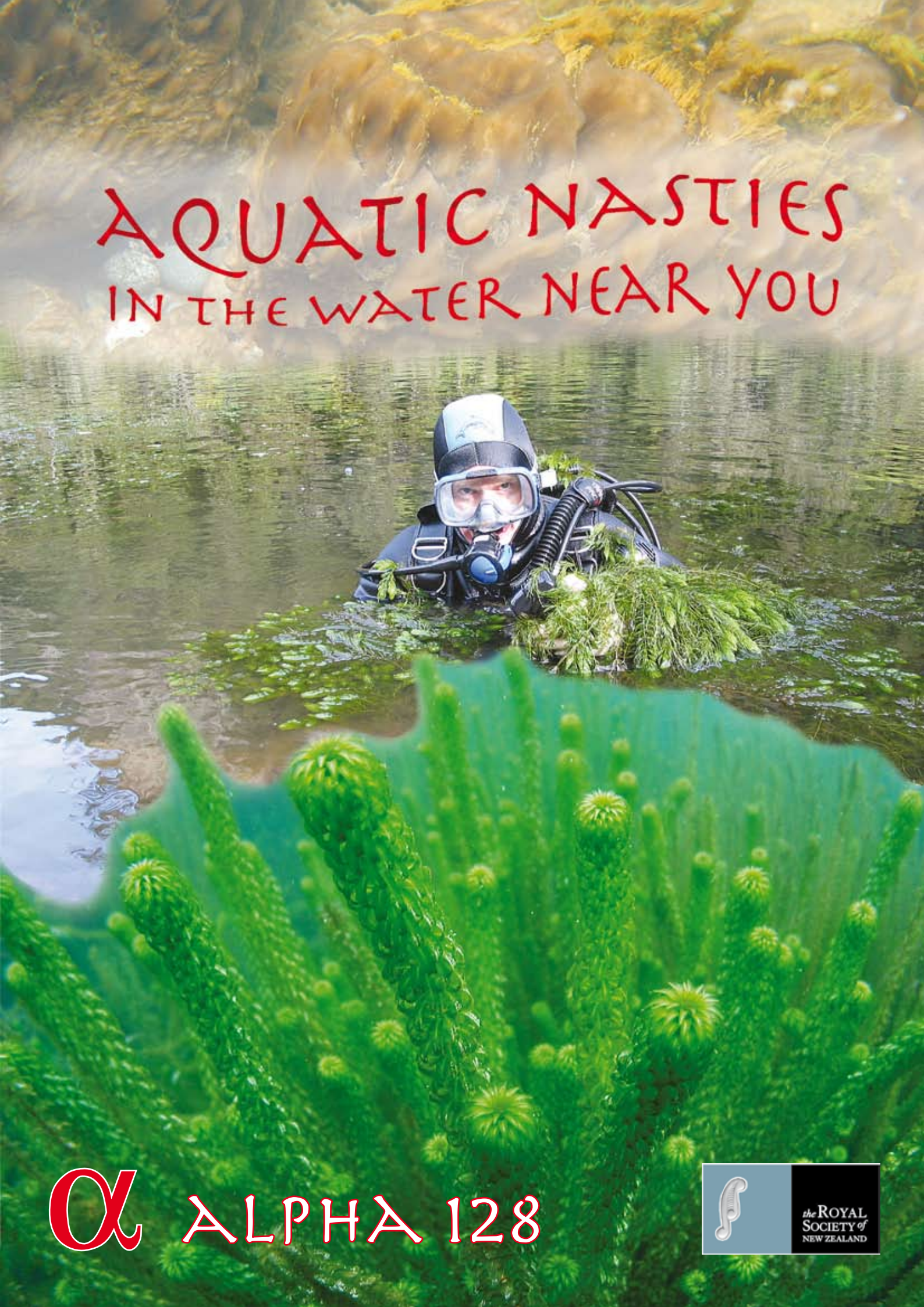
# AQUATIC NASTIES
## IN THE WATER NEAR YOU



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## INTRODUCTION

Alien aquatic plants are invading a waterway near you. In the South Island, infestations of didymo (*Didymosphenia geminata*), aka rock snot, are plaguing the waterways. In the North Island, your local stream or lake may be fouled with alligator weed (*Alternanthera philoxeroides*) or hornwort (*Ceratophyllum demersum*).

Hornwort.
PHOTO: ROHAN WELLS, NIWA.

Many lakes, streams, ponds and rivers are infested with introduced plants. Most of these pests have no natural enemies, and they rapidly squeeze out native aquatic species, both plant and animal, from their habitats. They also cause problems to humans by ruining aesthetic appeal (some grow rampant and some smell bad); clogging hydropower dams; bunging up irrigation; blocking flood control drains; fouling boating navigation channels; contaminating drinking water; reducing tourism and affecting property values; and restricting swimming, boating, fishing and other recreational activities.

Algal blooms are regularly reported in the news. Algae are usually not alien or introduced plant species (the notable exception being didymo) but they can be a nuisance when they bloom.

Both toxic algal blooms and unwanted introduced aquatic plants can present a health hazard. Dog deaths and human sickness have been recorded from drinking toxic algal bloom-affected water. Vigorously-growing water weeds can be a danger to swimmers who may become entangled and drown.

*Lagarosiphon major*.
PHOTO: ROHAN WELLS, NIWA.

Such aquatic weeds are known as 'invasive' weed species and humans are nearly always responsible for their establishment and spread, although a few are spread by bird droppings and other animal movements. The most serious aquatic weeds have often originated as escapees from garden ponds and fish tanks. According to the Department of Conservation (DOC), 50 percent of introduced freshwater weeds get into the environment this way. National Institute of Water and Atmospheric Research (NIWA) scientists believe the percentage is closer to 75 percent.

Hornwort and Lagarosiphon infestations can be the result of people emptying fish tanks and ponds into waterways. Both species were once commonly used in aquariums, but are now banned from sale. Many aquatic weeds can grow from tiny stem fragments. These can easily become snagged on boats, trailers, four-wheel drives and fishing equipment (especially multi-layered nets), and then transported from one waterway to another.

DOC has coordinated weed surveys to keep an eye on the spread of such pests. Researchers recently found an unusual upsurge in Lagarosiphon and the first record of Egeria (*Egeria densa*) in a particular area. After some detective work they discovered that the infestation was caused by misguided pond owners gifting plants to friends – unaware that both these species are banned from sale and distribution. In the same survey, Lagarosiphon was identified in wetland areas frequented by eel fishers, suggesting it may have been spread by unclean eel nets.

Controlling aquatic weeds differs for every area depending on the type and extent of the infestation and the ecological value of the site, but measures fall into four broad categories. The first is a 'do nothing' approach. Nature is left to fight the rise of the invader in the hope that the weed settles into a harmonious balanced relationship with its new environment. For weeds which can be invigorated by manual clearing, this is often the best policy, especially if the infestation is in a contained area with little human contact. The other three options are **containment** (see Hydrilla), **control** (see alligator weed) and **eradication** (see hornwort). The following are species we could do without in New Zealand.

## ALGAL BLOOMS

Most algae in lakes and rivers are harmless and are an important part of freshwater ecosystems, especially the commonly found bright green algae. However, under the right environmental conditions some types can 'bloom' to form dense colonies (often a symptom of nutrient enrichment in the water). Some types that bloom can emit toxins which pollute drinking water and make humans and animals sick. The algae which currently adversely affect us most in New Zealand are blue-green algae (*Cyanophyta*) and didymo (*Didymosphenia geminata*).

### Cyanobacteria aka blue-green algae and pond scum

Cyanobacteria species occur naturally in rivers, lakes and streams throughout the world. They range in colour from olive-green to red. Generally they exist in waterways as unseen microscopic cells. These cells can multiply rapidly (bloom) during hot and fine conditions with low or steady water flow. They require light, phosphorus and nitrogen to survive. In lake or pond environments the bloom mass can alter its buoyancy up and down to absorb these materials. This buoyancy control is operated by light. During the day, algae produce oxygen from photosynthesis and rise to the surface to form a surface scum.

According to Health Canada, between 30 and 50 percent of cyanobacterial blooms are harmless and contain only non-toxic species of freshwater cyanobacteria. However, several species can produce a range of poisons, called 'cyanobacterial toxins' or 'cyanotoxins', that are harmful to people and animals. The toxins are stored in the cells of certain species of cyanobacteria and are released into the water when the cells rupture or die. There are several different types of toxins; some attack the liver (hepatotoxins) or the nervous system (neurotoxins), and others irritate the skin.

A group of cyanobacterial toxins called 'microcystins' were first isolated from a blue-green alga called *Microcystis aeruginosa*. Microcystins are the toxins usually responsible for poisoning animals and humans who come into contact with blue-green algal blooms. Microcystins are stable in water because of their chemical structure. They can survive in both warm and cold water and can tolerate radical changes in water chemistry, including pH. They can contaminate fish and shellfish, making them unsafe to eat.

Symptoms of cyanobacterial toxin poisoning may include: headaches, fever, diarrhoea, abdominal pain, nausea and vomiting, or itchy and irritated eyes and skin, as well as other hay fever-like allergic reactions. Long-term liver damage is possible but few, if any, human deaths have been recorded, in contrast to livestock and dogs. Dogs in particular will drink anything and love splashing in any available water whereas humans are more circumspect about drinking and swimming in water which appears unclean and smells unpleasant, and most drinking water supplies are monitored and treated in New Zealand.

In the summer of 2002/03, the genus *Anabaena* was recorded in the Waikato River, Lake Taupo and several other lakes, including Waahi and Hakanoa. Where cyanobacterial toxins were detected, health warnings were issued advising people not to drink untreated water or to have recreational contact in or on affected water bodies. During the summer of 2005/06, continuous warm weather and low river flows resulted in the widespread growth of cyanobacterial mats in various Kapiti Coast and Hutt Valley rivers. It is believed four dog deaths in the Hutt Valley are attributable to this toxic algal bloom. Authorities put up signs advising people to keep their pets out of the water, and some sections of the river remained off limits until the fine weather broke and heavy rain washed all the algae and any toxins out of the waterways.

## NOT EVERY AQUATIC PLANT IS A PEST

Not all aquatic plants or algae are pests, they are only a nuisance if they are an introduced species, or, in the case of algae, if they have a bloom in the wrong place at the wrong time. Some of the good things aquatic plants do are:

- dissipate wave energy and reduce shoreline erosion
- stabilise sediments, remove nutrients and help keep water clear
- provide cover and nursery habitat for fish and other aquatic animals
- help combat global warming by removing some 10 billion tonnes of carbon dioxide from the atmosphere each year during photosynthesis (Hutchison 1993)
- provide food for waterfowl.

Algal bloom and warning signs, Ngaroto, March 2003.
PHOTOS: TRACY EDWARDS, NIWA.

## Didymo aka rock snot

The alga didymo (*Didymosphenia geminata*) has been causing problems in the South Island. Didymo is part of the algal family of single-celled aquatic plants known as diatoms. Their cell walls contain silica, and the blooms are silky to touch, although they look slimy – didymo feels like wet cotton wool. Like other algae it is invisible to the naked eye until it blooms to form dense colonies.

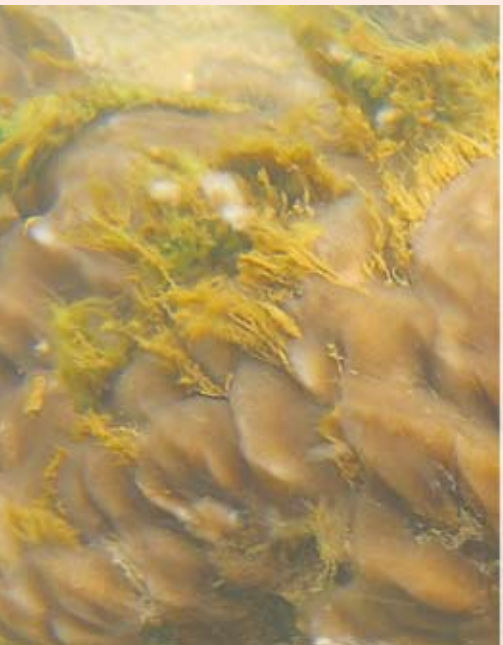
Didymo contains chlorophyll which enables it to make its own food by using energy from the sun. However, it also contains other pigments which give it a range of colours from beige or brown to white.

The population grows mainly by asexual cell division, with occasional sexual reproduction to exchange genetic material and restore cell size. When the alga blooms, its cells ooze mucilage that attaches the didymo to underwater surfaces. Young colonies look like small dimples on the surfaces of river rocks, but as the bloom progresses the dimples grow to form stalks and then impenetrable mats with thick strands which can cover any underwater surface, including other plants, rocks and debris. It attaches itself firmly and does not fall apart when rubbed between your fingers.

Didymo prefers cool to warm water with a neutral or slightly alkaline pH, in moderately flowing rivers with a firm, stable river bed exposed to plenty of sunshine. It was first found in the lower Waiau and Mararoa Rivers in Southland in October 2004, although it was possibly living undetected in some South Island rivers before then. In 2005, didymo was found in the upper reaches of the Buller River, and various rivers in Otago and Southland. In January 2006, NIWA confirmed it was growing in Canterbury's Waitaki River where it now poses a threat to hydropower generation.

Although didymo is not considered to be a direct threat to human health, it does come with a substantial range of other problems. It can:

- clog hydropower dams and water supplies for irrigation
- become entangled in boat propellers
- make rocks slippery and therefore dangerous for swimmers and wading anglers
- reduce populations of fish (trout, salmon, whitebait, bullies and eels) because the blooms smother streambeds, affecting the habitat of insects such as mayflies and caddis flies that fish rely on for food
- alter the pH of the water
- reduce dissolved oxygen
- taint the taste of the water
- create an offensive smell when blooms die off.



We don't know how didymo first came to New Zealand, but it was probably unintentionally transported on recreational or industrial equipment from overseas. Didymo originally comes from cool temperate regions of the Northern Hemisphere. New Zealand's infestation is the first time it has been found in the Southern Hemisphere.

Biosecurity New Zealand has issued a 'controlled area notice' over the South Island to try and prevent didymo from spreading further, especially to the North Island. This means that people using the waterways must obey certain rules, such as checking, cleaning, and drying their gear before leaving a waterway. Failure to do this could result in penalties of up to five years in prison and/or a fine of up to $100,000.

Didymo, Wairau River.
PHOTOS: JOHN CLAYTON, NIWA.

# AQUATIC PLANTS

## Alligator weed (*Alternanthera philoxeroides*)

Alligator weed.
PHOTO: NIWA.

Alligator weed is a problem in many waterways in northern New Zealand. It is an introduced, sprawling, rooted, perennial herb that can grow on both land and in the water. In the water it can form dense floating mats up to 1 metre tall which cover the surface and smother other vegetation, although it will not root below 2–3 metres.

It was first recorded here early last century. To control its spread, Landcare Research released various natural enemies of the plant (**biocontrol** or biological control). Scientists might recommend the use of a biocontrol when there are dangers of herbicides adversely affecting waterways. Also, sometimes clearing a weed manually can result in new infestations as new plants can grow from tiny stem fragments.

Biocontrol methods include the release of the alligator weed beetle (*Agasicles hygrophila*) and the alligator weed moth (*Arcola malloi*) in the 1980s. Both species are effective at defoliating the plant (eating its leaves) and controlling mats of weed on lakes and ponds. However, biocontrol methods were not effective on land-based infestations or in areas prone to frequent flooding or frost. In these instances, NIWA has tested a range of herbicides which are now used.

Alligator weed is widespread in the Northland and Auckland regions, with scattered sites in Waikato, Bay of Plenty and Manawatu-Wanganui, and also one site each in Canterbury and Westland.

Biocontrol will never eradicate a pest species, only control it. As the pest species is reduced in number, so too is the control species which feeds on it, allowing the pest species to again grow in number. Scientists are careful about releasing biocontrol species as it is disastrous when the control has a preference for eating some native species and itself becomes an introduced pest. The introduction of new species into New Zealand's ecology is now also regulated by the Environmental Risk Management Authority (ERMA), a Government organisation which manages the HSNO Act (Hazardous Substances and New Organisms Act 1998).

## Eelgrass (*Vallisneria gigantea* and *Vallisneria spiralis*)

There are two similar species of eelgrass in New Zealand. Both are introduced, attached, submerged, stoloniferous, freshwater perennials. Eelgrass forms a dense mass of straplike leaves which arise from rhizomes. It can grow up to 5.5 metres high and roots in sediments in depths of up to 9 metres in standing or flowing waters, displacing native vegetation and impeding drainage. Eelgrass is difficult to control.

Swan on eelgrass drift, Lake Pupuke.
PHOTO: JOHN CLAYTON, NIWA.

Both species are dioecious (so each plant is either male or female, but not both). Only female plants of *V. spiralis* have been found, and only one mixed population of male and female plants of *V. gigantea*. Spread of *V. spiralis* has been linked to the aquarium trade and is to be added to the list of those restricted from sale and distribution.

Eelgrass is found in a few sites in the North Island, with Lake Pupuke the most well known. It had been found in Marlborough but the regional council acted quickly to control the site.

Egeria flowering in Piako River.
PHOTO: ROHAN WELLS, NIWA.

## Egeria (*Egeria densa*) aka dense oxygen weed

Egeria is an introduced, bottom-rooted, submerged, perennial plant that forms dense beds up to 5 metres high which may reach the water surface. It roots in either silty-organic or sandy-gravel substrate and thrives in turbid and slow-flowing waters, competing with and displacing native plants. It can also block dams and waterways. New plants grow from stem fragments containing lateral buds. Egeria is dioecious; no seeds are produced because only the male plant is present.

Egeria is abundant in the Waikato district, and scattered throughout the North Island. It is found in a few sites in the South Island including Marlborough, Westland and the Avon River in Christchurch. According to scientists at NIWA, suction dredging and diquat chemical control appear to have eliminated it from the Avon River. Diquat has also been highly effective against Egeria in Marlborough streams.

## Hornwort (*Ceratophyllum demersum*)

Hornwort is an introduced, submerged, freshwater perennial found in both still and flowing water. Until recently, it was thought to be a problem only in the North Island, where it is particularly common in the Waikato River and Rotorua lakes. Unfortunately, it has recently been found in the Tasman region and, in February 2006, in the Centennial Park Lake in Timaru.

Diver with Egeria.
PHOTO: T. EDWARDS, NIWA.

Although historical infestations may have been caused by people emptying their ponds and fishtanks into stormwater drains, the location of sites suggests that it may have been accidentally moved around on eel nets or hitched a lift with coarse fish that have been illegally liberated into waterways in the South Island.

Hornwort thrives in fertile, nitrogen-rich waters, but can grow in a range of nutrient conditions. Amazingly, this rootless weed can be found in water up to 16 metres deep, forming huge growths. Examples in low-nutrient conditions include extensive growths in lakes Taupo and Tarawera. The branched, brittle stems can grow up to 7 metres long. Hornwort is usually either free-floating (making it one of the worst water weeds in New Zealand), or forms submerged weed beds with stem bases anchoring the plant in sediment.

Unfortunately, a whole new plant can grow from a tiny stem fragment, which breaks off easily – a motor boat propeller can create hundreds of new plants. The plant can be transported between waterways by machinery, boats, trailers or nets. Biosecurity New Zealand is attempting to eradicate the weed from the South Island.


Signage at Hawke's Bay lake, February 2004.
PHOTO: JOHN CLAYTON, NIWA.

## Hydrilla (*Hydrilla verticillata*)

Hydrilla is an introduced, branched, submerged, perennial plant that is usually firmly rooted in the bottom mud up to a depth of 10 metres. It forms dense beds that can displace other submerged plants and block dams and waterways. It has conspicuous toothed leaves. It can spread by rhizomes, stolons and stem fragments, and can also grow tubers. It is dioecious.

Hydrilla was first identified in Hawke's Bay lakes in the 1960s. Currently its distribution is limited to lakes Tutira, Waikapiro, Opouahi and Elands. The infestation is contained by geographical isolation and the prohibition of motorised boats on the publicly accessible lakes Tutira and Waikapiro. Further containment measures include the use of signage beside lakes that have Hydrilla, to ensure public awareness of the plant. Weed mat has also been used in selected areas of public access sites to minimise the likelihood of transfer.

As a type of biocontrol, NIWA released 400 grass carp into Lake Eland in 1988. By April 1990, the fish had eradicated 99 percent of the Hydrilla biomass. By the following summer there were no remaining weed beds, although occasional plants still grew from turions and tubers. Over the next 10 years viable tubers were still present, but no regrowth has been recorded since the early 2000s. While grass carp remain in this lake it is not certain whether Hydrilla has been effectively eradicated and NIWA will be evaluating this trial further.

Hornwort removed from screens at hydro intakes.
PHOTO: ROHAN WELLS, NIWA.

Weed on boat propeller.
PHOTO: A. BROW, DOC.

Grass carp recovered by NIWA and DOC for gut analyses.
PHOTO: ALEKI TAUMOEPEAU, NIWA.

## Lagarosiphon (*Lagarosiphon major*) aka curly oxygen weed and South African oxygen weed

Lagarosiphon is a vigorous, perennial, freshwater herb that grows submerged in lakes, ponds, rivers and streams from shallow water up to depths of 6.5 metres. Once common in garden ponds, it escaped to become a problem in waterways throughout New Zealand. The plants are brittle, fragmenting easily and growing rapidly from stem fragments. They also root easily in sandy or silty substrates. A single fragment can result in the weed becoming established. It then forms dense beds that smother native plant communities. Only the female plants of this dioecious species are present.

Lake Wanaka has had problems with Lagarosiphon since the early 1970s. Inconsistent clearance of the weed has allowed the infestation to affect amenity and recreational values such as swimming, water skiing and fishing. A Lagarosiphon Management Plan was put together in 2005 which aims to direct and focus the effort by the authorities to control the weed. Goals include removing all infestations that occur outside an agreed containment line, and minimising the spread of Lagarosiphon by boats, by reducing high biomass weed beds, which are the main source of stem fragments that attach to boats, trailers and fishing gear. Lagarosiphon is also being cleared from wharves and launching ramps, where boats can easily become carriers.

Lagarosiphon has recently become established on the West Coast where it is being spread by hobbyists via ornamental ponds, diggers clearing drains and very likely nets used for eel fishing. There is also a threat to many Canterbury, Otago, Southland and Fiordland lakes. It has also recently established in the Waitaki River catchment – specifically in Lake Benmore, where it poses a significant threat to hydropower.

Maintenance and public education needs to be ongoing. Although the sale of Lagarosiphon is illegal, the weed is widespread in parts of New Zealand. This increases the likelihood of amateur garden pond and aquarium enthusiasts taking samples from local waterways and growing them, then releasing them back into different waterways or selling them at car boot sales and school fairs.

## WHO DOES WHAT?

New Zealand has several agencies which deal with aquatic weeds. The responsibility for nationally led aquatic weed programmes (e.g. hornwort) lies with MAF's Biosecurity New Zealand. Land Information New Zealand (LINZ) is responsible for the management of some lake beds and associated weed control programmes. DOC manages containment and exclusion of freshwater species through both the aquatic life transfer controls under the Conservation Act 1987 and by the Chief Technical Officers (Conservation) appointed under the Biosecurity Act 1993. Regional Councils have planning and regulatory functions under the Resource Management Act 1991 (RMA), and are often required to monitor water bodies under the Biosecurity Act 1993. District Councils can also administer District Plans which regulate land-use activities, including activities on the shoreline, bed and surface of water bodies. Many of these agencies work together in teams and also contract work out to NIWA, which has expert scientists and researchers who deal with aquatic weed control and identification.

## WHAT TO DO IF YOU SEE ONE OF THESE WEEDS

Alligator weed
Cyanobacteria
Eelgrass
Egeria
Lagarosiphon
*consult your regional pest management plan and pass reports through to regional council*

Didymo
Hornwort (South Island only)
Hydrilla
*contact Biosecurity New Zealand, ph. 0800 809 966*

## Internet references


AgResearch – http://www.agresearch.co.nz
Biosecurity New Zealand – http://www.biosecurity.govt.nz.
Department of Conservation (DOC) – http://www.doc.govt.nz
Environment Waikato – http://www.ew.govt.nz
Health Canada – http://www.hc-sc.gc.ca
Hutt Valley District Health Board – http://www.huttvalleydhb.org.nz
Ministry for the Environment – http://www.mfe.govt.nz
National Institute of Water and Atmospheric Research – http://www.niwascience.co.nz
Weedbusters New Zealand – http://www.weedbusters.org.nz

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