

SAPIA NEWS

SOUTHERN AFRICAN PLANT INVADERS ATLAS

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Inside this issue:

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Focus on invasive aquatic plants

Invasive aquatic plants cost South Africa millions of rands every year to control. The most problematic species are alien ornamentals that have spread from garden ponds. Their prolific growth is in direct response to nutrient-enriched/polluted waters and the absence of natural enemies.

One of the major problems in the fight against invasive aquatic plants is that infestations often spread alarmingly before their danger is realised. This may be because the identity of the plant is not known early enough or alternatively because it is not recognised that the plant constitutes a potential danger.

This issue of SAPIA News gives some background to the problem of invasive aquatic and wetland plants in South Africa and provides a photographic guide to the most troublesome species and some of the emerging species.

Aquatic weeds are a symptom of poor water quality!

Invasion of water hyacinth (*Eichhornia crassipes*) at Kleinfontein Dam in Benoni, Gauteng, January 2010. Photo: Lukas Otto.

Water hyacinth can double its biomass in less than 2 weeks during the peak of its growing season! This means that it can reproduce quicker than it can be removed mechanically. The absence of natural enemies and highly enriched/polluted water allows for prolific growth. Kleinfontein Dam and neighbouring lakes require an integrated strategy, combining biological control with herbicides and /or mechanical control and water purification.

Problems with AGIS/WIP

The Weeds and Invasive Plants website: www.agis.agric.za/wip is currently not being managed due to ongoing operational problems at AGIS.

Requests for information from the SAPIA database and submission of records of invasive plants should be sent directly to Lesley Henderson at L.Henderson@sanbi.org.za.

SAPIA newsletters are posted at the ARC website: www.arc.agric.za
under ‘News Articles’.

Invasive aquatic plants in South Africa

Invasive aquatic plants in South Africa and the law

Invasive aquatic plants invade major rivers, dams, lakes and irrigation canals. They disrupt navigation, fishing and other recreational activities, adversely affect waterflow, increase the loss of water from storage dams and pose a threat to hydro-electric installations. High densities of the plants degrade aquatic ecosystems and are a threat to biodiversity.

Currently 14 alien aquatic and wetland plant species are declared weeds or invader plants in South Africa and their control is subject to the Conservation of Agricultural Resources Act (CARA), Act 43 of 1983, and amended in 2001. Another 13 species have been proposed for listing under CARA and the National Environmental Management Biodiversity Act (NEMBA), Act 10 of 2004.

CARA categories
1 = prohibited
2 = permit required for cultivation
3 = no further cultivation or trade

Proposed CARA and NEMBA categories
1a = top priority emerging species; aim at eradication or strict control
1b = widespread species that require a management plan
2 and **3** as above

Opportunistic species

These are mainly indigenous or cosmopolitan (world-wide) species that can flourish and become troublesome in disturbed aquatic habitats. They respond to various disturbances and are usually **symptomatic of a problem, and not the problem itself**. Disturbances range from nutrient enrichment of the water, through runoff of fertilizers from farm lands, and contamination of rivers with sewage, to manipulation of river flow and water levels, such as the building of dams, and destruction of riverine and other wetland vegetation.

The families with the biggest representation are Potamogetonaceae, the pondweeds, with six species of *Potamogeton* (see *P. schweinfurthii,* broad-leaved pondweed **photo 1**) and Lemnaceae, duckweeds, with seven species belonging to the genera *Lemna* (see **photo 2**)*, Spirodella* (**photo 3**) and *Wolffia.* The latter are cosmopolitan, free-floating and very small, ranging from less than 1 mm to 10 mm long. They can completely cover a water surface, looking much like an algal bloom. They are often mistakenly identified as *Azolla* spp., or seedlings of the larger floating aquatics. Other opportunistic species included in this newsletter include *Najas horrida*, saw-weed (see p. 4), *Ceratophyllum demersum*, water hornwort (see p. 4) and *Lagarosiphon* spp., oxygen weeds (see p. 5).


1


2

Photo: CJ Cilliers


3

Photo: CJ Cilliers

There are various control options available:

Utilisation, in most instances, will not be sufficient to control invasive aquatic plants, and in some instances might even promote spread. **Manual/mechanical control**: removal by hand is extremely labour-intensive and not cost-effective. The use of mechanical harvesters has generally not been successful in South Africa because of shallow water depth and obstructions. Cables or floating booms have been very successful on some rivers or part of a dam. Floating aquatic plants bank up against the cables and are then treated with herbicide. This technique is cost-effective and prevents the time and cost spent to track down small infestations or individual plants. **Herbicides** can be sprayed onto leaves above the water surface to control floating and emergent weeds and injected underwater (direct metering) to control submerged plants. **Only use herbicides that are registered for use in aquatic ecosystems and read the label! Large weed populations should be controlled by a series of herbicide applications to portions (not more than 30%) of the waterbody over an extended period. Beware of non-target/ knock-on effects, especially with underwater treatments. Water level manipulation** refers to the raising or lowering of water levels to control aquatic plants. This technique is limited to ecosystems with adequate water control structures such as sluice gates and weirs. **Biological control** uses natural enemies, usually insects or pathogens, to reduce aquatic weeds to manageable levels (see page 7 for more information). Effective biocontrol agents are available for the 'big five' aquatic weeds, *Azolla filiculoides* (red water fern), *Eichhornia crassipes* (water hyacinth), *Myriophyllum aquaticum* (parrot's feather) (see page 7), *Pistia stratiotes* (water lettuce) and *Salvinia molesta* (salvinia). **Biocontrol is the preferred method for large infestations because it is environmentally acceptable and cost-effective. In most instances acceptable control of the major aquatic weeds can be achieved through biocontrol alone. The level of control achieved will vary greatly and depend on the specific characteristics of the system such as weed species present, nutrient conditions, water flow, climate etc.** *Chinese grass carp* is one of the fish species that eats submerged aquatic vegetation and is effective in controlling some species of submerged aquatic plants (not floating water hyacinth or water lettuce). *Only sterile grass carp can be legally used for aquatic weed control in South Africa*. Overstocking with grass carp severely damages aquatic ecosystems and their use should be limited to urban lakes and farm dams to limit their spread. **Integrated control** refers to the integration of herbicide or mechanical methods and biological control and applies essentially to water hyacinth as the other species can usually be controlled using biocontrol alone. When integrating herbicide and biocontrol methods, care must be taken to leave unsprayed mats, called reserves or refugia, where the biocontrol agents can persist and disperse from.

The management of any aquatic plant infestation has to be carefully planned, tailored to the specific system's characteristics and needs, and efficiently implemented in order to maximize the strategy's effectiveness and limit undesirable or negative impacts.

Guide to identification of invasive aquatic plants

Free floating (normally unattached and float on the water surface)

CARA categories & proposed categories under CARA and NEMBA
▲ = should be proposed (see page 2 for definitions of categories)

leaves tiny (< 7 mm across)

***Azolla filiculoides*, red water fern**, leaves overlapping, branching irregular, whole plant ~ round in outline; root tips often coiled; prefers cooler, highveld areas e.g. Free State

***Azolla microphylla*, tropical red water fern**, leaves and branching pattern similar to *A. filiculoides*; prefers tropical areas e.g. lowveld of Limpopo & Mpumalanga

***Azolla pinnata* subsp. *asiatica*, Asian mosquito fern**, leaves mostly not overlapping; branching regularly pinnate; prefers tropical areas (coastal KZN)

Indigenous ***Azolla pinnata* subsp. *africana***, known only from Ndumu in KwaZulu-Natal, has more pointed leaves than *A. filiculoides* and *A. microphylla,* a regular pinnate branching pattern giving a 'Christmas tree' shape, and delicate lateral roots. *A. pinnata* subsp. *asiatica* differs from subsp. *africana* by leaves that only closely overlap towards the branch tips and a narrow transparent leaf margin. *A. microphylla* (= *A. mexicana*) has recently been confirmed in South Africa through molecular analysis (pers. comm. Martin Hill).

leaves large (> 10 mm across)

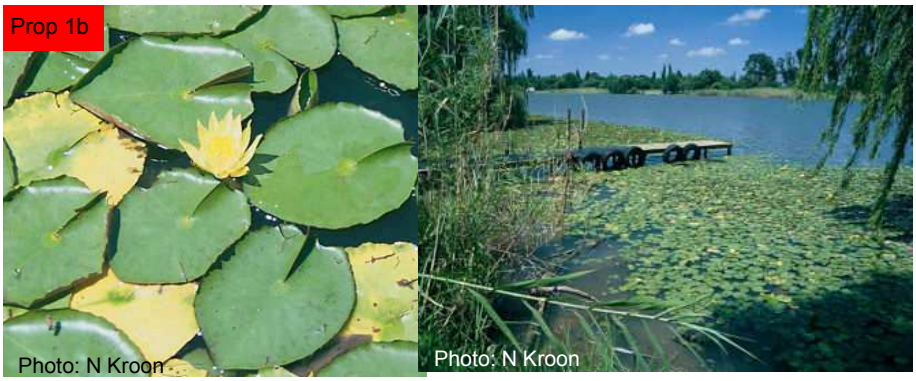
***Eichhornia crassipes*, water hyacinth**

***Pistia stratiotes*, water lettuce**

***Salvinia molesta*, salvinia**

Floating, attached (rooted in the substrate but usually have at least the mature leaves floating on water surface)

***Nymphaea* hybrid water lily**, petals rounded, pale yellow



***Nymphaea mexicana*, yellow water lily**, petals pointed, deep yellow; invasive on Vaal River.

Yellow water lilies are the most invasive of the introduced water lilies (there are no indigenous yellow water lilies in South Africa). Other hybrids with white and pink flowers have been noted as garden escapes growing along riverbanks and in farm dams.

Guide to identification of invasive aquatic plants cont.

Submerged or emergent with fine or feathery leaves (rooted in substrate; stems submerged or emergent, with most leaves finely divided)

***Cabomba caroliniana*, fanwort**; leaves opposite or whorled, repeatedly branched; flowers with 3 white sepals and 3 white petals each with two small yellow spots in the throat. Aquarium plant. Potentially invasive; with ability to obstruct water flow and dominate nutrient-rich dams and lakes.

Don't confuse this species with fanwort:
***Ranunculus rionii*, water crowfoot**, leaves alternate and flowers with 5 green sepals and 5 or 6 white petals. Widespread; invasive status uncertain; perhaps indigenous/cosmopolitan.

***Myriophyllum aquaticum*, parrot's feather**; leaves whorled, unbranched; emergent leafy stems; flowers inconspicuous in leaf axils

***Myriophyllum spicatum*, spiked water-milfoil**; leaves whorled, unbranched; stems usually completely submerged; flowers in emergent spikes 50–100 mm long

Don't confuse with these indigenous/cosmopolitan species

***Ceratophyllum demersum*, water hornwort**, leaves whorled, stiff, branching; leaf margins toothed.

***Najas horrida*, saw-weed**, leaves whorled or in opposite pairs, narrow with coarsely toothed margins.

***Potamogeton pectinatus*, fennel-leaved pondweed** has thread-like leaves no more than 2 mm wide and flowers in spikes.

Guide to identification of invasive aquatic plants cont.

Submerged, not feathery (rooted in the substrate; leaves normally fully submerged, not finely divided; flowers either float on the water surface or protrude above it)

***Egeria densa*, dense water weed**; leaves usually in whorls of 4–5, 15–30 mm long.

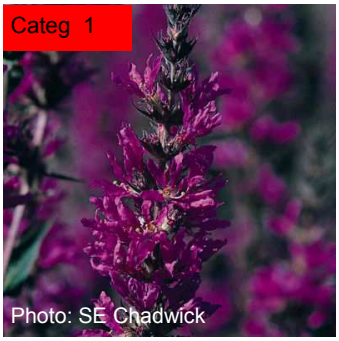
***Elodea canadensis*, Canadian water weed**; leaves usually in whorls of 3, 5–15 mm long.

Egeria, Elodea and *Lagarosiphon* have leaves with very finely serrated/toothed margins (not visible with the naked eye); *Hydrilla* has leaf margins markedly serrated (visible with the naked eye). *Egeria, Elodea* and *Hydrilla* have leaf tips ending in one spine cell; whereas *Lagarosiphon* species have leaf tips ending in two spine cells (visible with a handlens)

***Hydrilla verticillata*, hydrilla**; leaves in whorls of 3–8, margins prominently toothed; only known from Pongolapoort Dam in KwaZulu-Natal.

***Lagarosiphon* spp., oxygen weeds**, are indigenous species that can flourish under certain conditions and grow very densely; leaves are arranged spirally and are often strongly recurved.

Emergent, broad-leaved (rooted in the substrate; stems, flowers and most leaves project above the water surface; leaves usually broader than 10 mm)



***Lythrum salicaria*, purple loosestrife**, perennial herb up to 2 m tall; flowers in axillary whorls, in dense spikes 150-250 mm long. Only known from Liesbeeck River, Cape Town.

***Nasturtium officinale*, water cress**, herb up to 1 m tall; leaves once-divided with 3-11 leaflets, leaflet margins entire; flowers in terminal elongated racemes.

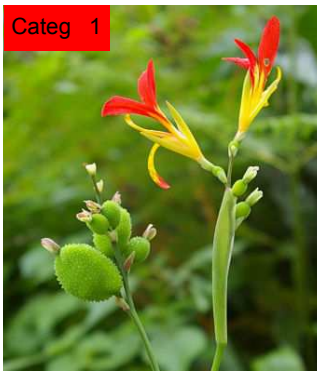
***Pontederia cordata*, pickerel weed**; perennial herb; rhizomatous; erect, emergent stems and leaves; flowers in spikes 50-150 mm long.

***Sagittaria platyphylla*, slender arrowhead**; perennial herb up to 1.5 m tall with creeping stolons. Submerged leaves are strap-shaped. Flowering stems always below leaf height.

Guide to identification of invasive aquatic plants cont.

Emergent, broad-leaved continued

Categ 1

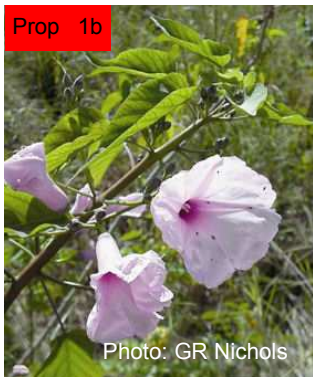


***Canna indica,* Indian shot**, has narrow red or orange flowers and usually yellow below; invades riverbanks, wetlands and other moist sites. *Canna* x*generalis*, garden canna, has much larger flowers and is also invasive but not declared.

Prop 2

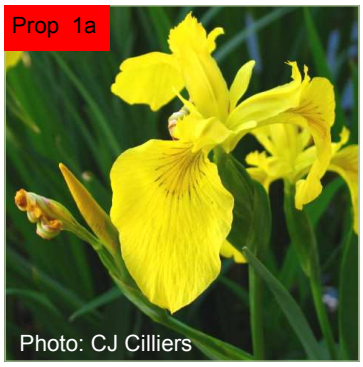
***Glyceria maxima,* reed sweet grass**, aquatic reed-like grass, 1–2.5 m high, shorter than indigenous reeds (*Phragmites*) with a non-fluffy/silky inflorescence and unfringed, membaranous ligule (see SAPIA News no. 7)

Prop 1b



***Ipomoea carnea* subsp. *fistulosa*, morning glory-bush,** shrub, stems woody at the base and hollow; invades riverbanks, edges of dams and swamps. Cultivated as a hedge plant and tolerates dry conditions.

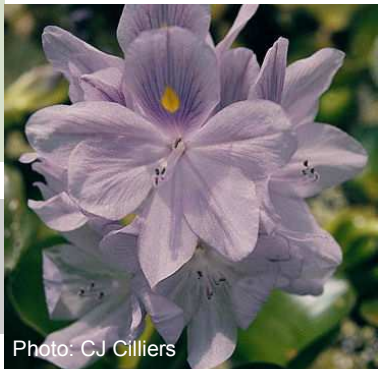
Prop 1a



***Iris pseudacorus,* yellow iris**, can form floating mats in rivers. Leaves look similar to those of *Typha* spp., bullrushes, but have raised midribs). South Africa has no indigenous yellow irises.

Categ 1

***Arundo donax*, giant reed**, robust 6–10 m tall; distinguished from indigenous reeds (*Phragmites*) by its compact and spear-shaped inflorescence, leaf tips that are not rigid and penetrating (like *P.mauritianus*) and persistent leaf sheaths. Unlike the indigenous reeds it often grows on roadsides or other sites away from water.



Reference consulted (out of print):

Henderson, L. & Cilliers, C.J. 2002. Invasive aquatic plants—a guide to the identification of the most important and potentially dangerous invasive aquatic and wetland plants in South Africa. PPRI Handbook No. 16, Agricultural Research Council, Pretoria.

Other useful literature and web addresses:

Cook, C.D.K. 2004. Aquatic and wetland plants of southern Africa. Leiden, Backhuys Publishers.

Hill, M.P. & Coetzee, J.A. 2008. Integrated control of water hyacinth in Africa. *OEPP/EPPO Bulletin* 38: 452–457. (a ten step plan)

http://www.agis.agric.za/wip (more descriptions and photos of invasive alien aquatic plants)

http://www.weeds.gov.au/publications/guidelines/index.html (weed management guides, Australia)

http://web.wits.ac.za/Academic/science/APES/Research/WaterHyacinth.htm (water hyacinth in South Africa, University of the Witwatersrand)

http://plants.ifas.ufl.edu/ (aquatic and invasive plants, University of Florida, USA)

Useful contacts:

Biological control:

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Integrated control:

University of the Witwatersrand, Dr Marcus Byrne: marcus.byrne@wits.ac.za, Tel: 011 717 6491;
Rhodes University, Prof Martin Hill: m.hill@ru.ac.za, Tel: 046 603 8712;
Department Water Affairs: Working for Water, Mrs Debbie Sharp: SharpD@dwa.gov.za, Tel: 053 802 0500/38.

Water hyacinth has been a major problem along the Vaal River for many years—infesting more than 300 km of river. Biological control has been used effectively on sections of the river and within the next five years the Department of Water Affairs plans to have water hyacinth under biocontrol alone.

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Excellence in Research and Development

The Weeds Research Programme of the ARC-Plant Protection Research Institute is responsible for research on the ecology and control of invasive alien plants in South Africa. These plants were introduced either intentionally (e.g. for ornamental use or agroforestry purposes), or accidentally (e.g. in livestock feed) and now threaten biodiversity and agriculture. In addition, they reduce run-off from water catchments, thus diminishing flow in streams, and adversely affect the quality of life of communities.

- Biological control
- Chemical control
- Bioherbicides
- Integrated control
- Monitoring the emergence and spread of invasive alien plants

We are on the Web:

www.arc.agric.za

see Plant Protection News

for current news from the Weeds Research Programme

Read *Plant Protection News* No. 85 for the following news from the Weeds Research Programme:

- Towards the biological control of *Parthenium hysterophorus* in Africa
- Testing of a rust fungus, *Prospodium tuberculatum*, as a possible biocontrol agent of *Lantana camara* in South Africa
- 38th Annual Workshop on the Biological Control of Invasive Alien Plants in South Africa

Biological control of invasive plants

Feeding damage to parrot's feather (*Myriophyllum aquaticum*), by the leaf-chewing beetle, (*Lysathia* sp.)
Photos by CJ Cilliers

Biological weed control is the use of natural enemies to reduce the vigour or reproductive potential of an invasive alien plant. The principle is that plants often become invasive when they are introduced to a new region without any of their natural enemies. The alien plants therefore gain a competitive advantage over the indigenous vegetation, because all indigenous plants have their own natural enemies that feed on them or cause them to develop diseases. Biological control is an attempt to introduce the alien plant's natural enemies to its new habitat, with the assumption that these natural enemies will remove the plant's competitive advantage until its vigour is reduced to a level comparable to that of the natural vegetation. Natural enemies that are used for biological control are called biocontrol agents.

The potential risk posed by a candidate biocontrol agent is determined by biocontrol researchers through extensive host range studies (specificity tests) that are carried out in a quarantine facility. These trials determine the range of plants that a potential biocontrol agent is able to use as host plants throughout its life cycle, as well as its host plant preferences. Permission to release a biocontrol agent will be sought only if the host-specificity tests prove without doubt that the potential agent is sufficiently host-specific for release in this country. To be regarded as sufficiently host-specific, the candidate agent must be either monophagous (i.e. the insect feeds on only one plant species, the target weed in this case) or it could have a slightly wider host range, provided that none of the additional host plants occur in South Africa or surrounding countries, either as indigenous or introduced crop plants.

South Africa is regarded as one of the world leaders in the field of biological control of invasive alien plants. Since the 1930s we have brought 29 invasive alien plant species under complete or substantial biological control. In the process, 111 species or biotypes of natural enemies were released, 85 of which became established. Remarkable successes have been achieved with either controlling or reducing the invasive potential of many invasive plants including cacti, aquatic weeds, Australian wattles, chromolaena and lantana. Seed feeders feature strongly in many of our projects. Tested and safe biocontrol agents are distributed in co-operation with the *Working for Water* Programme of the Department of Water Affairs.