SPECIAL PROMOTION

SYDNEY INSTITUTE OF MARINE SCIENCE

Something in the water

Scientists are restoring Sydney's lost aquatic forests, writes **Matthew Benns.**

Abalone are prized, precious and not readily available in the waters off Sydney. But now a scientist with the Sydney Institute of Marine Science is working hard to bring the highly valued sea snails back to the Sydney coast.

Dr Ezequiel Marzinelli, a research associate with SIMS and the University of NSW, has been looking at the lost forests of seaweed that are the traditional home of the coveted delicacy.

"There is a seaweed, commonly known as crayweed, which provides habitat and food to a wide variety of organisms, including abalone, crayfish and commercially important species of fish, such as wrasse and leather jacket," he says.

Unfortunately, in the 1970s and 1980s, the weed stopped growing in a stretch from Palm Beach in the north to Cronulla in the south. "It seems to be very sensitive to environmental change," he says. "The poor water quality at that time, with sewage being dumped directly into the sea, may have contributed to its disappearance."

However, the improvement in water quality in recent years has not seen the crayweed, *phyllospora comosa*, return to the shallow rocky reefs where it used to grow.

Marzinelli and colleague Dr Alexandra Campbell have undertaken a study, planting seaweed taken from Palm Beach and Cronulla in small areas at Long Bay and Little Bay in the south and at Cape Banks on the north head of Botany Bay. The results have been encouraging.

"What we have found is that when you put adult plants in here, their numbers grow and you actually start to get recruits, baby plants," he says.

Wanted weed … crayweed plantations in Sydney waters will hopefully bring about a spike in abalone numbers. Photos: Ezequiel Marzinelli

It appears the crayweed has not returned to the Sydney metropolitan area because it had no way of getting there, or plants to reproduce with once it was there.

"We are finding that the transplanted plants are doing much better here than in the areas where it has never been lost. We don't know if that is just because there is space for it here."

To understand what is happening more clearly, Marzinelli, along with Campbell, Professor Peter Steinberg from SIMS and Department of Primary Industries (DPI) scientists, has secured funding and permission from NSW's DPI to plant larger, 60-square-metre plantations of crayweed at the same three locations.

Marzinelli has recruited local dive groups DiVo and USFA to assist with the planting. "The seaweed has a holdfast but it gets its nutrients from the water and the holdfast is just an anchor point," he says. "That makes it harder to transplant."

> '[Crayweed] seems to be very sensitive to environmental change.'
>
> **Dr Ezequiel Marzinelli, University of NSW**

Much time and energy has been spent on perfecting a technique to transplant large fields of the weed. In the end, the scientists perfected a system of fixing the weeds to a plastic mat with plastic cable ties.

"Unfortunately, it is plastic but it is the only thing we could find that was strong enough to last in the ocean and did the least environmental harm," he says.

"If we can actually show with this pilot project that we can enhance biodiversity and the numbers of abalone and crayfish in these areas, I think the NSW government will want to put the crayweed down all along the Sydney coastline," he says.

Although commercial abalone fishermen dive for their catch, large numbers of smaller abalone live in the crayweed at a depth of between half a metre and three metres. Marzinelli would like Sydneysiders to have a similar experience to that enjoyed on the NSW south coast.

"At Batemans Bay, where there is plenty of crayweed, you can find 10 to 15 abalone in three minutes of snorkelling, as opposed to searching for ages in normal seaweed or bare rock for just one," he says.

Sands of time

Popular beaches are disappearing but the locals now know why, writes **Matthew Benns.**

RESIDENTS in the prestigious homes opposite Jimmys Beach in Port Stephens have looked with dismay at the erosion of their beautiful shoreline and wondered why it was happening.

In 2007, they got together with local councils, NSW government departments, an industry partner and the Australian Research Council to fund a scientific project to find out. The result was not what they expected.

"Nature abhors a vacuum," says the project's leader, Dr Ana Vila-Concejo, a future fellow of the Australian Research Council and senior lecturer at the University of Sydney.

"Basically, nature has been trying to fill up the holes – the estuaries along the NSW coast – for thousands of years."

Jimmys Beach has been the happy recipient of that natural process for at least the past 6000 years as sand has been swept in and deposited on it.

> 'We humans do not see a problem unless we are going to lose something.'
>
> **Dr Ana Vila-Concejo, University of Sydney**

"However, things have changed and now it has become one of NSW's hot spots for coastal erosion," Vila-Concejo says.

Other beaches of the estuary, such as Shoal Bay, also have erosion problems. To find out why, Vila-Concejo and her team chose to study the entire estuary system rather than focus on one beach. The results were enlightening.

"Beaches are formed by waves dumping sand on the land – the bigger the waves, the bigger the beach," she says.

The sand is swept out to sea and the action of the waves naturally brings that sand back to shore and replenishes the beach.

In estuaries, it is different. Beaches are smaller and if a storm hits, the impact is greater.

Water rushes quickly into the estuaries through the narrow opening and then, as it slows, the sand drops to form the flood-tide delta – sand shoals – in the estuary. This can be washed on to the narrow beaches.

"At Jimmys Beach, the beach itself has been eroding … at least since the 1960s," Vila-Concejo says. "It has lost 100 metres in that time." But why?

"Our study has found there is no more sediment offshore to come into the estuary and the flood-tide delta is now stealing sand from the beaches as it erodes during storms," she says. "The same mechanisms that were once bringing sand to build a flood-tide delta and beaches are now pushing [it] away." Put simply, the sand has run out. "It is nature," Vila-Concejo says.

The beach next door, at Winda Woppa, has also been pushed further inland but no one is complaining about that.

Eroding … Jimmys Beach. Photo: Nathalie Craig

"The difference is there are no houses on Winda Woppa so we have let it erode," Vila-Concejo says. "We humans do not see a problem unless we are going to lose something. The houses on Jimmys Beach are very expensive."

Residents have been battling the erosion by driving in fresh sand every year. For Vila-Concejo, this is a better solution than building a seawall, which would immediately remove any hope of a beach and would need constant, expensive maintenance.

At the end of the study, Vila-Concejo went to Port Stephens to give the local residents a talk about her findings.

"The people were not upset," she says. "They were grateful."

Rocking on

One of Sydney's favorite delicacies is being saved from extinction, writes **Melinda Ham.**

NEXT time you slurp a succulent raw Sydney rock oyster, pause for a moment to consider the future of this little shellfish. It's part of Australia's oldest aquaculture industry – more than a century old and the state's most valuable, with a current annual production of more than 106 million oysters worth more than $40 million. But it is being threatened by global warming.

Luckily, it seems we'll be tucking into oysters for many decades to come thanks to a group of scientists at the Sydney Institute of Marine Science who are trying to identify particular genes that enable the shellfish to survive some detrimental aspects of climate change, such as the predicted higher water temperatures and increased concentrations of carbon dioxide that will make the ocean more acidic.

An associate professor at Macquarie University, David Raftos, is leading a collaborative team of scientists at SIMS tackling this problem. The team includes Associate Professor Pauline Ross and Dr Laura Parker, both of the University of Western Sydney, as well as scientists from the NSW Department of Primary Industries (DPI) and the Alfred Wegener Institute for Polar and Marine Research, in Germany.

"We've found that the wild Sydney rock oysters are particularly susceptible to increased water temperature and acidity, especially when the oysters are in the larvae stage," Raftos says. "They are seriously impacted and usually their growth is retarded or their development is abnormal."

But a solution isn't far away. Since 1990, scientists at the DPI have bred a special line of oyster, the Lime Kiln Bar, for fast growth and disease resistance.

Parker and Ross came up with the idea of subjecting the special oysters to warmer and more acidic water in a laboratory setting, compared with the conditions familiar to wild oysters. The scientists discovered that the parents thrived in this simulated environment, it further increased the resilience of their larvae, and the babies actually grew faster and larger than the wild variety.

So what's the next step? Raftos, Ross and their team have just won a $285,000 Australian Research Council grant to carry out more research over the next three years.

Future assured … a Sydney rock oyster. Photo: Michele Mossop

> 'This is not genetic engineering; it's selective breeding.'
>
> **Professor David Raftos, Macquarie University**

"We are now trying to find out which inherited gene seems to make these oysters more tolerant," Raftos says.

"This involves advanced molecular analysis of their genes and proteins to determine whether increased metabolism and genetic adaption is responsible for their survival."

By the end of this year, the team hopes to have isolated and identified the resistant genes.

"In the project, we are trying to produce climate-change-proof oysters," Raftos says. "This is not genetic engineering; it's selective breeding."

As for oyster connoisseurs, rest assured that the taste is the same. You've probably eaten one already and not even noticed.

The results of this SIMS research into climate-change resilience in oysters may also have implications for other aquaculture, such as abalone, scallops and mussels, and not just in Australia.

Faux reefs net approval

Man-made sites are boosting fish numbers, writes **James Robertson.**

FISH can be surprisingly choosy about real estate.

Dr Iain Suthers is researching whether placing artificial reefs in estuaries can boost fish populations.

His conclusion? If you build it, they will come. "When you put in more real estate, you get more fish," he says.

But it has to be the right kind.

Humans have tried to improve their catches by creating artificial reefs for centuries. But the selection of materials has been haphazard and, in the second half of the 20th century, it was a process that seemed indistinct from dumping rubbish.

Military surplus, car wrecks, shopping trolleys, used tyres and whatever other cheap material was at hand have been used in an attempt to house fish.

"It was a totally unscientific approach," Suthers says. Over time, much of the material degraded and slowly released toxins into the water, killing fish.

These days, reefs are engineered to mimic the naturally occurring rock and sand formations that fish call home.

Reef Balls are large concrete spheres with holes designed to mimic natural water flows.

Suthers, working with a team from the Department of Primary Industries (DPI), studied the effect of these artificial reefs on fish populations in three estuaries – Port Macquarie, Botany Bay and St Georges Basin.

They wanted to answer a long-standing debate in marine science about the reefs: do they produce more fish or simply attract them from other places?

Suthers and his team monitored the reefs using video for two years. It took some time to see some action.

> 'We will farm the continental shelf.'
>
> **Dr Iain Suthers, University of NSW**

It started with a community of "bio-fouling organisms", such as algae, beach worms and barnacles. Beneath the surface, they formed the beginning of an ecosystem – and new life.

"There was a whole food chain, from the bacterial film through to the sea squirts, sponges and plants," Suthers says.

South Korea has more than 40 such reefs, which are paid for by recreational fishing charter companies.

After two years, the concrete balls started to look like ancient Greek vases, discarded centuries ago and overgrown with life. Octopuses, banjo rays, eels and leatherjackets chased each other through the openings.

The reef was supporting new populations of fish, not just drawing them from elsewhere. "The numbers of bream and tarwhine grew on the artificial reef and the natural reef numbers increased as well," he says.

Now the team wants to see if the same thing happens in the ocean and with heavier-duty, design-specific reefs.

Suthers's research team will study marine-life activity at Australia's first offshore ocean reef. A 42-tonne steel cage was dropped in last October, 1.2 kilometres off the coast from South Head. The $900,000 reef, funded by the Recreational Fishing Saltwater Trust, is weighed down by four 60-tonne blocks of concrete.

The research is continuing but early results suggest that while life has been slower to accumulate in the ocean, the reef is showing a fuzz of algae and barnacles that portend the beginning of a new ecosystem.

Lively spot … an artificial reef at Botany Bay, 11 months on.

Suthers says reefs could be used as a cost-effective way to increase fish habitats, offset marine park exclusions and farm fish sustainably.

"We will essentially farm the continental shelf off the coast, just as we in some way farm the hinterland," he says.