our science

# Biosecurity


Chris Woods, NIWA

*Nick Gust (left) leads the search for* Styela clava *in Lyttelton Marina.*

## Finding foreign species in our ports

Foreign marine species brought in by vessels pose a potential threat to New Zealand's aquaculture industry, fisheries, and marine ecosystem. The Ministry of Fisheries and MAF Biosecurity New Zealand have commissioned NIWA to find out what species are found in key ports and marinas.

Drawing on our considerable marine survey and taxonomy expertise, NIWA has this year reported on 23 port surveys involving dozens of NIWA staff. These recorded standardised baseline data on native and non-native species from 16 of our busiest ports and marinas – from Opua to Bluff – and repeat data from seven sites to estimate the arrival rate of new species.

We found 84 non-native species out of the 1000-odd marine species identified in these surveys, including 18 that were new records for New Zealand. Some of these, such as the clubbed tunicate *Styela clava*, are notorious invaders elsewhere in the world.

This research represents the first comprehensive field investigations of marine biodiversity within first-ports-of-entry in New Zealand. It has built a valuable national database of biodiversity information for both native and non-native species and a valuable collection of voucher specimens. Surveys are ongoing at seven additional ports and marinas.

## Efficient service for marine species ID

NIWA continues to provide an efficient species identification service for MAF Biosecurity New Zealand (MAFBNZ) through its Marine Invasives Taxonomic Service (MITS), drawing on the expertise of taxonomists within NIWA and around the world.

Identifying the species is crucial to understanding a plant or animal's origins and, if non-native, their potential for invasion. Non-native species identified by MITS come from all around the world and cover a broad spectrum, from crabs to algae. New records are reported promptly to MAFBNZ.

In the last year, MITS has processed some 11 165 samples and identified 610 species from a range of MAFBNZ projects, including port surveys, hull fouling studies, and surveillance. Non-native species totalled 164, many of which were new records for New Zealand. A large number have only been found on visiting international vessels and are not known to be established here.

Importantly, this vast series of specimens is curated as a reference collection within NIWA's nationally-significant Invertebrate Collection, and Te Papa's herbarium collection.

Alan Blacklock, NIWA

*Andrew Hosie.*

## Front-line defence against freshwater weeds

Early detection of freshwater pests is crucial to contain or eradicate them effectively, but many are hidden beneath the waves. NIWA has designed underwater surveillance programmes, targeting at-risk water bodies and focusing on likely sites for introduction. Detection methods include manoeuvrable diver tows and sonar mapping.

This year, surveillance programmes undertaken by regional councils detected major new submerged weeds in four iconic lakes: Wakatipu, Rotomahana, Okataina, and Ototoa. NIWA advised on ways to delimit and contain the extent of the incursions, and assess if and how eradication might be achieved. Early detection and decisive action has led to realistic prospects of eradication at three of the above sites.

NIWA also advised on containment of lagarosiphon, a weed that threatens hydro-generation and amenity values in the Waitaki Valley system and Lake Wanaka. This included advising on weed control, inspecting weed control outcomes, and formulating strategies for future containment and reduction of the weed.

NIWA's generic guidelines for waterbody surveillance and incursion response will incorporate these experiences and provide agencies with stronger tools for early pest plant interception.

## Breakthrough in didymo control

NIWA research has identified a compound that could potentially control localised early stage didymo infestations with minimal impact on other aquatic life.

Intensive trials in laboratories and artificial stream channels identified a chelated copper formulation, now named Gemex™, as the best agent to kill didymo while having minimal non-target effects. After obtaining the necessary consents, we released Gemex™ into Princhester Creek, a tributary of the Mararoa River, at a prescribed rate over an hour on a single afternoon in February.

Gemex™ successfully eliminated didymo six weeks after treatment over the initial 0.3 km of waterway that was in the early stages of infestation, and it suppressed growth in 1–10 mm thick didymo mats for up to 4 km downstream. Overall, effects on non-target species, particularly invertebrates and native galaxiid fish, were minimal. Further investigation is needed of juvenile trout mortality at localised downstream sites, and the long-term effects of Gemex™.

This research, commissioned by MAF Biosecurity New Zealand, is attracting interest from other countries where didymo has become a nuisance, from North America to Scandinavia.

Case study: didymo (under fold)

John Clayton, NIWA

Bill Jarvie, Fish & Game New Zealand

*Phil Jellyman sampling algae in Princhester Creek after Gemex™ trials.*

National Centre for
Aquatic Biodiversity & Biosecurity

*protecting our natural heritage*

*See p. 25 for an outline of our capabilities & services*

our science

# Targeting didymo

When NIWA scientist Cathy Kilroy identified a microscopic alga she collected from the lower Waiau River (Southland) in October 2004, the news was alarming. The alga was *Didymosphenia geminata*, aka didymo or rock snot, a single-celled diatom capable of smothering waterways with its prolific growth.

Extensive fleece-like mats of didymo now cover stretches of many rivers in the South Island. This unsightly alga clogs jetboat and water intakes and poses a significant threat to New Zealand's angling, tourism, and hydroelectricity industries.

NIWA is at the forefront of didymo surveillance and research, responding rapidly to changing research needs, building on new information as it comes to light, and always with careful consideration of practicalities and environmental protection. The research outlined here was commissioned by MAF Biosecurity New Zealand (MAFBNZ) to inform their decisions on didymo containment and control.

## Defining didymo's limits

In September 2005, didymo was discovered in several more South Island rivers. MAFBNZ commissioned NIWA to help undertake a nationwide search for the pest. Within days field teams were in action, and within three weeks they had sampled 475 sites nationwide. NIWA has since led several nationwide delimitation surveys. Didymo has progressively spread to more areas – 14 major South Island river and lake systems as of July 2007 – but has not yet been detected in any North Island waterways. To prepare for that eventuality, we've developed plans to assist implementation of MAFBNZ's North Island didymo response strategy.

Early detection is crucial, but didymo cells aren't visible to the naked eye, and it's not feasible to search every part of every waterway. We've therefore helped to refine surveillance methods and identify high-risk sites. Initial analyses of habitat suitability, based on didymo's environmental preferences in other countries, showed that more than 50% of New Zealand's river area – mostly in the South Island – would be suitable for didymo. More recent analyses based on new survey data from 145 South Island sites show a similar broad pattern, with South Island rivers more susceptible to didymo incursions. Colour-coded maps showing predictions of percentage cover and thickness of didymo in river reaches will help managers to assess the risks of impacts from didymo in currently unaffected rivers, and to identify and manage high-risk sites.

## Didymo ecology and impacts

To contain and control a pest, you first need to understand what makes it tick. MAFBNZ commissioned NIWA to study didymo's ecological requirements and impacts in Southland rivers in 2005 and again in 2006–07 – the latter with Fish & Game New Zealand, the Cawthron Institute, and the University of Otago.

The early studies showed that didymo can thrive in a broad range of water depths and speeds. Nutrients may stimulate cell growth, but thick mats can develop even if nutrient concentrations are very low. More recent research suggests floods are a major factor controlling didymo abundance.

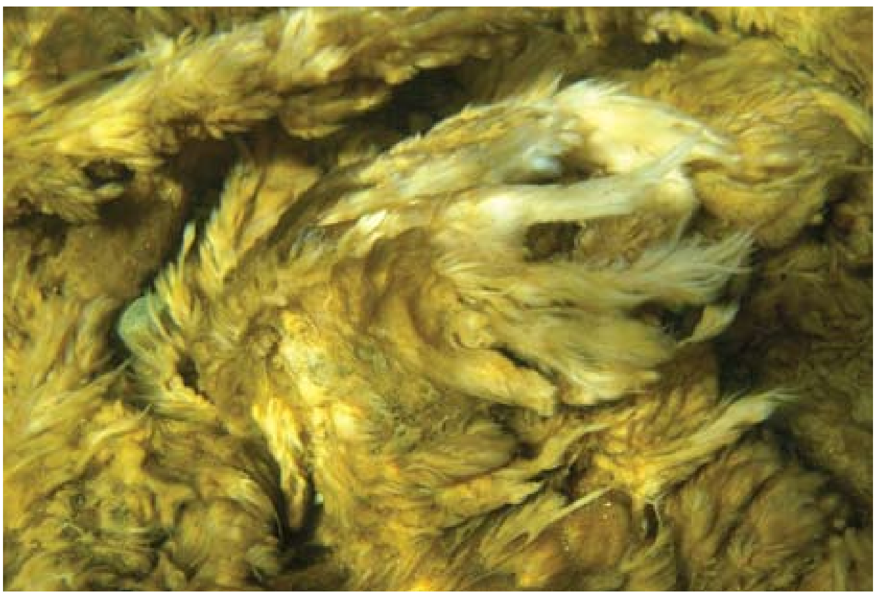
Understanding didymo's effects on river ecosystems may help to identify species and processes at high risk, and aid in prioritising conservation efforts. Quantitative studies of invertebrates in the Oreti, Mararoa, and Waiau Rivers showed that thick didymo growth is associated with overall increased invertebrate abundance and diversity. But species favoured by fish (mayflies, stoneflies, and caddisflies) decreased in proportional abundance. It is still too early to predict long-term effects on ecosystems.

## Experiments in didymo survival

"Early on, the priority was to contain didymo within its original catchment, which required rapid development of methods for decontaminating materials and equipment that may have come into contact with didymo", explains Cathy Kilroy. NIWA made preliminary decontamination guidelines available within two months of the first didymo discovery, and quickly tested the effectiveness of various methods to kill didymo mats and cells on gear. Common household cleaners and desiccation were the most effective.

Once didymo was discovered in several rivers, priorities shifted to containing and slowing its spread within the entire South Island. This required an assessment of the risk of transporting didymo within New Zealand and decontamination of equipment on a massive scale.

Laboratory experiments showed didymo is capable of surviving outside its natural



Neil Blair, NIWA

environment for much longer than was previously thought – more than two months in optimum conditions of low temperature (about 9 °C), and adequate moisture and light. Drying and extreme temperatures rapidly killed didymo, and these methods were incorporated into MAFBNZ's decontamination recommendations in the 'Check, Clean, Dry' campaign.

Tests of the effectiveness of 14 different decontamination products and protocols resulted in decontamination recommendations for a wide range of river users – from the casual angler, to jetboat operators and other high volume commercial users.

Further lab research confirmed felt-soled waders as a prime candidate for transferring didymo between rivers because of their ability to retain moisture and, therefore, live didymo cells. Trials of various decontamination methods suggested felt-soled waders should be frozen solid or soaked in hot water – preferably with detergent – for long periods, if used at all. As a result, MAFBNZ's 'Check, Clean, Dry' recommendations were updated to incorporate separate methods for absorbent and non-absorbent items.

## Steps to identify a control agent

The search for a biocide that would control didymo, while having minimal environmental impacts, began in November 2005, building on earlier studies of its ecology and survivability in different conditions. Trying to entirely remove an established population of a microscopic organism from a waterway without serious impacts on other aquatic life is a huge challenge. "A more realistic goal was to focus on finding a tool to reduce the impacts of didymo blooms and control early infestations", says NIWA's Dr Sue Clearwater.

A wide-ranging scientific review of algal control chemicals identified ten compounds as possibilities, which were narrowed to four through a series of screening trials on cobbles covered in didymo mats. We tested these four for their effectiveness at different application rates and flow conditions in an artificial stream environment, built at Pioneer Energy's Monowai power station in


Alan Blacklock, NIWA

*Cathy Kilroy with cultured didymo samples.*

early 2006, and concurrently tested their impact on freshwater fish and invertebrates in laboratory trials. The chelated copper product, Gemex™, emerged as the most promising. The next step was to test it in a natural waterway. After careful preliminary work and consultation, we trialled Gemex™ in Princhester Creek, a tributary of the Mararoa River, in February 2007 (see article on p. 27).

Results of the trial suggested Gemex™ has the potential to eliminate didymo from a waterway with minimal impact on non-target species if the infestation was detected and treated in the very early stages. Short-term Gemex™ treatment is likely to result in negligible accumulation of copper in the environment. However, heavy use of Gemex™ for repeated or long-term treatment is not viable due to the potential cumulative effect.

"NIWA has played a pivotal role in the Government's response to the didymo incursion in New Zealand," says MAFBNZ's Didymo Science Programme Leader, Dr Christina Vieglais. "NIWA's expertise has been instrumental in understanding didymo's ecology and potential distribution, and in quickly developing practical tools for cleaning freshwater gear. These tools empower everyone using New Zealand's awe-inspiring freshwaters to play their part to prevent spreading didymo."