornamental plant for many water garden and pond plant enthusiasts. Ornamental plantings in backyard ponds and farm dams can spread water hyacinth to new waterways when plant material is washed downstream during rain events. An emerging trend is the detection of new incursions in dams on lifestyle blocks in semi-rural and peri-urban areas.

Once water hyacinth invades a catchment, it is often spread further through flood events. Other means of spread include boat trailers and fishing equipment spreading smaller plants and birds spreading seeds.

What to do about it

Prevent further spread

The best method to control water hyacinth is to prevent it from entering a water body. Education programs are the most effective tool in preventing further spread as water hyacinth is often introduced into catchments by people for ornamental purposes. Gardeners, hobby farmers, property owners and the general public are discouraged from planting water hyacinth in their ponds, farm dams or water gardens. People who have unknowingly cultivated water hyacinth should contact weed control authorities for information on how to correctly dispose of it. Burial in flood free areas is the quickest means of disposal.

Enforcing the nationwide ban on its sale is also a useful tool and nurseries or weekend markets that illegally display or sell the plant to customers should be reported to weed control authorities.

Early detection

Early detection is critical for the management of water hyacinth, as successful eradication or containment is normally only possible when infestations are small. Even in such cases, its persistent seed bank means ongoing commitment will normally be needed to ensure that previously destroyed infestations do not re-establish and spread further.

Where it grows

Water hyacinth best grows in ponds or slow moving water bodies, such as rivers, dams, lakes and wetlands, in tropical to temperate climates. It can survive frosting but requires temperatures above 10 degrees Celsius for growth, with optimal growth occurring between 28 degrees Celsius and 30 degrees Celsius, but not exceeding 35 degrees Celsius. It tolerates a pH range from 4.0 to 8.0 and can survive in water with salinities up to 15 per cent that of sea water. Although water hyacinth will grow in low-nutrient conditions, it requires abundant nitrogen, phosphorous and potassium for optimal growth. It favours water bodies with high-nutrient levels, such as those found downstream of agricultural or urban areas.

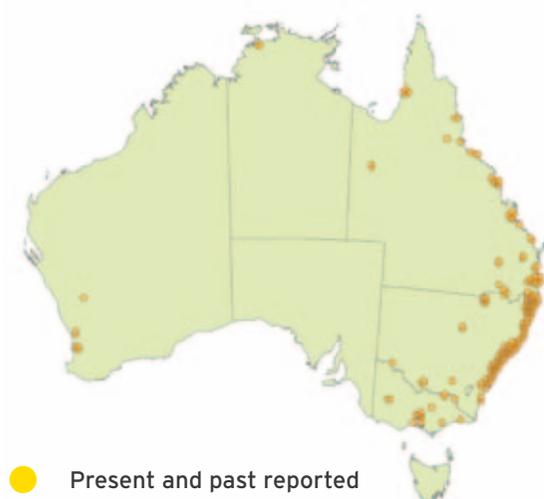
Potential distribution

The potential distribution of water hyacinth has been determined using Climex, a climate based model that assesses habitat suitability. It predicts that nearly the entire mainland Australia has favourable climatic conditions for water hyacinth, providing water is available.

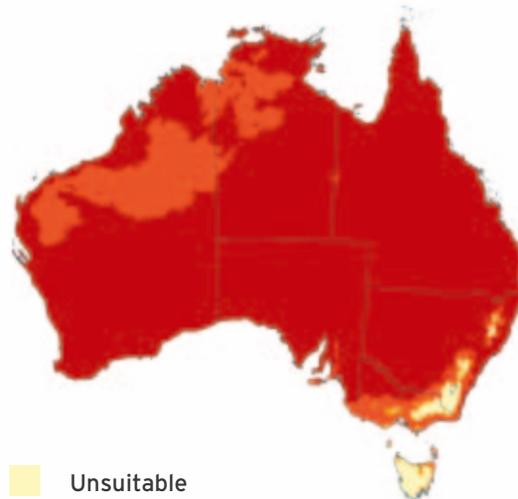
Naturalised infestations of water hyacinth are present on Australia's east coast from the Cape York Peninsula in Queensland to Kiama in New South Wales. Smaller outlier infestations are present in Victoria, Western Australia and in the Murray Darling Basin.

Map 1: Past and present reported occurrences of water hyacinth in Australia.

Map 2: Potential distribution of water hyacinth in Australia.



- Present and past reported occurrence
- No reported occurrence



- Unsuitable
- Marginally suitable
- Moderately suitable
- Highly suitable

Growth calendar



- Growth pattern in suitable conditions
- General pattern of growth



Spraying water hyacinth in northern New South Wales waterway. Photo: A Petroeshevsky.

Monitoring and early detection should be carried out in catchments at risk from water hyacinth invasion, especially after floods where there is a high risk of plants washing out of backyard ponds or dams into downstream waterways.

Control

Current control options for water hyacinth include herbicides, biological control and physical removal (mechanical and manual). Due to its large and persistent seed bank, long-term commitment is needed to control established infestations. This may involve multiple treatments over a number of years. Control of large infestations can be difficult due to the rapid regrowth of the plant.

Although initial control costs can be expensive in the short term, a long-term commitment using tools appropriate to the situation can successfully reduce infestations to a more manageable level.

Herbicides

Spraying is effective for controlling small infestations or as part of an ongoing integrated control program. Herbicides registered in Australia for water hyacinth control include glyphosate, diquat, amitrole and acid formulations of 2,4-D, which are applied as foliar sprays. Most control programs use high-volume spraying with hand

gun power sprays from either a boat or the shore. Aerial spraying has also proved successful in treating larger infestations. Herbicide treatments should commence in spring before the plant flowers and will normally require several follow up treatments over the growing season.

While herbicides will often provide the most cost effective treatment a potential drawback is the risk of the decomposing vegetation detrimentally affecting water quality, particularly dissolved oxygen. This can be avoided by spraying only one half of the infestation at one time or physically removing as much of the weed as practical before spraying. Another potential drawback is the withholding period on water bodies treated when some herbicides are used.

The use of herbicides in or near water bodies is strictly regulated. Always use herbicides strictly in accordance with the directions specified on the label.

Physical removal

Hand removal is most effective for small infestations such as small dams and drains. It is highly laborious and should only be used where the rate of removal can exceed the rate of regrowth. It should be done before flowering and seed set in spring. It is also the best method for removing infestations from ornamental fish ponds and water gardens.

Mechanical harvesting can be an effective tool for removing larger infestations, particularly where there is a need to immediately restore the functions of the water body, for example, boating. It traditionally involves a specially designed aquatic weed harvester, but small boats can also be used to push the floating mats of water hyacinth to an extraction area, where it can then be removed by an excavator or similar machinery.

Physical removal provides a number of advantages over other methods. It removes the water quality issues associated with spraying and the resulting decomposition of large quantities of plant material in the water column. In addition, there are no withholding periods associated with its use, so waterways can immediately be used for irrigation, swimming or stock watering. However, it is an expensive and time consuming process due to the sheer weight and volume of the harvested biomass. Mechanical removal is often not practical in shallow water or areas with accessibility issues.

Biological control

Biological control is most effective on larger infestations but it can take several years for it to provide successful control. Four insects from South America have been introduced into Australia for water hyacinth biological control.

These include two weevil species *Neochetina eichhorniae* and *Neochetina bruchi*, and two moth species *Niphograptus albiguttalis* and *Xubida infusellus*. Both moth species can be very damaging to young water hyacinth plants but their impact on adult plants is often temporary and patchy.

The two weevils can provide successful control. Adult weevils feed on the leaves causing them to desiccate and curl. The weevil larvae tunnel through and damage the plants tissue, which is then attacked by bacteria and fungi. The combination of adult and larval feeding causes the plant to become waterlogged and eventually sink and die.

The weevils are particularly effective in tropical northern Australia but less so in sub-tropical and temperate regions. The *N. eichhorniae* weevil is only active during warmer months whilst *N. bruchi* tends to be more active during winter.

Because both species generally complement each other, better control is often achieved when both are present. Both weevils are well established in New South Wales and Queensland and re-release strategies may only be necessary after major flood events.

Integrated control

In many cases the best control is achieved when a combination of control methods are used in an integrated way. It is essential that control methods chosen suit the specific situation hence selection of methods will need to be done on a case by case basis.

Biological control and herbicides

Research from the United States found that limited spraying of water hyacinth infestations allowed weevils to move from sprayed to unsprayed plants, which increased both the density of weevils on surviving plants and biological control damage. This integrated approach has not been researched in Australia, however anecdotal evidence suggests that careful use of herbicides may enhance biological control performance.

Herbicides and mechanical removal

Mechanical removal of the bulk of material followed by a multiple herbicide treatments of remaining plants can be used to control severe water hyacinth infestations, while minimising water quality impacts. This approach has been successfully used to restore a number of floodplain wetlands and creek systems in northern Queensland.

Floating booms

The deployment of floating booms can also help improve the effective use of other control methods. Booms can help contain infestations to one area, which helps reduce both herbicide and mechanical treatment costs. Booms also have the added benefit in that they can help prevent further downstream spread.

Other management strategies

The growth of water hyacinth responds well to nutrients. Discharge from sewage treatment plants, storm water and agricultural run-off are the main preventable forms of nutrient input so strategies that target these can aid in water hyacinth control.

Lowering the level of water is not a reliable method in most situations. Plants can survive in the mud and the low water level can provide favourable conditions for seed germination.

Weed control contacts

Contact the weed control authority in your state for up to date information on pesticides and legislation.

	Department	Phone	Website
National	Australian Pesticides and Veterinary Medicines Authority	02 6210 4701	www.apvma.gov.au
ACT	Department of the Environment and Sustainable Development	13 22 81	www.environment.act.gov.au
NSW	Department of Primary Industries	1800 680 244	www.dpi.nsw.gov.au
NT	Department of Natural Resources, Environment, the Arts and Sport	08 8999 4567	www.nt.gov.au
Qld	Department of Agriculture, Fisheries and Forestry	13 25 23	www.dpi.qld.gov.au
SA	Department of Primary Industries and Regions SA	08 8303 9620	www.pir.sa.gov.au
Tas	Dept of Primary Industries, Parks, Water and Environment	1300 368 550	www.dpipwe.tas.gov.au
Vic	Department of Primary Industries	13 61 86	www.dpi.vic.gov.au
WA	Department of Agriculture and Food	08 9368 3333	www.agric.wa.gov.au

Legislation

Water hyacinth is a declared noxious weed in all Australian states and territories. It is illegal to sell, distribute and possess water hyacinth. In most cases landholders are required by law to control water hyacinth when it occurs on their property. Check with your local council and state or territory government about requirements for water hyacinth control.

Acknowledgements

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Potential distribution Climex modelling by CSIRO.

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A mechanical harvester removes water hyacinth from the lagoon. Photo: Fisheries Queensland.

Case study: Restoring aquatic life to Sandringham Lagoon, Queensland

Sandringham Lagoon is a 2.2 kilometre long freshwater lagoon located approximately 20 kilometres south of Mackay in central Queensland. Until recently, the lagoon was heavily infested with water hyacinth and other aquatic weeds, which formed dense floating mats of vegetation. These mats completely smothered the lagoon and significantly reduced its habitat values.

In 2006, key stakeholders initiated a project to remove the weed mats and restore Sandringham Lagoon's natural values. Both mechanical removal and herbicides were used to remove the weed mat. Due to the thickness and extent of the mat, mechanical removal was selected as the primary control tool. An excavator equipped with an extension arm and weed rake was used to remove the bulk weed mat. For sections of the lagoon beyond reach of the excavator, an aquatic weed harvester was used to break up the weed mats and push them to the banks where the excavator removed them. Once harvested, the weed mats were left on the banks to dry and later transported to dump sites.

Herbicides were used to destroy the weed infestations in sections of the lagoon which were inaccessible to the excavator or harvester, and to treat re-emerging infestations of water hyacinth and other aquatic weeds after the mats were removed. Roundup bioactive[®] was used with operators using both 200 litre vehicle mounted tanks and 15 litre knapsacks.

The benefits of the weed removal to Sandringham Lagoon were demonstrated by a water quality and fish monitoring program. Results show the dissolved oxygen levels in the water improved from 1.04 mg/L prior to weed removal to up to 5.77mg/L after treatment. Monitoring of fish populations demonstrated an increase with only 23 fish recorded prior to the weed mats removal to 3992 fish (over 13 species) recorded after treatment.

To help maintain habitat quality and minimise future weed growth a range of restoration works were implemented, including revegetation of banks and installation of sediment traps. In addition, landholders were supplied with Roundup bioactive[®], which enabled them to undertake ongoing treatment of re-emerging aquatic weeds.