

John Zeldis, NIWA

## Diagnosing estuary health

NIWA is leading a study of the health of the Avon-Heathcote estuary before and after the installation of the Christchurch City wastewater outfall in late 2008.

The estuary has had heavy nitrogen loading from wastewater for the past 40 years, and the outfall will remove about 90% of it. We are using a range of tools to investigate the physical, chemical, and biological response of the estuary to this dramatic change. The resulting toolkit will be applicable to estuary remediation projects around the country.

The scientific team is separating sources of pollution using stable isotope analysis, and estimating the pollution load in the sediments through analysis of nutrient and oxygen levels.

*Peter Wilson (left) and Kay Vopel measure microprofiles of oxygen and pH in estuary sediments.*

They're also monitoring the abundance and, in some cases, physiology and population dynamics of key species. These include microalgae which support the base of the estuary food chain, sea lettuce (the source of nuisance smells in summer), and abundant animal populations.

This research is in collaboration with the universities of Canterbury, Otago, and Birmingham (UK), Environment Canterbury, Christchurch City Council, and the Ihutai Trust, with direct financial support from the Department of Conservation and the Foundation for Research, Science & Technology.

## What drives coastal productivity?

Nutrients in coastal waters come from the ocean and land via mechanisms such as upwelling, tidal mixing, and river flows. Understanding these mechanisms has applications for the aquaculture and fishing industries and regional councils.

NIWA research has shown that nutrients in Pelorus Sound – New Zealand's largest aquaculture area – come both from Cook Strait and the Pelorus River, and that climate has important effects on this input. Southeast winds during La Niña summers suppress upwelling and nutrient delivery from Cook Strait to the outer Sound. In winter, southerly winds are associated with decreased river flow and less nutrient input to the inner Sound.

Our research has shown that a large downturn in mussel meat yield between 1999 and 2002 occurred when climatic conditions favoured decreased nutrient input to the Sound. This suggests that climatic conditions, rather than resource over-use, drove the downturn.

These findings were based on climatic, oceanographic, and mussel industry historical data. To understand the underlying mechanisms of nutrient supply to coasts, NIWA is developing coastal ocean models, and validating them with data from ships, satellite sensing, and telemetered buoys.



Barb Hayden, NIWA

## The vital role of coastal ecosystems

Worldwide, there is growing recognition of the services nature provides that effectively sustain life and business on our planet. NIWA research is highlighting the vital services provided by estuarine ecosystems and the threats they face.

A key service is the cycling of nutrients from seafloor sediments to the overlying water. Seafloor habitats can supply up to half the nutrients for primary production in coastal waters, supporting fisheries, shellfish production, and shorebirds.

Estuaries function like a liver or kidney in the coastal zone, processing nutrients, contaminants, and sediments that are washed off the land. We are researching the role key seafloor species play in this processing these inputs, and what happens when they become overloaded.

Species like horse mussels, heart urchins, and cockles help release nutrients from the seafloor and create habitats for other species. Seagrass and large shellfish also provide nurseries for juvenile fish. Because of feedback mechanisms, small changes in the abundance of key species can rapidly alter an estuary's ability to process nutrients and contaminants.

This Foundation for Research, Science & Technology funded research will help coastal managers devise policies and strategies that avoid damage to estuaries and maintain the important ecological services estuaries provide.

*Top right: Drew Lohrer setting up benthic chambers on Waitemata Harbour sandflats to measure changing levels of oxygen and nutrients associated with the activity of sediment-dwelling organisms.*



Luca Chiarini, NIWA

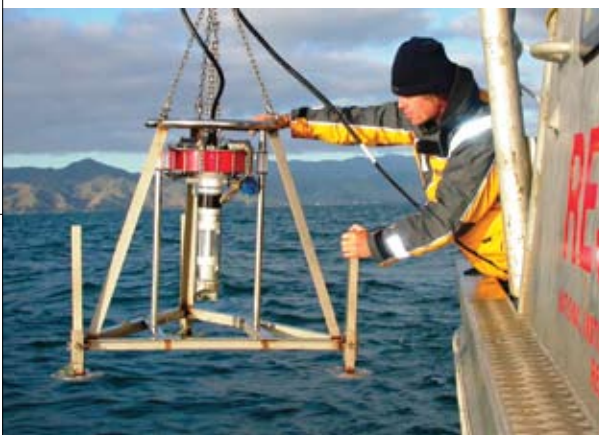
## New advances in sediment biogeochemistry

Coastal sediment acts as a biogeochemical reactor, breaking down organic matter through microbial activity and chemical processes and releasing nutrients. Understanding the functioning of this reactor is key to predicting the effects of human activities, such as wastewater discharge, on coastal ecosystems.

NIWA has developed a new method to assess sediment functioning using a combination of two high resolution measuring techniques and a numerical model of the processes involved in organic matter breakdown.

We use a scanner to capture vertical sediment colour profiles which result from a sequence of 'redox' (reduction-oxidation) reactions and the mineral composition of the sediment. The interpretation of these profiles is aided by millimetre-scale profiling measurements of key pore-water solutes and the numerical model. The pore-water solute measurements also help to fine-tune the model, which not only characterises the status quo of the sediment reactor, but also predicts its function under future scenarios of human activities.

This three-pronged tool has many applications, including assessing the environmental effects of fish and mussel farming, urban development, and dredging on coastal regions.



Kay Vopeli, NIWA

*Cliff Hart deploying the sediment profile imaging device in Wilson Bay, Firth of Thames, to investigate the effects of longline mussel farming on seafloor function.*

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