

FISH



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JUNE 2013

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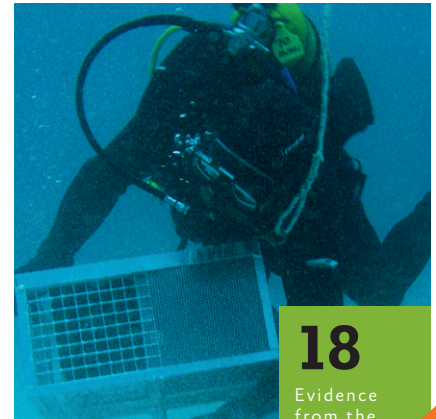
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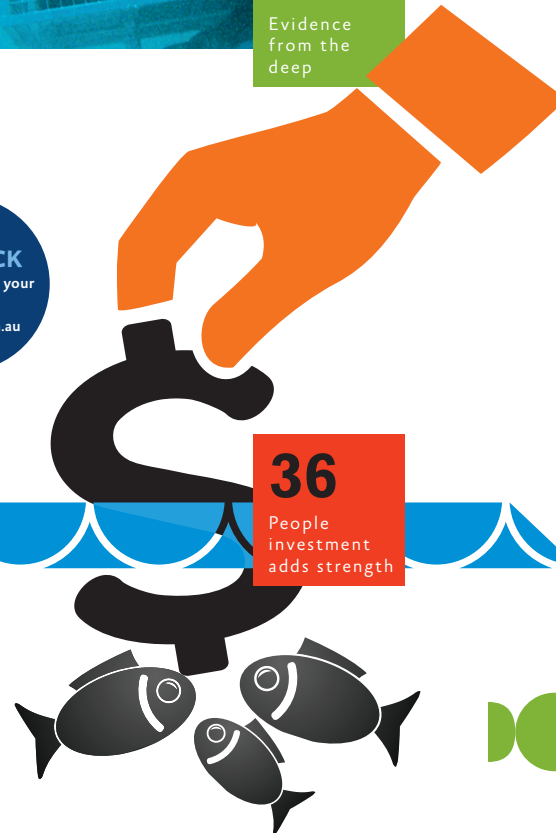
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 Photo by Austin May

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CLIMATE CHANGES PUT HEAT ON FISHERIES

A severe marine heatwave and associated warmer ocean temperatures off Western Australia have changed the nature of marine life, presenting opportunities and challenges for fishers and fisheries management

Something strange has been happening lately in the waters off Western Australia. Something that indicates a significant shift in the ocean environment. Fishers as far south as Albany on the Southern Ocean have reported for the first time catching Spanish Mackerel (*Scomberomorus commerson*), which is usually confined to the tropics. Other tropical species such as Threadfin (*Polynemidae*) and Common Dart (*Trachinotus botla*) are regularly turning up in catches off Perth. Even Manta Rays (*Manta birostris*) have been spotted.

While the change may appear positive for these tropical species, the impact on temperate species, particularly in the transition zone between tropical and temperate waters around Shark Bay, midway up the WA coast, are less welcome. The fisheries for Saucer Scallops (*Amusium*) and Blue Swimmer Crabs (*Portunus armatus*), once prevalent in Shark Bay, are doing it tough and there are real questions being raised about the potential effects on Snapper (*Pagrus auratus*) that are at the northernmost end of their range there.

These unprecedented changes are the result of a warmer south-east Indian Ocean over the two past summers, which has seen

an increase of 1°C to 2°C in WA waters. These warmer temperatures followed the extreme marine heatwave of 2010-11, in which WA waters were more than 3°C above long-term seasonal averages, peaking at more than 5°C above average for two weeks across February and March between Shark Bay and the Abrolhos Islands.

Caused by several climatic drivers including unusually hot, still weather, this dramatic event allowed tropical species to move south on an abnormally strong Leeuwin Current. But it also had a severe impact on the marine ecology. Fish kills were reported down the coast, corals were bleached and a Roe's Abalone (*Haliotis roei*) fishery at Kalbarri was wiped out.

To make matters worse for Shark Bay, which has already been hit by the marine heatwave, two major cyclones caused the Gascoyne and Wooramel rivers to flood and flush fresh water and sediment into Shark Bay. This contributed to the devastation of its Scallop and, in particular, Blue Swimmer Crab populations and the forced closure of both valuable fisheries.

Since the heatwave, fisheries managers in WA have been keeping a keen eye on the effects. A workshop held in the weeks afterwards detailed an inventory of fish kills,

coral bleaching and species reported out of their traditional ranges by recreational and professional fishers, researchers, divers and beach-walkers all along the coast.

This included thousands of dead fish, eels, crabs and rocklobster washed up on beaches, as well as dead pelagic fish floating on the sea surface. Coral bleaching was reported at the Abrolhos Islands and Rottneest Island, where new records of Red Bass (*Lutjanus bohar*) and Parrotfish (*Scaridae*), among other species, were also reported. At Dunsborough, a dead Leatherback Turtle was washed up well south of its normal range.

But it is information gleaned from a follow-up workshop, 'The Heatwave: Two Years On', supported by the FRDC that is helping build a fuller picture of the effect on fisheries of not only the heatwave, but also the above-average sea temperatures that have followed.

That workshop, held in March this year as part of a broad FRDC-funded project looking at the effects of climate change on WA fisheries, heard from fisheries scientists investigating a range of marine species including crabs, prawns, scallops, seaweeds, seagrasses, finfish and even penguins.

Workshop co-convenor Gary Jackson says that while much of the research is still

PHOTO: CHRIS DOWLING



Common Dart collected by Department of Fisheries WA netting surveys at Pinnaroo Point, just north of Perth. The smaller fish were collected in September 2011 after the heatwave and the larger fish about one year later in 2012, indicating they have survived over two winters and grown.

Seagrass in Shark Bay before (opposite page) and after (above) heatwave and flooding.

PHOTO: MATT FRASER

work-in-progress, a clear theme emerging from the workshop is that species are moving from their traditional ranges at unprecedented rates. This is prompting fisheries' managers to re-evaluate the landscape of the fisheries themselves.

The evaluation of fishery boundaries is an important consideration not only because higher sea temperatures over the past three years have led to species' movement, but also because the average temperature of WA waters is expected to rise permanently by 1°C to 2°C in the next 50 years. Therefore, the changing distributions of species are likely to be more lasting.

Evidence of this from the ocean is that fish species have already adapted to the changing conditions and are being found in new areas that can support their survival. This happened, Gary Jackson says, in two waves. First, adult fish species as well as eggs and larvae came down on the strong 2010-11 Leeuwin Current and then, in the ongoing warmer conditions further south, were able to survive.

Now, two years later, with continued warmer-than-average temperatures, those fish have been breeding and are now spawning in southern waters, further growing the populations.

"We have had a number of species turn up around Perth and further south such as Threadfin and Common Dart, which we

haven't had in our records before," Gary Jackson says. "We know they've arrived as very small juveniles but they've persisted and there's even evidence that a couple of species have become sexually mature and are now possibly spawning in southern waters."

Gary Jackson says this is the real test of whether conditions are changing: "that a tropical species can move hundreds of kilometres and find conditions so that individuals are able to go through a full life cycle and reproduce".

While tropical fish species that are extending their range southwards could be considered 'winners' of the changed conditions (along with the recreational fishers who are happy to see them), there have also been species – and fishers – that have lost out.

The Roe's Abalone population at Kalbarri that was wiped out by the heatwave is undergoing a translocation program, with hope the species will recolonise from a population that has been sourced from a site further south. This temperate abalone species is very sensitive to temperature changes, and a large recreational abalone fishery near Perth could also struggle as warmer sea temperatures are increasingly experienced.

One of the biggest challenges is that facing the Scallop and Blue Swimmer Crab fishers operating in Shark Bay, whose resource was decimated by the conditions

and whose fishery two years later remains closed. While an FRDC-funded project into Blue Swimmer Crabs is showing signs of rejuvenation, the outlook is not so optimistic for the Scallops, which are showing little sign of recovery.

Temperate seaweeds around Jurien Bay took a 'hammering' in the heatwave. This has implications for both the seaweed itself and for other species that may rely on it.

While the ink is not yet dry on much of the science, researchers are working closely with fisheries managers and fishers in the Shark Bay fishery – and others – to monitor the progress of the affected stocks and to discuss future options including whether fisheries are opened, closed, expanded or changed.

Fisheries scientists and managers are operating in "unchartered waters", says Gary Jackson, but while they have no control over a warming ocean they can control the management of the mobile marine populations and protect the breeding stocks.

"It's our job to try and understand the changes that are going on and then look ahead to try to manage the outcomes for fisheries," he says. "What we're trying to achieve is to manage fisheries sustainably the way we always have but now against a backdrop of the warming oceans. As long as we've got the science in place I'm confident we will be able to do what needs to be done." **F**

NINGALOO NIÑO – MARINE HEATWAVE EXPLAINED

By Melissa Marino

The events that conspired to create the deadly marine heatwave – the ‘Ningaloo Niño’ of 2010-11 – can be traced all the way to Alaska.

Ming Feng is the CSIRO Wealth from Oceans Flagship scientist whose research inspired the term ‘Ningaloo Niño’, referencing the specific Western Australian phenomenon.

He says that a long-term trend in the Pacific Ocean that affects fisheries as far north as Canada and Alaska set the scene for the events that led to the extreme sea temperatures recorded off the Western Australian coast in 2011. This trend, known as the Pacific Decadal Oscillation (PDO), was identified by North American fisheries scientists in the 1990s. It refers to the warming or cooling of surface waters in the northern realm of the Pacific Ocean, which affects salmon production regimes.

In the PDO’s current cool phase, more heat builds in the western Pacific Ocean, the Indonesian seas and waters off north-west Australia. There is also a greater likelihood of *La Niña* events, in which sea surface temperatures north of Australia are often warmer than normal. The summer of 2010-11 witnessed the second strongest *La Niña* of the past century, sweeping a body of warmer water through Indonesia on fierce easterly winds and driving it down the WA coast on an unseasonably strong Leeuwin Current.

The Leeuwin Current is a warm ocean current that flows southward all year, bringing tropical water with it. Usually it runs strongest in autumn but in the summer of 2010-11 it surged due to the strong *La Niña* associated with the PDO. Ming Feng

says the *La Niña* also drove a pressure system off the coast, which caused a southward wind anomaly to further enhance the strength of the current.

These events also helped create an on-land heatwave that saw no real sea breeze and a long run of days of more than 40°C; the hot, still air lying over the ocean further increased the sea temperature.

“The combination of remote and local wind forces caused the warming event in February and March 2011, where the temperature was almost 3°C higher than normal, centred around Shark Bay and the Abrolhos Islands,” Ming Feng says. “This was more than double the previous recorded temperature increase set in 2000 in line with another *La Niña* event.”

The water temperature peaked during a two-week period at 28°C, up from the usual 23°C. It was so high it was underestimated by the numerical models and surprised the marine community. “We have seen what I would call ‘normal’ temperature fluctuations according to *El Niño* or *La Niña* events but these kinds of temperature extremes we have probably never seen here before,” he says.

In the two years since the heatwave, sea temperatures have remained high at 1°C to 2°C above average. In 2011-12 this was attributed to another, weaker *La Niña* event, but in the most recent summer in which there was no *La Niña*, the higher temperatures were probably linked to the continued cool phase of the PDO, according to Ming Feng.

He says WA fishers and fisheries managers

should get accustomed to operating in warmer waters as higher ocean temperatures are expected to become the norm, with an increase of 1°C to 2°C in 50 years. This is despite indications that the Leeuwin Current will weaken in that time. “In 50 years’ time we will see these higher temperatures as normal,” he says.

In the meantime there will be year-to-year temperature fluctuations and the possibility of another extreme event such as the Ningaloo Niño cannot be ruled out, he says, particularly while the PDO remains in a cool phase. Intergovernmental Panel on Climate Change scientists are working on models to better predict the duration of PDO phases, he says.

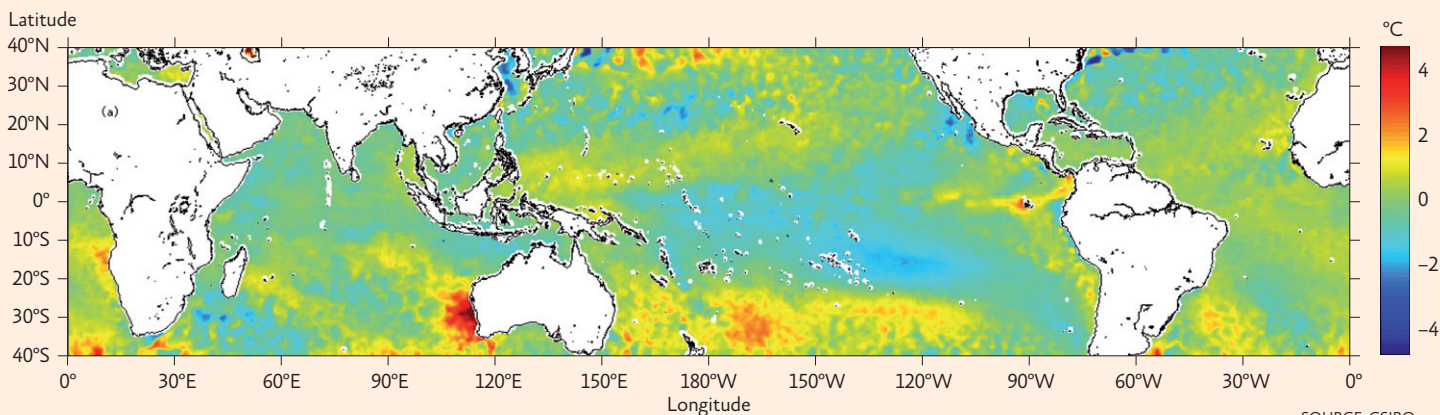
While present climate models can predict the likelihood of a *La Niña* or *El Niño* event about one to three seasons in advance, models would need to improve to predict such extremes as were witnessed in 2010-11, he says. Ming Feng and other oceanographers are continuing to work with the Department of Fisheries WA to optimise communication of climate information with stakeholders.

The FRDC is also funding research with collaborators from CSIRO and the Department of Fisheries WA on the projected impact of climate change on WA fisheries. Ultimately, climate information will help fisheries managers design optimal fishery management plans, he says.

FRDC Research Code: 2010/535

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SEA SURFACE TEMPERATURE ANOMALIES 21 FEBRUARY – 6 MARCH 2011 AT THE PEAK OF THE EXTREME WARMING EVENT.



DEVASTATION IN SHARK BAY NIPPED BY DIVERSIFICATION

By Melissa Marino

If it was not for diversification, the freak natural events that two years ago closed the Shark Bay crab trap fishery in Western Australia where Peter Jecks' vessels catch Blue Swimmer Crabs (*Portunus armatus*) may have also shut down his business.

Whether it was dumb luck or foresight, his decision a few years ago to branch into hand-picked crabmeat – and other value-added seafood products – on top of his premium whole cooked crab has kept Abacus Fisheries afloat in an extremely challenging environment.

Developed as part of an Australian Seafood Cooperative Research Centre project with support from the FRDC, Peter Jecks' crab cake product has continued to sell while the fishery has been closed thanks, in part, to a quantity of crabmeat he had previously processed.

As the project's name suggests, the 'Accelerated new product development: Blue Swimmer Crab pilot' fast-tracked the product's development from concept to market. It also established a template that Peter Jecks is using to create more diverse products including 'seafood shots' using Australian seafood and a soon-to-be-released Shark Bay King Prawn burger.

"Normally product development takes a considerable period of time, but we effectively in 18 months had gone from the water to a product that was plate-ready," he says. "The project I believe catapulted us two or three years ahead of where we would have been."

While the experience has not been easy – the original plan was to underwrite the new product development with the established whole crab business – it has at least provided some revenue. And it has shown a clear way forward.

Before the 2010-11 marine heatwave and cyclone-associated floods closed the fishery, more than 90 per cent of his business was reliant on fresh crabs. But now, and even when the fishery re-opens, Peter Jecks wants fresh crabs to make up no more than 30 per cent of sales.

Not only will this spread risk across the business should another natural calamity occur, but it is also a better business model in its own right, he says.

Consumer-ready products, such as his recently developed prawn with tom yum and salmon with wasabi and sesame 'shots', provide consistent

margins while giving better yield and cost control than fresh seafood sales.

"We are making Australian products you just cook and eat and the good news is there is an opportunity to grow that market in Australia as consumers are becoming more discerning of the origin of the food they order," he says. "When this all turns around we will have a very robust business model that will have a diverse range of incomes."

Risk is also being spread by the use of seafood products from areas other than Shark Bay, such as Atlantic Salmon. As well, Peter Jecks is investigating the potential to develop products made from the thousands of tonnes of locally grown fruit and vegetables that would otherwise end up in landfill because they are not the right shape or colour for the big supermarkets.

Peter Jecks says the fishery's closure has woken up a lot of people in the seafood game, including himself.

"We are taking advantage of a bad situation and trying to make it better," he says. "It's been challenging, but I actually like a challenge and it's made me get off my arse and go back and do things that I'd got past having to do."

Despite his optimism, the experience has not been without losses that he will never be able to redeem. One of the biggest was his staff of 40 people who, since losing their jobs, have also for the most part left the business's base in Carnarvon.

The Jecks also lost a treasured family home in Perth, which had to be sold to sustain the business when the fishery was closed. "The impact has been devastating," he says. "There is no other way to describe it."

The Shark Bay Blue Swimmer Crab and Scallop fishery was closed voluntarily by fishers in the wake of the marine heatwave that increased temperatures by an unprecedented 5°C above average for two weeks in the area.

While heat stress affected crab numbers,

Peter Jecks with a haul of Blue Swimmer Crabs he relied on before his Shark Bay fishery was closed in the wake of the 2010-11 marine heatwave.

PHOTO: MELISSA MARINO



Peter Jecks says a deluge of cyclone-related freshwater that flooded into the bay also had an effect, decimating seagrass beds and changing salinity levels and water quality in the bay. The immediate result on the seabed, he says, was chaos, with the usual crab distribution patterns thrown into disarray. Then within a few months the entire population collapsed.

The positive news is that recent surveys have shown a re-emergence of juvenile crabs. Given the species' rapid growth rate, he hopes to see plenty of mature crabs in the fishery by the end of the year.

That data is being assessed by Department of Fisheries WA researcher Mervi Kangas, who is leading an FRDC-funded project on Blue Swimmer Crab recruitment and biology in Shark Bay, including sampling crab stocks five times a year.

She says that while early 2013 surveys show signs of recovery, a "softly, softly" approach is required to the fishery reopening because surveys from 2012 also showed an abundance of small crabs but by November they had almost disappeared.

"We have to take it survey by survey but we are keeping our fingers crossed that they do grow into sizeable crabs and that fishing can follow," Mervi Kangas says. "That is what we are all hoping for."

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Cockles harvested from virgin territory in Western Australia.

Cockles a silver lining to heatwave wipeout

PHOTO: JOHN CRAIKE



PHOTO: WAYNE BUSST

Sorting his catch: John Craike is targeting Venus clams and waved Venus clams collected from the shallow waters of Shark Bay.

When the Roe's Abalone populations in Western Australia's north were all but wiped out in the 2011 marine heatwave, John Craike was forced to find an alternative to the species that has provided his livelihood for the past 20 years.

His search for something new led him to a friend's operation in South Australia harvesting cockles, then back to the shores of Shark Bay, north of his base in Kalbarri. Local knowledge suggested that Shark Bay might be home to an abundance of cockles.

On further investigation, John Craike has identified two species at Shark Bay worth targeting: Venus clams (*Callista inpar*) and a waved Venus clam (*Gomphina undulosa*) similar to the eastern Australian Vongole species (*Katelysia*).

He and fellow fisher Bob Holt are now WA's first cockle producers. They have been granted three-year exploratory licences to develop the newly discovered resource.

"We feel very privileged because it is a fishery that's never been touched. We're going into these areas that have never been harvested, and it seems like there is an infinite quantity there; obviously there isn't," John Craike says.

"The Department of Fisheries WA has a format where a few years down the track they will try and estimate what's there, but it is very difficult at the moment." He says the experience of the cockle industry in the eastern states will obviously provide a guide for the west.

It is a three-and-a-half-hour drive from John Craike's base in Kalbarri to Shark Bay,

so he and his crew make the trek north once every 10 days or so. When they come to a new area, they essentially hand rake through the sand in the shallow waters off the beach for about half an hour. The number of cockles collected in that time provides an indication as to whether there are likely to be enough for commercial harvest at that site.

They harvest for two to three days, depending on tides, before returning home. In that time they gather about 400 kilograms of cockles, which they sort on location and pack into foam coolers with saltwater ice before transporting to market. They supply wholesaler Hills Seafood Wholesale Food Merchants and also sell at auction in Perth.

A distinct identity

"We are only harvesting what we can sell, so we are starting slowly and hoping the market will grow." John Craike says Shark Bay's World Heritage listing provides a marketing point because "you can't get water any cleaner than that", and the WA cockles are slowly gaining a reputation distinct from that of eastern cockles.

He says one of the biggest problems is to counter the widespread mislabelling of seafood in Australia.

"I was visiting the Tweed River in New South Wales recently and I saw WA Vongole in a fish shop there. I wondered how they had got hold of them, because there are only two suppliers and I am one of them. When I read the fine print, the Vongole were packed in WA, but they were actually Vietnamese. Mislabelling is a real problem for the whole industry."

Fluctuating fortunes

While developing the new cockle fishery, John Craike is also assisting with efforts to revive Roe's Abalone stocks. Small abalone from populations south of Kalbarri have been relocated north, with John Craike and other divers hand planting them onto the reefs at six different sites. The research that underpins this process is being led by Anthony Hart at the Department of Fisheries WA and will also involve introducing spat produced by a hatchery at Bremer Bay into the abalone fishery.

John Craike says while it may be possible to re-establish the abalone, he doubts the biomass will ever return to previous production levels.

The fishery had an annual quota of 36 tonnes, although the industry voluntarily agreed to reduce this to 12 tonnes a year for three years from 2008 because of concerns about sustainability of stocks. "A month before that [2011] hot water event, we had successfully improved the stocks and we were asking to have the quota lifted again. And then we lost the lot."

Roe's Abalone is just one of several species with fluctuating fortunes he has witnessed during his 38 years as a fisher, some as a result of declining stocks or changes to government regulations. John Craike began as a commercial crayfisher in Victoria, before moving to shark fishing and then – 20 years ago – to abalone. Of his latest change, he says it is significantly safer than abalone diving: "You don't have worry about white pointers biting you in half, just the odd rouge sea snake." **F**

By Catherine Norwood

FRDC Research Code: 2008/339

More information: Jesse Leland, jesse.leland@scu.edu.au

Age barrier breakthrough

Crustaceans grow by moulting their exoskeletons, which has made it difficult to tell how old they are using traditional ageing techniques. From a fisheries management perspective, a lack of age information also makes it difficult to assess how changing environmental factors may affect growth.

However, researcher Jesse Leland has published details of an innovative ageing technique that uses cross-sectional analysis of gastric ossicles (stomach bones) and other calcified structures. He recently won the FRDC-sponsored 2013 Science and Innovation Awards for Young People in Agriculture, Fisheries and Forestry.

He says the FRDC award will allow him to continue researching invertebrate ageing as his primary area of interest.

“Hopefully, it will be a stepping stone towards other larger projects that will keep Australia at the forefront of crustacean ageing research worldwide, while facilitating continuing sustainable management of our fisheries.

“The idea actually came from my colleague who was fascinated by the usefulness of gastric ossicles in taxonomy,” Jesse Leland explains. “We were pleasantly surprised, when I sectioned some, to find that they contained growth marks. Now the fact that gastric growth records can be retained through moulting has been validated in the scientific literature.”

He says that until recently it was assumed that growth by moulting excluded the possibility of a permanent growth record; only indirect, and somewhat imprecise, methods for age estimation were available.

“Knowledge of age, growth rates and life span is critical for understanding important events in a species’ life history, such as reproductive maturity, entry into the fishery and natural mortality.”

Based at Southern Cross University’s Lismore campus and the National Marine Science Centre at Coffs Harbour, Jesse Leland will use his \$16,000 award from the FRDC to apply his ageing methodology to two



PHOTO: STEVE KEOUGH PHOTOGRAPHY

Jesse Leland (left) and FRDC chair Harry Woods at the Science and Innovation Awards ceremony in Canberra.

commercially and recreationally important Australian crustaceans, beginning with Redclaw crayfish (*Cherax quadricarinatus*) and Mud Crab (*Scylla serrata*).

“I chose Redclaw as an ideal model species for developing ageing protocols, which can then be applied to Mud Crab. But this is just the beginning. In the future, I hope to age many other Australian crustaceans, starting with the most economically important and potentially long-lived species.”

Jesse Leland expects the protocols will also be extended internationally, especially to long-lived and deep-water species for which even indirect ageing methods are impractical.

“The knowledge obtained from this research will facilitate sustainable management of Australia’s crustacean fisheries, which is of utmost importance to the entire industry.

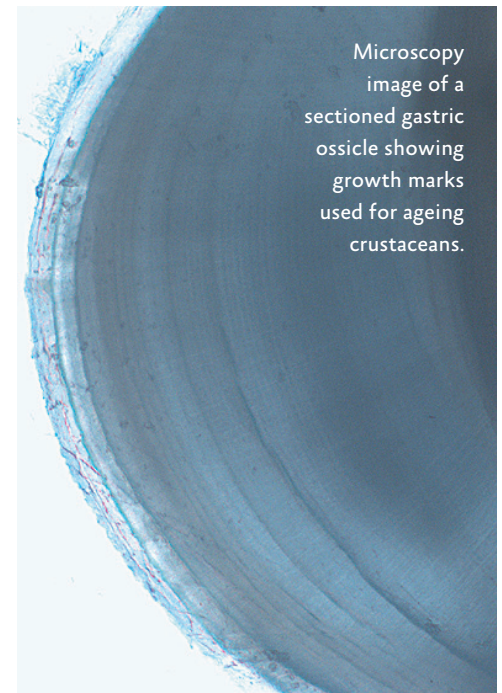
“One major uncertainty currently facing fisheries managers is how changing environmental conditions may affect crustacean growth rates. But as a prerequisite to this, we must first accurately understand current – ‘normal’ – growth rates. In the future, validated age and growth models will be a valuable tool for monitoring changes among crustacean stocks.”

Jesse Leland is completing his PhD thesis on the physiology, injury and survival of discarded crustaceans in NSW, and preparing scientific publications on determining the age of Australian beachworms. Soon, his research will focus solely on crustacean ageing, and he says he is excited about the prospects for his chosen field, crustacean biology. **F**



PHOTO: JESSE LE LAND

A gastric mill. Recent studies have used them to solve the long-existing problem of crustacean age determination.



Microscopy image of a sectioned gastric ossicle showing growth marks used for ageing crustaceans.



PHOTO: AUSTIN MAY

Freediver surfacing with hand-collected Eastern Rocklobster off the coast of Coffs Harbour, NSW. Young NSW researcher Jesse Leland (on board the vessel) has turned his attention inwards to solve the problem of determining a crustacean’s age.

PERFECT SEAFOOD SECRETS REVEALED

A new FRDC website aims to provide the answers seafood consumers have been craving for more than a decade, namely how to choose, buy, handle and prepare seafood

“Mention seafood to most Australians and it conjures up a kaleidoscope of wonderful images and memories. Seafood is not only visually exciting and exotic; it tastes wonderful and is healthy and versatile. Best of all, as Australians we are blessed with oceans, rivers, lakes and other waterways that provide abundant supply and dazzling variety for all to enjoy. But despite this wonderful reputation, seafood is generally not well understood in this country by the public at large.”

GEOFF JANSZ, AUSTRALIAN SEAFOOD USERS MANUAL, 2000

The digital age is offering new opportunities to share the wealth of knowledge about the best ways to handle, prepare and serve seafood to create a memorable eating experience.

Video interviews with chefs, links to the latest science and fish stocks information, recipes, and how-to guides on storage, selection and preparation are all part of the FRDC’s online Fishfiles mix, launched in May.

The FRDC’s investment in research, development and extension (RD&E) during the past 20 years has included several projects focused on improving consumer understanding of seafood and providing wholesalers and retailers with advice to share with customers. The most notable of these projects is the *Australian Seafood Users Manual*, conceived to address the concerns raised by consumers – both professional chefs and home cooks.

Originally published in 2000, its guidelines provide the foundation for Fishfiles. Other existing documents being integrated into the mix include the Seafood Quality Index, developed by Sydney Fish Market, and the *Seafood of Eyre Peninsula* developed by Regional Development Australia Whyalla and Eyre Peninsula Inc. with the local Eyre Peninsula fishing industry.

A consumer web project

The Fishfiles website and information portal has been driven by the recognition that many Australian seafood consumers are not comfortable with and do not understand seafood. This is despite market research showing that more than 90 per cent of Australians consume seafood at some point each year.

The research shows consumption can vary from several times a week, for a seafood fan, to those who only buy seafood for a special occasion. This has provided the FRDC with a very clear idea of what was needed for the development of Fishfiles.

Fishfiles has three primary web platforms:

- the Fishfiles website, which provides factually based research information;
- the Fishfiles Facebook page, which will act as the conduit to information and start a dialogue with consumers; and
- the Fishfiles YouTube channel, which will host new and creative video content that gives a fuller, personal insight into seafood.

Website – www.fishfiles.com.au

A major component of the information provided on the website is based on the *Australian Seafood Users Manual*. It provides a logical and easy-to-use format that explains handling and preparing seafood. In addition to the manual, recipes, videos and research on storage, quality, cooking and safety have been added.

The ultimate goal is to have a content mix that educates and is engaging, fun and quirky. Content will be roughly divided into one-third better handling, storage and cooking, one-third on the science of sustainability, and one-third from partner organisations (Sydney Fish Market, the Australian Seafood Cooperative Research Centre, universities, chefs and fishers).

Fishfiles Facebook page
– www.facebook.com/fishfiles

The Fishfiles Facebook page is designed to be the link between the FRDC’s three websites (www.frdc.com.au, www.fish.gov.au and www.fishfiles.com.au), as well as linking to the FRDC’s partners and the broader community. The Fishfiles Facebook page will also broaden the reach of the FRDC to the community and provide a way to share the information that underpins the fishing industry.

Facebook provides the FRDC with a way to start a dialogue with the community, responding to questions about the information being put forward.

Fishfiles YouTube channel

Video is an important component of the Fishfiles website. It will be integrated into the website, but hosted on its own Fishfiles YouTube channel.

The video content will provide behind-the-scenes insight into what fishers, retailers, scientists and chefs think and know about seafood. The stakeholders taking part are experts in their chosen fields and will provide the viewer with confidence in the message being delivered.

Ultimately, the website will help consumers to get more from the seafood they buy through improved handling,

reduced waste and a better end product: a tasty seafood meal.

Each segment will be compiled into one of three formats designed to give information in a different way – ‘All Access’, ‘60 Seconds With ...’ and ‘How To?’. They will be filmed in a style that gives the viewer confidence that the FRDC’s Fishfiles is a legitimate and reliable source of information.

Fishfiles was officially launched and showcased at the Noosa International Food and Wine Festival, which ran from 16 to 19 May. **F**





ACCESSING ALL AREAS

Mussels, clams, garlic and ... ? What is the secret ingredient used to turn these items into the most delicious pasta sauce? Find out in the new Fishfiles 'All Access' videos.

The new videos take the viewer behind the scenes, hearing from some of Australia's most celebrated chefs and seafood producers and allowing them to share their personal perspectives on seafood.

FRDC's digital media manager Rachelle Etienne-Breidenbach says some of Australia's leading chefs have already been interviewed for the 'All Access' videos. "Our goal now is to produce more stories from a broad range of chefs and fishers."

She says their stories and insight will inspire people to use more seafood and prepare it like a professional chef. Or perhaps, just like mum does; several chefs have let slip that they still get cooking lessons from their mothers.

Head chef at Casa Barilla in Sydney Luca Ciano says: "Fall in love with the product. Buy it whole, learn to fillet it and use the rest of it for stock. It sounds hard, but really it is not."

He shares his top seafood choices, which include seafood many Australians may not know well, such as eel. A traditional ingredient in northern Italy, where he was born and raised, in Australia it is often used only in sushi dishes. "You can do so much more with it," Luca Ciano says. Versatility is one of the features he prizes in seafood, also recommending prawns and snapper for the same reason.

Mark Jensen from Red Lantern, also in Sydney, loves the humble Ocean Jacket, and shares his first seafood memories of fishing with his dad. Mark believes the variety of seafood on the market today is making chefs and consumers more adventurous.

"Twenty years ago customers just wanted a plain white fillet. The rise in popularity of many cuisines – Asian, Mexican and Mediterranean to name a few – has seen chefs looking for the new or unknown. Restaurants are serving molluscs, crustaceans and many different species of fish, and people are appreciating them more," Mark Jensen says.

Rachelle Etienne-Breidenbach says the chefs and fishers provide the inspiration and the Fishfiles website provides tips and easy-to-follow guides. Although Fishfiles is now live and contains a lot of information, it will never be 'finished'. The FRDC wants feedback from users so that it can continue to source content that meets consumers' needs.

Much of this content will come from industry partners, Rachelle Etienne-Breidenbach says. "Technology and social media allows us to connect with

others like never before. There are many seafood companies and producers out there that we would like to work with. For example, the Sydney Fish Market is an Australian seafood icon. If someone has a question and they have the answer, Fishfiles will point the way."

Similarly, if people are after information on the status of a fish stock, Fishfiles will point them to www.fish.gov.au, she says, which provides information on the government stock status reviews for 49 key Australian culinary seafood species.

Pete Evans from the TV series *My Kitchen Rules* has similar advice for consumers: "If you are at the supermarket and don't know which fish to buy ... just pick one and check the internet, or visit www.fishfiles.com.au, for suggestions on how to prepare it."

While the FRDC has a statutory obligation to ensure knowledge generated from the work it funds is publicly available, Rachelle Etienne-Breidenbach says Fishfiles aims to do this in the most easily accessed and targeted way for seafood consumers.





PHOTO: CHEVNE JONES

Something sounds fishy

Australia is home to a species of animal whose mating call is almost as loud as a rock concert. While a blue whale or other large mammal may come to mind, the call actually comes from the humble Mulloway.

FRDC-funded research has found that Mulloway produce three different call types when spawning, with some calls exceeding 172 decibels in underwater sound units when recorded from one metre away. By comparison, a loud rock concert roughly compared to underwater levels reaches about 177 decibels. Mulloway calls can be detected from more than 110 to 400 metres away using correct equipment, and their calls can actually prove painful to divers in close proximity.

There are more than 700 fish species worldwide that make sounds as part of intricate social and reproductive behaviour. These including several recreationally important species such as Samsonfish, trevally, Dhufish, some tuna species, Spanish Mackerel, and species belonging to the family of fish we call cod, which includes Queensland Groper and Coral Trout. The Goliath Grouper, for example, advertises its presence with such power that they can be heard up to 2000 metres away.

Fish species have developed the ability to produce sounds in a variety of ways, including drumming their swim bladder with specialised muscles or bones, as well as hydrodynamic tail slaps, fin flicks, fin spine extensions and jumps.

Recreational fishers have known for years of the noise-making ability of many species they catch. Some fish have earned common names like grunters, croakers, blurters and yakkas as a result. The ability of fish to hear has also helped to shape our fishing practices and anglers have been tiptoeing along the riverbank ever since.

So why do fish species use the ability to make and hear sounds? Finding a mate appears to be the primary reason. In some species, huge groups of males form and they call together to attract females to their large aggregation.

This underwater acoustic communications opens new avenues for research. Overseas researchers have developed innovative techniques to monitor the size of the spawning stock of species such as Coral Trout and jewfish using passive acoustic recording. Other researchers in Australia have explored 'calling' pest species such as Tilapia into traps to control their populations.

Several important species for recreational fishers including trevally are known to use sounds to communicate.

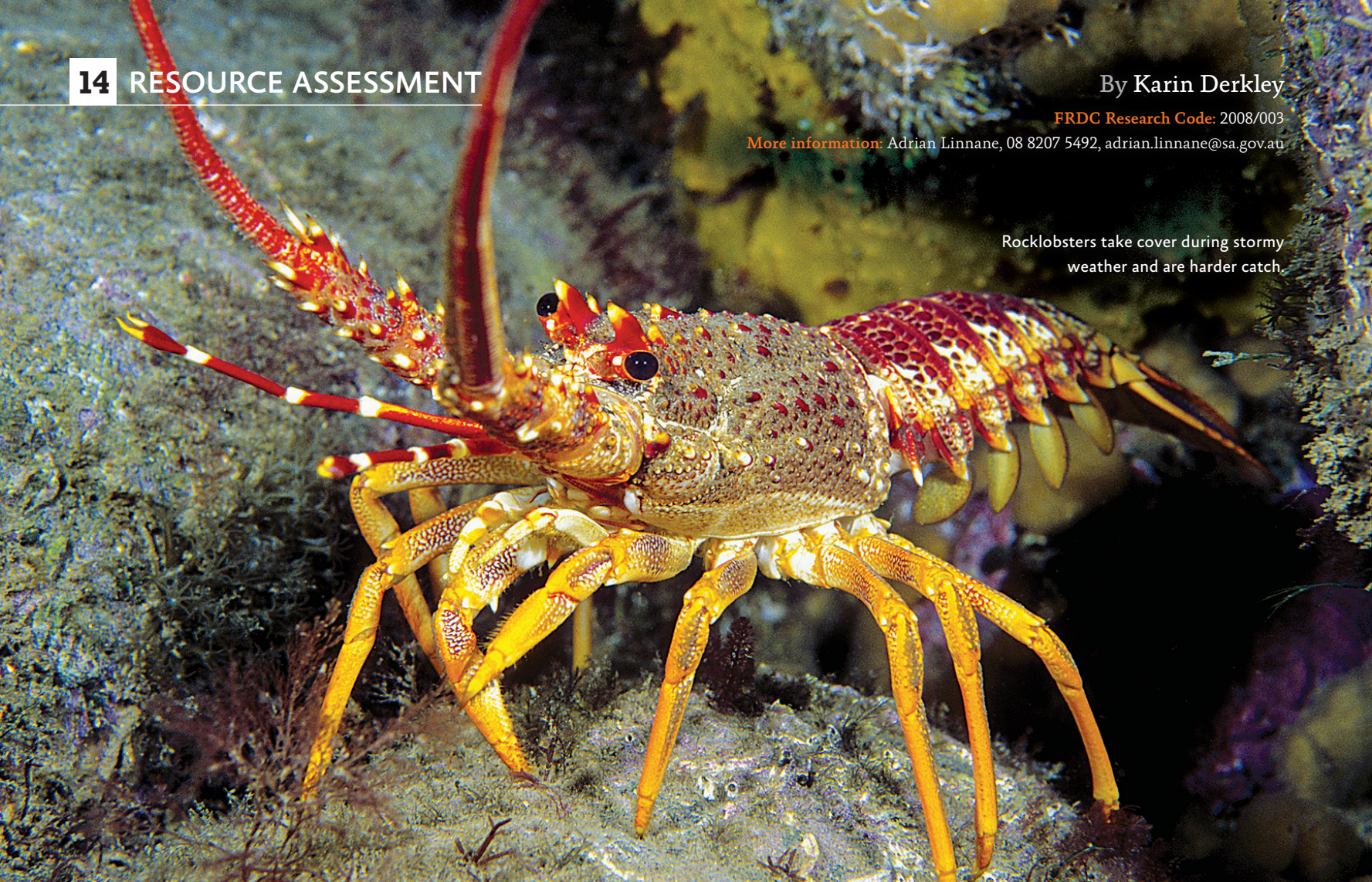
The fact that many of our fish species both make and respond to sounds raises questions about the impact of human-generated sound. In the US, the sound of a faulty gearbox on a vessel in the albacore fishery was inexplicably associated with increased catch rates. International research has suggested that sounds of large ferries, and even outboard motors, may affect fish, increasing their heart rate or even disrupting cohesion of schooling. There is a need to better understand the potential effects of sound on fish stocks, particularly in areas of intense shipping activity, or perhaps seismic exploration/drilling activity.

Research has also shown that larvae of corals, crabs and fish (at least) are attracted to the sounds made by reef complexes, and may use these sounds to navigate towards their eventual home. It is possible that increases in background noise levels may make it harder for them use their 'sonic compass'. Researchers have highlighted concerns that increasing noise levels may mask the communication of adults (basically drowning out the conversation), perhaps making it more difficult for them to find a mate.

Recreational fishers intuitively recognise the need for a stealthy approach to maximise catch rates, and the rapid adoption of the use of electric motors, drift fishing in open waters, use of poling platforms on the flats, and proliferation of kayaks in recent years demonstrate various approaches adopted in the search for increased strike rates.

While reduced sound during fishing activities may reduce negative effects on fish behaviour and help maintain catch rates, it may be valuable to gain a better understanding of the impact of noise pollution on key recreationally important fish species. Some Australian states have no regulations relating to underwater noise in fishery management plans and do not recognise noise as pollution. Establishment of long-term baseline monitoring programs would help to track how noise levels are changing over time as development continues to increase. **F**

Rocklobsters take cover during stormy weather and are harder catch.



PHOTOS: SARDI

Light shed on rocklobster catches

A new range of environmental factors is to be added to the calculations used to set the commercial annual catch from Australia's Southern Rocklobster fishery

New research has verified the anecdotal evidence from rocklobster fishers in South Australia, Tasmania and Victoria: the best catches are made in the calm after a storm, and in the lead-up to a full moon. But strong waves or warm water could leave their pots empty.

The findings are part of a tri-state research project, led by Adrian Linnane from the South Australian Research and Development Institute (SARDI), into the environmental factors affecting rocklobster catch rates. The FRDC-funded project analysed more than a decade of wave height, moon phase, water temperature and catch data.

The Southern Rocklobster (*Jasus edwardsii*) fishery is one of Australia's most valuable. In 2010-11 the Victorian catch was valued at \$15.3 million, \$59.5 million in Tasmania and \$81.3 million in SA. The commercial catch totalled more than 3000 tonnes.

The fishery is managed through total allowable commercial catch (TACC) systems in each state, which are revised annually to ensure sustainable harvesting of stocks. The

TACCs are largely influenced by the annual catch rate of both legal and undersized rocklobsters. For most of the 2000s the catch rates were in decline, with TACCs accordingly revised down. The fishery modelling on which the TACCs are calculated is among the most sophisticated in the world and is becoming more sophisticated every year as more and more variables are brought to bear on the calculations.

While there is evidence to suggest that rocklobster recruitment into the fishery generally declined during the 2000s, resulting in lower catch rates, the aim of this project was to evaluate the influence of other environmental factors on the ease of catching rocklobsters and whether it was important to incorporate these factors into TACC calculations.

“In particular, we needed to know if catch rates were being affected by factors other than rocklobster abundance,” says Adrian Linnane, subprogram leader, offshore crustaceans, at SARDI.

To determine whether, and to what extent, environmental factors might influence catch rates, SARDI correlated a time series of historical daily catch rates with a range of environmental conditions between October 1998 and May 2009.

Data for the study came from various sources. Daily catch rates were estimated from the logbooks of commercial fishers, while environmental data came from a range of sources. Sea surface height and wind data were provided by the Australian Bureau of Meteorology. Moon phase was sourced from the US Naval Observatory website, and daily average bottom water temperatures were compiled from loggers maintained by SARDI Aquatic Sciences. The wave dataset was obtained from WAVEWATCH III, a wind-wave model run by the US National Weather Service.

The strongest impact on the catch rate was from wave action, especially during a storm. The study found that when wave height was 25 per cent above the median height, the catch rate that day fell by an average of 10 per cent. However, three days after a storm, the catch rate would increase by about five per cent.

“Fishers routinely provide information on the impacts of wave action on catch

rates, so it was interesting to see that in the scientific evidence,” Adrian Linnane says. “One theory is that during a storm rocklobsters dig in and don’t feed. But after the storm, there’s more food exposed on the disturbed seabed, bringing the lobsters out again to feed.” He says this theory is supported by the observation that the effect was stronger in shallower waters where it could be assumed that the impact of wave action would be greater.

Moon phase was another factor that had an obvious impact on rocklobster catch rates. Again there was a lot of anecdotal evidence from fishers that their catch rates changed according to the phase of the moon, with more rocklobsters being caught just before the full moon and fewer as the moon went into its waning phase.

This industry knowledge was again confirmed by the data, which showed that there was an average increase of 10 per cent in catch rates in the three days before the full moon and an average fall of five per cent after the full moon. “One explanation for this impact is that the stronger tides in the lead-up to the full moon expose more food sources,” Adrian Linnane says.

Water temperature

One of the main environmental events that initially triggered the project was a strong upwelling of cold water within the Southern Zone Rocklobster Fishery in February 2008. The assumption was that this surge of cold water from the Antarctic onto the shelf – which resulted in the sea temperature dropping substantially to 9°C to 10°C – caused the rocklobsters to become less active, lowering catch rates.

But Adrian Linnane says there was little evidence to suggest that lower water temperatures had affected catch rates. “It turns out that rocklobsters can handle cold water perfectly well.” However, during warmer periods when water temperatures reached 18°C to 19°C, catch rates decreased notably, indicating that rocklobsters start to become inactive and therefore feed less at these temperatures. “The current fishing season [2012-13] saw bottom temperatures up around the 18°C to 19°C mark, so there’s a big question over what impact this might have on the ability to catch rocklobsters this season.”

While these environmental factors did have a measurable impact on the day-to-day catch rates, it seems they cannot account for the fall in catch rates seen during the 2000s. The study found that their impact had less effect when smoothed out over monthly catch rates and negligible impact over the annual catch rate.

Environmental factors were estimated to account for only seven per cent of the change in catch rates, while abundance rates accounted for 84 per cent of the change.

Senior fisheries scientist at Fisheries Victoria Terry Walker has also been involved in the research and says environmental conditions do play a part in determining the number of rocklobsters caught, and as such will be added to the factors used to calculate the TACCs. However, he says it is unlikely that their impact would significantly alter the TACCs.

“As a result of this project our stock assessments from here on will be much more scientifically defensible, and the bounds of uncertainty as we project forward to estimate stock recovery will be much narrower than before. That should give the industry and the fishery managers a lot of confidence in our TACC setting process, which should be a big plus for the industry,” Terry Walker says. **F**



South Australian researcher Adrian Linnane has been investigating the environmental factors that make rocklobsters more or less catchable.

UNITED, FOR THE LOVE OF PRAWNS

In the face of competition from imports, the Australian prawn industry – both fishers and farmers – is coming together to support a national marketing campaign

PHOTO: ISTOCKPHOTO.COM

In the not-too-distant past, Australian prawn fishers and farmers were seen as fierce competitors; there was a perception that the “bloody prawn farms” would take over the wild-catch market. But the reality today, and for quite a while now, is that imported prawns have held the biggest portion of the market. Australia imports more than 40,000 tonnes a year – almost twice the volume of Australia’s wild catch and farmed production combined.

Past attempts to promote prawns have been successful for the duration of specific campaigns, such as ‘Queensland Prawns’, which was the first attempt to bring prawn fishers and farmers together for marketing. The Australian Prawn Farmers Association (APFA) and Queensland Seafood Marketing Association each contributed \$60,000 for a two-year campaign.

The Queensland Prawns website (www.queenslandprawns.com) is still active. It has

8570 Facebook ‘likes’ and captures current news stories about prawns. The idea of this campaign was to celebrate Queensland Day by eating Queensland prawns. It was a great idea but lacked a long-term strategy, did not have industry buy-in and there was no funding to keep it going.

The FRDC is aware of the issues relating to marketing for seafood and has been exploring ways to assist industry. This has included assisting with funding for the research and development component of the prawn campaign, and investing significantly in the Australian Seafood Cooperative Research Centre (Seafood CRC). However, the Productivity Commission inquiry in early 2011 and subsequent release of the Government Research and Development Policy Statement in July 2012 indicated that the government would look to make changes to the *Primary Industries and Energy*

Research and Development (PIERD) Act that would allow research and development corporations (RDCs) to undertake marketing and promotion activities. Foreshadowing these changes, the FRDC will put in place the necessary processes and resources to carry out the marketing and promotion activities as required.

In April 2011, the Seafood CRC’s managing director Len Stephens and product innovation program manager Graham Mair put forward the challenge to establish a national program: “The consumer thinks a prawn is a prawn is a prawn ... why can’t we have a national prawn strategy?”

With the support of the Australian Council of Prawn Fisheries (ACPF), the APFA members also agreed that something needed to be done. The exchange rate was hurting the industry and competition among and between each prawn fisher and farmer

was fierce. However, lowering costs to get sales only leads to a downward spiral in commodity pricing.

For the first time, there was a general national willingness from the wild-catch prawn fishers to work with national prawn farmers. However, not all industry members are convinced. The ACPF and APFA committed to collaborate on a market development strategy to build demand for prawns in the domestic market, which is ultimately expected to improve the price paid for Australian prawns.

Research partners

A Seafood CRC research project was developed to work with prawn suppliers and retailers to identify how to enhance the profitability of the Australian-produced prawn category. A total of \$350,000 was provided from equal portions of R&D money from the ACPF and the APFA.

A competitive tender process was carried out to develop the national prawn strategy, from which Brand Council was chosen. The Brand Council proposition of 'Love Australian Prawns' is simple and goes to the heart of all prawn lovers. The logo has been key to industry agreeing to participate further.

The expected outcomes of the research were:

- a national prawn market development plan that would encourage prawn fishers and farmers to work together to lift consumer demand for Australian prawns;
- encouragement by industry leaders of the establishment of a marketing levy, underpinned and supported by the existence of this plan; and
- a plan to be used by project participants to build consumer awareness of the complete range of prawn products (frozen and fresh), so that individual companies could build their brand as well as support the whole category.

The success of the strategy development process has been an open and transparent approach to industry, involving of key industry stakeholders and ensuring it was

an industry-led approach. Advancement during each stage has only come about because industry has endorsed what has been developed.

A tangible strategy led to the development and support of the next stage in which fishers and farmers agreed to commit to paying a voluntary levy; industry could see the benefits. A voluntary levy was agreed to while steps are put in place for when changes to the *PIERD Act* enable the FRDC to collect funds for marketing and allow the collection of compulsory statutory levies from industry.

In October and November 2012, there was a series of presentations at meetings of fishers and farmers by consultant Ewan Colquhoun and Seafood CRC representatives Janet Howieson and Karen Hollamby.

Meetings were held in Brisbane, Cardwell, Hervey Bay, Sunshine Coast and Townsville in Queensland, Spencer Gulf in South Australia, Perth in Western Australia, and Coffs Harbour, Maclean and Sydney in New South Wales. In addition, there were special presentations to Northern Prawn Fishery members, individual corporate entities and association board meetings. Presenters have also been on hand at industry meetings for marketing and levy raising.

Each presentation to industry highlighted the issues of product substitution and retailer engagement as critical to the success of the strategy. A further two research projects have been developed, submitted and approved to address these key issues.

The need for investment in the strategy become clear in the light of industry figures as follows.

The ACPF

- six main species;
- 1780 licences;
- 15 fisheries;
- 529 vessels; and
- 20,533 tonnes a year (based on a three-year average) for a \$236 million gross value of production.

Australian Prawn Farms

- two main species;
- 91 licences;
- 25 active farms;
- 840 hectares of pond area farmed; and
- 4200 tonnes a year, (based on a three-year average) for a \$60 million gross value of production.

Imported prawns

- 46,000 tonnes a year, valued at \$427 million – increasing by 10 per cent per annum.

To date, 16 meetings have been held across Australia to present the strategy to more than 140 Australian prawn industry stakeholders. There has been overwhelming support for implementation of the strategy as developed by Brand Council. Consequently, the boards of the ACPF and the APFA have agreed to cooperate on the implementation of the national strategy and have signed a memorandum of understanding with the Seafood CRC. One of the first actions has been to trademark the 'Love Australian Prawns' logo.

Ewan Colquhoun, from the agribusiness consultancy Ridge Partners, has done a tremendous job of identifying the licence operators among both fishers and farmers across Australia who will be contributing to the voluntary levy. The Seafood CRC will collect the levy, with a minimum of \$500,000 needed to implement a one-year strategy. The official launch for the national prawn strategy is scheduled for September 2013 at Sydney Fish Market.

The success of the project so far has been based on communication, talking to the right people and getting the right people involved through the Seafood CRC, the FRDC, Brand Council and industry. Almost two years down the track there is still a lot of work to be done. While commitments have been made to pay a voluntary levy to start the strategy, the payment of invoices will be the real test of the industry's support for the strategy. **F**

* Helen Jenkins is executive officer of the Australian Prawn Farmers Association.

Evidence from the DEEP

A diver installs a prototype puerulus collector.

Technological and design innovations are providing new information about the early stages of the Southern Rocklobster life cycle

The settlement of Southern Rocklobster's final larval form – puerulus – has proven an important indicator of future catch trends in the Tasmanian rocklobster fishery. However, rough seas and deep water off much of the state's coastline have made it difficult to monitor settlement in many areas.

A collaboration of University of Tasmania scientists at the Institute for Marine and Antarctic Studies (IMAS) and fishers has successfully trialled a new

approach to puerulus monitoring, which is providing the first direct evidence worldwide of puerulus settlement at depths of more than 100 metres.

Southern Rocklobster larvae spend 12 to 24 months in the open ocean after hatching before they metamorphose into their final puerulus stage and return inshore to settle onto reef habitats where they moult into juvenile rocklobsters.

IMAS has been monitoring puerulus settlement in shallow inshore waters off

the east coast of Tasmania for more than 20 years. However, there are concerns that puerulus settlement observed in this area may not represent the entire fishery; sampling sites are few and most Tasmanian commercial rocklobster catch comes from remote deeper-water regions off Tasmania's west and south coasts.

The east coast monitoring uses artificial habitat samplers (puerulus collectors) placed on the sea floor. These mimic the natural reef habitats where puerulus settle. Divers retrieve the samplers to monitor the number of settled puerulus, and this has provided valuable early indications of trends in future catches in the east coast commercial fishery. Low puerulus settlement observed from 2003 to 2008 was reflected in a downturn in catches in this region in recent times.

Previous attempts to deploy puerulus collectors in shallow water off the Tasmanian west and south coasts have been unsuccessful due to the harsh sea conditions.

In January 2012, IMAS received funding from the FRDC for the first phase of a research project to determine the feasibility of collecting puerulus in the deep,

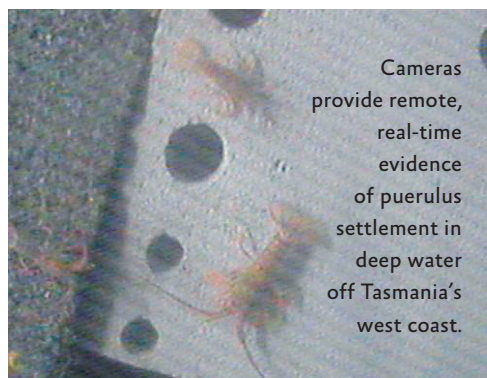
exposed waters off the Tasmanian west and southern coasts.

The project, titled ‘Developing cost-effective industry-based techniques for monitoring puerulus settlement in all conditions: trials in southern and western Tasmania’, has developed prototype puerulus collectors specifically for use in remote, deep and exposed waters typical of the south and west coasts of Tasmania. These can be easily deployed and serviced by vessels from the commercial fleet, which regularly fishes this coast.

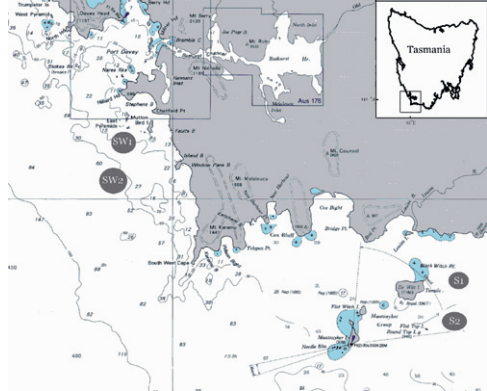
IMAS scientist Stewart Frusher, the principal investigator on this project, says recruitment to the fishery is important information for both fishers and managers. “This project will enable the fishing community to become actively involved in monitoring their future,” he says.

Prototype testing

The key to the deep-water collector design was ensuring that puerulus are attracted by the artificial habitat used, and that they are retained in the collector when retrieved.



PHOTOS: IMAS



The new monitoring devices have been deployed at four sites off Tasmania's south and south-west coast.

A range of artificial habitats was trialled in prototype deep-water collectors, which were placed adjacent to a routine east-coast shallow-water monitoring site. Of the artificial habitats trialled, booth crevice and fibreglass-reinforced-plastic habitat substrates consistently collected more puerulus than the existing collectors.

A workshop, attended by scientists, technicians and rocklobster fishers, was held to ensure that the new collector design could be safely and easily deployed, retrieved and serviced from the deck of a typical Tasmanian commercial rocklobster fishing vessel.

The prototype deep-water collector has a steel-framed substrate housing clad with three-millimetre perforated steel mesh on the downstream sides of the collector. This helps to retain puerulus flushed from the substrate during retrieval. The substrate is suspended on the underside of the lid of the housing, making it easy to remove the puerulus on deck, and the housing is nested in the top of a standard steel rocklobster trap.

Following successful inshore trials, 24 prototype collectors were constructed, galvanised and deployed in eight strings, each with three collectors, on the south and south-west coasts of Tasmania in September 2012 into depths up to 107 metres.

So far, the prototype collectors have been retrieved, serviced and re-deployed twice by vessels from the Tasmanian commercial rocklobster fleet after soak times of about six to eight weeks.

Southern Rocklobster puerulus have been encountered in prototype collectors retrieved from depths ranging from 57 to 102 metres. This is the first direct evidence globally of puerulus settling in deeper water.

The skippers and crew of the commercial fishing vessels that serviced the collector strings reported that the prototypes were easy and safe to handle on deck and, despite adverse sea conditions, the collector strings had not moved between retrievals.

Executive officer of the Tasmanian Rock Lobster Fisherman's Association Rodney Treløggen says the industry's fishers are experienced at operating in extreme weather conditions – some of the roughest in Australia. Their knowledge and skills have proved an essential part of efforts to

develop, deploy and service deep-water collectors in southern and western Tasmania.

Real-time vision

As part of this project, IMAS and CSIRO have developed a prototype remote underwater camera system that can capture images of puerulus on collectors on the sea floor at predetermined intervals. These images can be viewed remotely and in real time.

Images captured are transmitted via the 4G mobile telephone network to an online server and can be viewed on any computer with internet access. The system comprises cameras and lights attached to the puerulus collector on the sea floor. It is connected to a surface buoy, which houses a battery, solar charging system, single-board computer, wireless modem, analogue camera server, analogue-to-digital converter and relays.

The computer can also be accessed remotely to adjust capture intervals, spontaneously capture images and update or troubleshoot software.

In field tests, the camera system delivered discernable images of Southern Rocklobster puerulus on collector substrates, and the power system supported hourly capture and transmission of images. Most of the camera components are inexpensive and readily available, providing a cost-effective means of monitoring puerulus settlement and post-settlement behaviour.

With the success of the first, proof-of-concept phase of this project, a second stage is proposed using the deep-water collectors to investigate puerulus settlement patterns by depth at various locations around the Tasmanian coast. It is also planned to assess the efficacy of existing puerulus monitoring programs by using the camera system to observe puerulus behaviour between collector retrievals.

Stewart Frusher says collaborative projects such as this provide a great opportunity to use the skills, knowledge and experience of the fishing industry and demonstrate its commitment to a sustainable future.

“This project aims to provide industry and government with an increased ability to forecast fluctuations in future rocklobster catches, allowing management to improve the economic and biological sustainability of the Tasmanian fishery,” he says. **F**

POMS STRIKES ANOTHER AUSTRALIAN ESTUARY

The devastation wreaked by Pacific Oyster Mortality Syndrome in the Hawkesbury River in January 2013 is a warning for oyster growers in other parts of Australia

For oyster growers on the Hawkesbury River, in New South Wales, the outbreak of Pacific Oyster Mortality Syndrome (POMS) was every bit as vicious – and heartbreaking – as intimated by outbreaks in Europe and New Zealand, which halved the production of Pacific Oysters (*Crassostrea gigas*).

Bruce Alford, co-president of Broken Bay Oysters, was one of the Hawkesbury growers affected by the recent POMS outbreak, which began in Mullet Creek, a tributary of the river and major nursery area for most of the businesses. “It wiped out [our Pacific Oysters] in about 36 hours, probably about 10 million oysters over a three-kilometre radius,” he says.

“We watched them die. It was that violent that you could virtually sit there and watch [the oysters] open.”

Like most of his peers, he was only partially surprised by the mortality event in the Hawkesbury’s Mullet Creek.

POMS (which poses no risk to human health) arrived in the nearby Georges River in 2010. Since then, Bruce Alford and other growers have worked with University of Sydney researchers to develop mitigation strategies against the disease. “We were expecting it, but we were still hoping that we would get another couple of years.”

The economic loss from the Pacific Oyster mortalities for the Hawkesbury growers is estimated to be more than \$3 million. This was compounded in February when widespread rainfall in the catchment and release of water from Warragamba Dam resulted in the estuary being closed, and oyster harvesting was suspended until potential pollutants in the stormwater runoff had cleared.

Richard Whittington, a professor of Veterinary Science at the University of Sydney, describes POMS as the worst transmissible disease he has seen during his 30

years in the aquaculture and livestock sectors.

He and fellow researchers in the university’s Aquatic Animal Health team – Ika Paul-Pont, Navneet Dhand, Olivia Evans and Alison Tweedie – have worked even more intensively than usual on the Hawkesbury River since January to better understand the transmission of the disease. Their efforts are supported by funding from the FRDC, the University of Sydney, the Sydney Metropolitan Catchment Management Authority and, more recently, the Australian Seafood Cooperative Research Centre (CRC) and Tasmanian Oyster Research Council.

While it is still unknown how POMS arrived in Australia, or how it moves from estuary to estuary, the research team’s experiments are shedding new light on the disease, which they expect will spread nationally. In particular, they have found that the presence of the causative *Ostreid herpesvirus* does not necessarily lead to an immediate outbreak of the disease (see page 21).

Richard Whittington advocates various strategies of preparation for oyster growers across NSW, South Australia and Tasmania, who are as yet unaffected by the disease. These measures include diversifying the business to more than just a single species of oyster and investing in flexible infrastructure for leases.

POMS research in the Georges River has found that mortalities of adult oysters were halved if – before the disease struck – the trays were raised by 30 centimetres (so that oysters were submerged for less time as tides moved in and out). Unfortunately for the Hawkesbury farmers in January, those who had invested in flexible cultivation systems were also those first hit by POMS in Mullet Creek, and there was insufficient warning to lift the oysters.

Being prepared also means making basic risk assessments, Richard Whittington says.



“Planning for POMS must begin long before the disease arrives and needs to include things such as an assessment of the business model of the individual oyster business.

“What will be the impact of a sudden and complete cessation of cash flow? What are you going to do if, in a week’s time, you can’t sell oysters? Obviously people need to also look at debt levels.”

Ian Lyall, manager of aquaculture at the NSW Department of Primary Industries (DPI), agrees that species diversification is imperative, combined with culturing of disease-resistant oyster stock. “This outbreak is going to lead to the most dramatic change the industry has seen in NSW in terms of risk management and business preparedness.”

At the NSW DPI’s Elizabeth Macarthur Agricultural Institute, an FRDC-funded project is also underway for developing an infection model of POMS so that it can be used to test the resistance of various Pacific Oyster families. Another project, funded through the Australian Seafood CRC, with input from CSIRO, the NSW DPI and Australian Seafood Industries (an industry-owned company with a selective-breeding focus), is aiming to develop a POMS-resistant Pacific Oyster.



PHOTO: RICHARD WHITTINGTON

University of Sydney PhD student Olivia Evans collects a water sample in the weeks after the POMS outbreak.

CLUES TO A CONTAGION

While Pacific Oyster Mortality Syndrome (POMS) first arose as a threat to aquaculture in Australia in 2010, little is known about its transmission here or overseas. The University of Sydney Aquatic Animal Health team, which has worked closely with the Hawkesbury growers since 2011, was well positioned to study the POMS outbreak as it unfolded when the disease hit the Hawkesbury in January 2013.

The intention is that any new findings might help the industry to develop an early warning system that would give growers enough notice of imminent infection so that they could take mitigation measures, such as adjusting their infrastructure or accelerating harvest.

The findings of the Aquatic Animal Health team have first and foremost challenged a long-held theory that POMS is caused by oyster-to-oyster transmission. Richard Whittington says that the rapidity of onset and destruction in Mullet Creek in New South Wales, with an area of three kilometres, would not be possible if the virus was jumping from oyster to oyster.

“We’ve discovered that this virus actually arrives in the river quite some time ahead of any signs of disease. Based on testing archived samples we think it was present in the Hawkesbury as early as October 2012 in small quantities. We feel that there must be an environmental trigger for this disease to erupt,” Richard Whittington says.

A clue to what this trigger might be is in the distribution of dead oysters within longline baskets and 24 test trays in the Georges River.

“We are finding that oysters that start to die in the top left-hand corner of a tray, do not necessarily spread the virus either to the tray next door or to the neighbouring segment of the same tray. In fact, the distribution of the deaths is quite scattered and ‘clustered,’” he says.

Similarly, adjacent baskets on a longline will not necessarily experience the full-blown disease, with healthy baskets on some longlines bordered by baskets containing dead oysters.

“This pattern tells us that the virus is not uniformly distributed in the water. It is actually packaged in the water. You can imagine a raft of virus particles being carried along, then encountering part of an oyster lease,” Richard Whittington says.

He and postdoctoral fellow Ika Paul-Pont recently published a hypothesis in the journal *Diseases of Aquatic Organisms* that something in plankton, which oysters filter, is carrying the virus. “The general understanding of plankton is that it travels around a bay in tight packets. They’re not randomly or evenly distributed at all.”

For more research results and a complete diary of the outbreak as it unfolded in January, visit the Oyster Health Sydney website (www.oysterhealthsydney.org).

Growers take stock

The POMS outbreak comes just eight years after QX-disease devastated production of Sydney Rock Oysters in the Hawkesbury River and prompted a switch towards the Pacific Oyster. Now, many of the growers who made that change, such as Bruce Alford, are seeking to diversify from growing only Pacific Oysters by adding QX-resistant Sydney Rock Oysters to their production. But he says that the resistant spat can be difficult to source.

In the face of this new disease, several Hawkesbury growers have already sold up. A few others are relying on other businesses for income or have sought employment elsewhere.

Bruce Alford says most are focusing on the end of the POMS ‘disease window’, which is thought to run from October to April, when waters are warmer. “We’ve been through QX before this, and it always works out that, given a bit of time, different techniques and opportunities arise. The biggest thing for us, and the industry as a whole, is diversifying.”

The disease poses the greatest threat to spat, which are almost always completely wiped out by POMS, as opposed to adult

oysters, about half of which survive with improved husbandry (such as raising racks).

Richard Whittington’s team is now conducting two small experiments focused on improving spat survival, with supplies donated by commercial hatchery Shellfish Culture.

The first experiment focuses on identifying the closure of the window of infection, then putting commercial quantities of spat into the water and observing whether they can be grown out enough during winter to then be placed in a tray of elevated height for summer.

The second experiment looks at whether spat could be maintained on shore in an aquaculture system during summer. “We’re not interested in them growing,

but just keeping them alive until it is safe to put them in the river. This is also vital information for hatcheries,” Richard Whittington says.

Bruce Alford says that he and other growers are also evaluating possibilities for sourcing larger juvenile oysters of 40 millimetres from Tasmania that would require a shorter grow-out period than the current 2.4 millimetre spat that they purchase from hatcheries. To do this would require an amendment to NSW oyster importation protocols following assessment of an import risk analysis.

“If we can grow them through that safe window of May to October, we might be able to get them up to a saleable size, and therefore still have cash flow,” Bruce Alford says. **F**

Nutrition data to boost consumer confidence

To help consumers better understand the health benefits of seafood, some of Australia's most popular species have undergone nutritional evaluation

The release of the most comprehensive study of Australian seafood nutrition to be undertaken in more than a decade will provide the foundation for improved advice to consumers about the health benefits of seafood and help prepare the industry for new market requirements.

The study focuses on the top 20 seafood species Australians consume, including Atlantic Salmon, Barramundi, prawns, oysters and rocklobster.

It has been co-funded by the Australian Seafood Cooperative Research Centre (Seafood CRC) and the FRDC, and was undertaken by David Padula at the South Australian Research and Development Institute (SARDI) based in Adelaide.

Seafood CRC managing director Len Stephens says there were four drivers for the study. "Firstly, consumers are increasingly interested in what's in the food they eat and the previous study was conducted more than 10 years ago. So we wanted to provide updated data using the most accurate methodologies available," he says.

"Secondly, new species such as Yellowtail Kingfish are becoming very popular, so we wanted to ensure we had robust information about them.

"Thirdly, new labelling legislation is coming so we wanted to ensure seafood processors had up-to-date information in readiness. And lastly, our export customers in China tend to be very keen to know the

nutrient content of our seafood exports, so we needed to support that."

Project leader at SARDI Cath McLeod says the research generated a massive amount of important data on wild and farmed Australian seafood.

"Using advanced testing methods, including DNA profiling to confirm each fish species, we looked at the energy, protein, fat, sodium, fatty acids, water, vitamins and minerals in a variety of Australia's key seafood species, including farmed Yellowtail Kingfish, wild Banana Prawns and Native Oysters."

The study also focused on lead and cadmium levels, and all species tested met Australian regulatory standards.

The results are good news for Australian seafood lovers and the seafood industry, reinforcing the value of Australia's clean seas. "This should provide peace of mind for Australian consumers and ease market access issues for industry," Len Stephens says. "The results are a testament to the high quality of management of the Australian fisheries and aquaculture industries."

Seafood CRC program manager Emily Mantilla says the results show that seafood and fish compare well nutritionally with chicken and beef. "All of the species tested contained higher levels of health-promoting omega-3 fatty acids. Several species, including Atlantic Salmon and Sardines, were found to contain particularly high quantities of important vitamins and

minerals and omega-3 fatty acids."

Nutrition and dietetics experts from Flinders University in SA and the Centre of Excellence for Science, Seafood and Health at Curtin University in Western Australia evaluated the data for 'source' and 'good source' health claims for important vitamins, minerals and omega-3 fatty acids to develop key nutrient messages relevant to the consumer.

Food Standards Australia New Zealand has incorporated the data into its food composition reference database, which is used as an information source for nutrition information panels published on food items.

The findings from the study are being developed into a wide range of resources for industry, including nutrition information panels, dietary intake guides and other infographic images available for use in packaging and marketing materials and labels.

A handbook, *Super Seafood*, based on the report has been released to retailers to help Australian consumers understand the nutritional value of different fish and seafood. The *Super Seafood* kit is available from the Seafood CRC website (www.seafoodcrc.com). **F**



FACTS ABOUT FARMED BANANA PRAWNS

Farmed banana prawns – cooked tail meat

ENERGY 423kj DI* 4.9%	FAT 0.925g DI* 1.3%	SAT FAT 0.283g DI* 1.2%	SUGARS 0g DI* 0%	SODIUM 805mg DI* 35%
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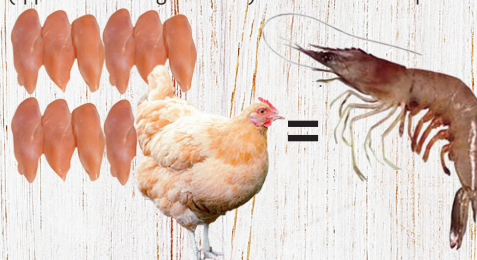
per 100-gram serve

* Percentage daily intakes are based on an average adult diet of 8700kj. Your daily intakes may be higher or lower depending on your energy needs.

Omega-3 comparison

970 grams chicken breast (approx. 10 x 100 gram fillets)

100 grams farmed banana prawns



Super Seafood is the Australian Seafood Cooperative Research Centre's new guide that details the nutritional analysis of our 20 most popular seafood species.

RECONNECT TO REVITALISE FISHERIES

The inland nurseries of many sought-after Australian marine fish have been losing out in the battle for competing land uses, but a new study finds a cooperative approach can help redress the balance

The vital role of estuaries, salt marshes, tributaries and wetlands as nurseries for many of Australia's favourite fish is receiving much-needed attention with a new series of reports assessing how functional these areas remain and potential restoration efforts to improve their productivity.

The first of these reports, *Revitalising Great Barrier Reef Estuaries and Coastal Wetlands*, has been completed, with an Australia-wide report to be completed later this year. Author Colin Creighton says the importance of estuaries and wetlands in fish life cycles has been well known for many years. "But we've somehow forgotten, not thought about or not really taken account of, all the little small changes to our estuaries."

Colin Creighton also chairs the FRDC's climate change adaptation/marine biodiversity and fisheries committee. He says the reports have come about partly because of concerns about how fisheries would adapt to a changing climate, and the role that oceans play in sequestering carbon – so-called 'blue carbon'. But the focus has returned to basics, in terms of improving estuarine and wetland productivity.

In the Great Barrier Reef region more than three-quarters of the commercial fish catch, and as much as 90 per cent of the recreational catch, spend at least part



Healthy mangroves on the Crookhaven River, near Nowra, NSW, provide an essential nursery for many popular recreational and commercial fish species.

of their life cycle within estuaries and inshore wetlands, according to the report. Commercially and recreationally important species such as Common Coral Trout (*Plectropomus leopardus*), Mangrove Jack (*Lutjanus argentimaculatus*) and Barramundi (*Lates calcarifer*) all have a juvenile or a larval phase in an estuarine environments.

However, these habitats have been suffering significant losses due to agricultural, infrastructure and urban development. More than 80 per cent of fresh to brackish wetlands in the Great Barrier Reef catchment have been lost, particularly in the wet tropics and Mackay-Whitsundays region.

Lost connections

There are several key threats to estuaries and wetlands, Colin Creighton says. At one level, these habitats have simply disappeared, making way for urban development and agriculture. A more insidious threat is the loss of connectivity in remaining wetland systems – cutting the habitats off from life-giving tides that bring flushes of oxygen, nutrients, microorganisms and macroorganisms, and clean water.

"Tide drives estuary productivity – without tide, there is no productivity," Colin Creighton says. "Along the eastern, southern and south-western coasts of Australia, we've



Disconnected from the wetland system, the water in this tributary has backed up behind a floodgate and is laden with aluminium.



Juvenile fish from a healthy tributary.



Once an estuarine environment, the Bagotville Barrage has cut off the Tuckean Swamp in northern NSW.

PHOTO: J. GALLAGHER

“Cane and cattle farmers want to stop the saltwater intrusion; those few biggest tides of the year, if you can stop those getting in, you can have a lot more freshwater land. You don’t need to build much – often it’s just a very small mound of dirt or a bit of concrete across a little bit of a waterway, a drain almost.”

But they add up. Marcus Sheaves says at last count there were about 1500 bunds across the Burdekin irrigation area of north Queensland. These barriers not only prevent tidal water from reaching the wetlands and salt marshes, but also stop juvenile fish from reaching nursery grounds. For the wet tropics, more than 5500 blocks to connectivity were counted. For drier regions to the south, such as around the Fitzroy River, massive areas of salt marsh have been lost to ponded pastures. In many cases the agricultural production from these ‘reclaimed’ areas is low.

“Like ‘a death of a thousand cuts’, it’s been going on for a long while,” Marcus Sheaves says. It is particularly damaging to iconic species such as Barramundi. “They live throughout the estuary in the freshwater, but they move down to the saltwater to breed. So they breed in the mouths of estuaries when there’s a flood, and then those babies have to get back up into places like big flooded wetlands,” he says.

In these wetlands, they are relatively safe from predators and can enjoy an abundance of insects and grubs to eat; however, as the water contracts after the flood, the young fish are trapped behind barriers.

Acid issues

According to Pia Winberg, director of the Shoalhaven Marine and Freshwater Centre at the University of Wollongong, another issue – one that particularly affects the Shoalhaven region on the New South Wales south coast – is acid sulfate soils.

“These transition and riparian zones in the floodplains and the tributaries are being changed functionally. You can’t say there’s less of it, just that it’s not functioning any more as a habitat, as it used to, and that’s because not much lives in a pH of 3.”

She says what can often happen is that a barrier built to prevent seawater from reaching an area also allows freshwater to

lost the tide getting into our salt marshes. Turbidity has wiped out the sea grasses and mangroves are not getting the tide anymore. The fresh to brackish wetlands where species such as Mangrove Jack and Barramundi spend the first two-and-a-half years of their life, post-spawning are blocked off and they’re no longer accessible.”

Connectivity loss is a global problem, says fisheries ecologist Marcus Sheaves, based at James Cook University, who was a contributor to the Great Barrier Reef report. “Coastal habitats are the places where we live, where we work, where we go to the beach, where we do all the development. In

Asia, if you look at coastlines and estuaries on Google Earth, the whole thing is covered with aquaculture ponds and paddy fields, everything is developed.”

In Australia, even in the undeveloped areas, these habitats are still being affected, he says. For example, Bowling Green Bay, a national park north of Brisbane, is recognised internationally as a significant wetland. However, there is only one estuary on the bay, out of about 30, that does not have some sort of physical barrier on it.

It does not need something as big as a dam or a causeway to block movement of the tide, Marcus Sheaves says.

build up behind it. In a flood, that ‘dead’ water behind the barrier, which has a low pH and virtually no dissolved oxygen, can be released as a big pulse into the estuary.

“So you have a physical barrier to fish recruitment and productivity but it’s also a chemical barrier because of the changes to pH and oxygen, simply because you’re not allowing a buffering of tidal water to go up and down these zones,” Pia Winberg says.

In the Shoalhaven River south of Wollongong through to the Clarence, Richmond and Tweed Rivers in northern NSW, this and other damage to estuaries and wetlands is affecting popular fish species such as mullet, flathead and bream. She says it has almost certainly contributed to the decline of the area’s prawn industry.

Flow restored

Given the size and complexity, what are the solutions? Colin Creighton says some are simple. A solid causeway blocking tidal flow to a lake could be replaced by culverts that allow movement of water and fish, as has been installed in Shallow Channel at the entrance to Lake Wooloweyah on the Clarence River in northern NSW.

“Two culverts are now in place and probably at least two more are needed, but it’s a start,” he says.

“Getting rid of a solid causeway will give you better flood protection; getting rid of a solid causeway will also give you recreational fishing opportunity. Now you’ve got the tide flowing back through you’ve got cleaner water, you’ve got sandy bottoms instead of muddy bottoms, instead of algae, you’ve got seagrass,” he says.

Another option is to replace fixed floodgates with smarter systems, Pia Winberg says. This simple structure contains a float and when open it allows seawater to pass up a channel, but if water levels reach a certain height, the float triggers the gate to shut.

“So you do get some water but the farm doesn’t have to have that maximum saltwater impact. This can reintroduce fish and prawns and primary production to those habitats that are small and intricate, but collectively very important to fisheries. Farmers and fishers can share in the benefits of a better managed estuary,” she says.

COORONG RECONNECTION REVIVES CONGOLLI

Until the mid-1900s, a small fish called Congolli used to migrate in huge numbers from the freshwater lower regions of the Murray River to South Australia’s vast Coorong wetlands and estuary and out into the open ocean to spawn. Young fish would then travel back up those same paths from the saltwater to the freshwater.

Then a series of barrages were built between the Coorong and the freshwater lakes that feed into it. This prevented saltwater from moving back up into those lakes – as was their purpose – but also prevented the movement of the Congolli between the river, lakes and ocean.

From those days of abundance, the Congolli is now a relatively rare sight in the region, says fish ecologist Brenton Zampatti, a senior research scientist at the South Australia Research and Development Institute (SARDI).

This is largely due to the barrages but also to the serious drought that affected south-eastern Australia during much of the past decade.

Brenton Zampatti says the estuary essentially became a marine embayment; it actually became saltier than seawater, with devastating consequences for the Coorong’s fish populations.

The barrages also prevented fish from moving upstream to freshwater. “Female Congolli migrate downstream in winter to spawn in the ocean and each spring and summer you get large abundances of these little juvenile fish trying to migrate upstream into freshwater.

“But the barrages essentially stop that migration and during the drought we saw massive declines in the abundance of Congolli in the freshwater reaches of the lower Murray.”

Two things have since improved the outlook for Congolli, he says. The first is the eventual easing of the drought, which restored some flow from the Murray River to the Coorong. The second is construction of fishways or fish ladders in the barrages, which the juvenile fish can use to gradually ascend to the lower reaches of the river.

“As soon as you put in a structure that regulates flow it also inhibits the movement of fish. The way to mitigate that is to build something into that structure that enables fish and other organisms to move through or over the structure,” Brenton Zampatti says.

“Those little [riparian] tributaries are immensely important to recruitment because it’s where some of the big fish species can have protection in their juvenile life stages as well as access to food.”

The solution also lies in finding a way for agriculture and these vital wetland habitats to coexist, which Pia Winberg says may require “a bit of give” on both sides. If farmers can agree to retain some riparian vegetation and salt marshes on the edge of their pastures, they will have less impact on the ‘paddock’ of fishers and oyster farmers than they do at the moment.

Colin Creighton focuses restoration



PHOTO: BRENTON ZAMPATTI

Congolli populations in the Coorong are rebuilding following the restoration of river flows and construction of fishways on barrages in the lower Murray River.

efforts on optimised outcomes – making the best possible gains for overall community benefit.

“We will never have the massive fish and prawn populations of 200 years ago, and remember many of our cities such as Brisbane or Bundaberg are on what were previously floodplains, so more levies will be required; they’re now people places,” he says.

“What we can do is repair key habitats and tidal connections where we know previous works were mistakes. With smart investment and strong community support we can deliver a net improvement in fisheries productivity.” **F**

By Bianca Nogrady

More information: *Marine Nation 2025*, www.aims.gov.au/opsag

Marine Nation 2025 calls for more investment in ocean research infrastructure

Six challenges for our marine nation

Our national anthem sings the praises of our ‘golden soil’ but perhaps a more significant phrase is ‘girt by sea’. Australia’s oceans contribute about \$44 billion each year to our economy, and that figure is projected to more than double by 2025.

A new report, *Marine Nation 2025: Marine Science to Support Australia’s Blue Economy*, makes a call to action for future investment in marine science to meet a number of “grand interconnected challenges” facing our maritime industries. These include national security, energy security, food security, biodiversity conservation, climate change and resource allocation.

Chief executive officer of the Australian Institute of Marine Science John Gunn chaired the Oceans Policy Science Advisory Group (OPSAG) committee that assembled *Marine Nation 2025* after extensive consultation across industry, government and science.

“We figured it was time, not just to write a statement of intent but to really try to outline what we thought were the big challenges facing Australia,” John Gunn says. “The marine science community is united in wanting to assist Australia to meet those challenges.”

The challenge of food security has particular relevance for the fisheries industry, which contributed a gross value of \$2.23 billion to the national economy in

2010-11, according to the Australian Bureau of Statistics.

John Gunn says there is significant opportunity for future growth in fisheries and aquaculture. Globally, aquaculture is expanding rapidly to meet growing demand for seafood. In 2009, fish accounted for about 16 per cent of animal protein consumption.

The report indicates that Australian aquaculture production, and associated total value, has increased substantially during the past decade, from \$0.68 billion in 2000 to \$0.87 billion in 2010.

“The document basically says that the path to sustainability has certainly been well charted and now what we must do is value-add – we must make sure that every tonne of catch is worth as much as possible in a food security way and in economic returns,” John Gunn says.

For example, developing cost-effective and sustainable aquaculture feeds and moving from reliance on wild broodstock to focusing more on domesticated, selectively bred stocks.

The report has also highlighted some additional challenges for wild fisheries management, such as improving data on fish stocks, mortality and total economic value, and moving towards ecosystem or multi-species approaches to fishery management.

“This will require a more detailed understanding of complex food-web dynamics, the effects of changing baselines

on fish stocks and the ecosystems that sustain them, and the social and economic drivers and impacts of fisheries,” the report says.

The chair of the Commonwealth Fisheries Association, Martin Exel, says *Marine Nation 2025* is important for three reasons. The report has reasserted the value, importance, independence and credibility of Australian marine science; it has recognised the limited dollars available and the need to better coordinate, collaborate and plan for marine research to be done in Australia; and it has developed an effective planning framework to clarify priorities for resource allocation and areas for investment in marine science.

“There is a critical need to investigate resource allocation for the marine environment. From the professional fishing industry and the aquaculture industry, that is going to be a central plank of all resource management, in my view, over the next 12 years,” Martin Exel says.

“From where I sit, the marine parks debate and a number of other major negative fisheries issues from the past 18 months have largely been around resource allocation,” he says. “There are different groups angling to promote their views over others, and so having a structured framework to deal with resource allocation within our marine environment and deal effectively and scientifically with society’s changing views on appropriate use of our waters is critical.”

Recognising that marine science is relevant to a range of disciplines and institutions, the OPSAG has called for more investment in significant national research infrastructure such as data networks, research vessels and large-scale experimental facilities.

It has also called for a plan for the next decade for marine science and the establishment of a formal national marine science steering committee “with the specific remit to coordinate provision of strategic advice to government and develop the marine science strategy”.

John Gunn says following the release of the report, the next step is to use it to guide development of a strategic plan to address each of the six challenges identified and to identify how science can help each of the sectors involved go forward. ■

PHOTO: ERIC MATSON

Less is more for WA lobster fishers

In a striking example of a 'less is more' philosophy, the Western Rocklobster (*Panulirus cygnus*) industry has significantly reduced fishing effort during the past four years and at the same time increased its profitability. What began as a theoretical exercise has been incorporated into the management of the fishery, increasing its value and improving long-term sustainability.

With an annual value of between \$200 million and \$400 million, Western Australia's rocklobster fishery leads the way as Australia's highest-earning single-species commercial fishery. But the industry, located along WA's lower west coast, was experiencing significant pressure from rising costs, declining prices and predicted reduced catches due to low recruitment of late larval stage rocklobsters, or puerulus.

In response to these pressures, the Australian Seafood Cooperative Research Centre commissioned Nick Caputi and his team at the Department of Fisheries WA to evaluate the level of effort required to achieve the maximum economic yield (MEY) from the fishery between 2008-09 and 2013-14.

MEY occurs when effort and catch levels maximise profit, where profit is defined as revenue earned minus fixed and variable costs. "This economic model accounts for direct operating costs such as gear, bait, fuel and crew, as well as vessel depreciation," Nick Caputi says.

A bio-economic model was used for the assessment. "We took a whole-of-industry view and assessed the effect of a range of levels of fishing effort on catch over a six-year period. Then we assessed what the likely economic effects would have been from applying different levels of fishing effort on the revenue, costs and profits and the number of vessels that would be expected to be operating."

The MEY analysis indicated that the net present value of the fishery could be substantially increased between 2008-09 and 2013-14 by reducing fishing effort to between 30 to 50 per cent of 2007-08 levels.

The long-term effect on catch would be only a five to 10 per cent reduction.

The MEY approach has the advantage of being more precautionary, taking a lower proportion of available rocklobsters.

Due to a series of very low juvenile settlement, fishing effort reductions were introduced for the 2008-09 season to enable carryover of adults to ensure stock sustainability. The reductions were achieved by limiting trap numbers and fishing periods and consequently vessel numbers declined. Some operators decided to lease or sell their units to other fishers, resulting in the number of vessels declining from 460 to 294 over two years.

Declining fishing effort and vessel numbers were associated with an overall increase in profit compared with what would have been achieved if all 460 vessels had still been operating at the 2007-08 effort levels. The increase was \$13 million in 2008-09 and \$49 million in 2009-10. Commercial catch rates also significantly improved and rocklobster egg production moved to record-high levels.

To maintain a biologically as well as economically sustainable fishery requires a reliable stock-assessment model to account for rocklobster populations and variables such as growth, mortality, migration and egg production. "Fortunately, we were able to use the number of juveniles as a reliable predictor of population numbers for legal-sized rocklobsters three to four years later," Nick Caputi says.

In 2010-11, a new management regime was introduced, changing the fishery from one based on effort control, where harvest was entirely dependent on the amount of

fishing, to a catch-controlled fishery. Fishers now have individual transferable quotas associated with the right to catch a specified weight of rocklobster. Management decisions are based on a threshold level for rocklobster egg production to ensure sustainability. The model developed by Nick Caputi's team will be used to evaluate the total allowable commercial catch in any season.

"The message for other fisheries is that fishing close to MEY levels provides higher profits and promotes conservation by protecting spawning stock. For Western Rocklobster, fishing close to MEY reduced the likelihood of overfishing during this period of low puerulus settlement," Nick Caputi says. "However, if puerulus settlement increases, the level of fishing and catch quota to achieve MEY can be recalculated, taking into account changing inputs such as the price of fuel and rocklobsters."

Nick Caputi says changes to Western Rocklobster management have generated much debate within the industry. "Overall, industry leaders have been supportive. And when the catch-per-unit effort increased from one kilogram to two to three kilograms per pot lift, many fishers realised the benefits. The challenge for management is maintaining higher catch rates in the future." **F**

Translocation lifts productivity

Over the past two fishing seasons, 160,000 Southern Rocklobsters (*Jasus edwardsii*) have been relocated from the deep, cold waters off Tasmania's south-west coast to reefs further inshore or northwards up the west coast. Here, their growth accelerates and their pale shells adopt the richer red colour that is much sought after in the marketplace.

These efforts are part of an industry-funded commercial-scale trial of rocklobster translocations that could increase the harvestable biomass of the Tasmanian fishery by more than 20 per cent on an ongoing basis.

Rocklobsters living in shallow water have more rapid growth, which means that each animal is more likely to contribute to fishery harvests. Shallow-water rocklobsters are also more desirable for marketing because of their vibrant red colour, better shape (wider tail) and because they are more robust when exported live, with lower mortality rates. They also lay more eggs, which may assist future recruitment. In contrast, deepwater rocklobsters may grow less than one millimetre a year and many never reach harvestable size.

Fisheries program leader at the University of Tasmania's Institute for Marine and Antarctic Studies Caleb Gardner says the commercial trial follows a successful proof-of-concept trial between 2008 and 2011.

The initial industry-driven trial involved relocating 30,000 rocklobsters over four years from an area of less than one square kilometre off the southern tip of Tasmania to eight shallow-water sites on the east coast. It was funded by the Australian Seafood Cooperative Research Centre and industry; fishers also assisted with the logistics of the translocations and data collection.

Growth changes

Environmental monitoring at the relocation sites showed no impact on algae, invertebrates, resident rocklobster populations, disease or fish stocks. The translocated rocklobsters generally remained in their new location and integrated with local populations. While 30

per cent of females translocated put a hiatus on egg production for the first year, all females returned to reproduction after that time.

The growth rates of translocated females increased at their first moult and in their first year after release even exceeded those of local shallow-water females. Translocated rocklobsters increased in weight by 30 per cent, while those remaining at the source increased by only five per cent.

With these positive findings, the commercial trial began in 2011-12 when the Tasmanian Rock Lobster Fishermen's Association (TRLFA) agreed to a levy of \$10 per unit of quota, raising \$105,000 a year to fund the project.

Caleb Gardner says the project essentially tests whether translocation can operate as a business enterprise. Tenders are called for the collection of rocklobsters from sites along the state's west coast. Businesses that tender for the work need to consider a range of factors including how far the rocklobsters are being relocated, fuel prices and other fishing activities that they could be doing at that time. The average translocation price to date has been about \$1.30 per rocklobster.

The translocation does not target any particular size or gender of rocklobster; anything undersized can be collected for relocation. The translocations are ideally run in November, when catch rates are highest, although Caleb Gardner says future tenders for October may occur. "The fishery is closed at this time, so fishers would be able to work on translocation without affecting their normal business. One of the most difficult aspects of the operation has actually been filling the translocation tenders."

In 2011 and 2012, 60,000 and 100,000 rocklobsters were relocated respectively. There is no legal issue with loss of quota or resource among fishers because the rocklobsters remain the property of the government until legally harvested. Quota is also state-based, not restricted to particular regional zones.

Some of the translocations involve bringing rocklobsters from deeper waters off the west coast to adjacent locations inshore,



PHOTO: RANDALL HARPER

A tray of Southern Rocklobsters collected off Tasmania's south-west coast are lifted from the well of the boat just prior to their translocation to their new reef home in shallower waters.

others involved moving the rocklobsters both inshore and further north. The translocation sites were identified by fishers as offering the highest growth potential for rocklobsters, as well as ease of fishing.

The translocation project has already resulted in the total allowable catch (TAC) being five kilograms per unit of quota higher than it would have been otherwise. A reduction of this order had previously been foreshadowed prior to the translocation project. For fishers this is a positive return on investment, Caleb Gardner says. Additional annual quota can be leased on the open market for about \$20 per kilogram; the same increase in catch funded through translocation equates to only \$2 per kilogram.

"If translocations continue, one of the issues we need to plan for is the situation where future translocation of rocklobsters is assumed in decisions about quotas but we aren't able to fill the tenders to relocate them. For example, in the first two years, 40,000 fewer lobsters were moved than we had planned. Fortunately, the details of the translocations that occurred meant that the quota decisions made were reasonable in this instance. But it does highlight a possible future problem."

The trial has been funded for only two years, but TRLFA president John Sansom says industry response has been generally positive. Association members will vote on the continuation of translocation operations at their annual general meeting later this year.

"It has been an innovative management strategy," John Sansom says. Increasing productivity without increasing catches is high on our priority list. Translocation offers the opportunity to change a lower-valued product into a more highly valued product, through increased growth rates. When this can also forestall a decrease in the TAC it is a win-win for industry," he says. **F**

Young abalone in the fast lane

A protein boost for young abalone sets the stage for a more profitable industry

New research exploring the nutritional needs of farmed abalone indicates that a feeding strategy tailored to different growth stages could increase the productivity of this lucrative industry by 10 per cent.

Production increases could add \$3.5 million to the income of Australian abalone farmers, based on national exports worth \$35 million in 2012, by reducing the time taken for abalone to reach market size.

The research, undertaken at Marine Innovation South Australia (MISA), has already stepped out of the laboratory and is being trialled by commercial abalone growers in Victoria and SA. The initial results are positive.

Key to the production improvements is the finding that the protein requirements of abalone vary throughout their life cycle, depending on the animal's age and seasonal temperatures.

Young, fast-growing abalone consume five per cent more protein than older abalone, particularly at warmer water temperatures, ranging from 18°C to 22°C, that are typical in summer, autumn and spring.

Leading the research at MISA is nutrition and feed scientist David Stone, who says nutrition is a major bottleneck in

abalone farming systems. Feed accounts for about a quarter of total production costs.

"Industry members have long suspected that farmed abalone were not achieving their growth potential, with one formula for feed provided throughout the 2.5-year production cycle, regardless of abalone life stages and varied seasonal conditions," David Stone says.

Wild abalone are known to have at least two distinct feeding strategies as they develop. Young abalone graze on epiphytic organisms while older animals feed on macroalgae.

The conventional diet for cultured abalone contains between 27 and 30 per cent protein. However, the research has found that an extra five per cent protein can optimise growth in one-year-old abalone and fast-track their weight to market sizes.

Spurred by the initial laboratory trials, scientists are now

collaborating with abalone producers and feed manufacturers to undertake large-scale commercial trials over 18 months.

Anton Krsinich looks over one-year-old abalone that are part of a commercial trial at Indented Head, Victoria.



Anton Krsinich



EFFICIENCY FEEDS INTO GENETIC SELECTION

For Anton Krsinich, chief executive officer of Great Southern Waters in Victoria, increased dietary protein in young abalone could add to the production gains the company has already achieved through selective breeding.

With seed funding from the FRDC, the company's selective breeding program developed in conjunction with CSIRO has led to a focus on farming a hybrid abalone breed, marketed as Jade Tiger Abalone® (JTA) (see Figure 1, page 32).

Since 2006, the move to producing only JTA instead of pure species of Blacklip and Greenlip Abalone has enabled Great Southern Waters to achieve 25 per cent faster growth rates.

Other advantages of the new first-generation breed produced by crossing Blacklip Abalone females and Greenlip Abalone males include decreased production costs and improved access to high-value live export markets.

In particular, the domesticated breed is characterised by a range of profitable traits, such as better growth, meat yield and survival rates in live export markets, plus the distinctive jade colour of the shell and tiger-like black stripes on the abalone's foot.

Anton Krsinich says these traits have played a large part in reducing overall production costs, which have declined by about 60 per cent in the past seven years.

Now Great Southern Waters aims to use genetic improvement as a mechanism to further optimise the 10 per cent lift in productivity that higher dietary protein in young abalone is expected to provide.

This means examining 270 parental abalone lines so that nutritional requirements, such as protein and feed-conversion efficiency, can be added to the selection criteria in the company's ongoing breeding program.

Three abalone farms – two in Victoria and one in SA – are hosting the trials and providing the animals. Meanwhile, all three of the country's abalone feed manufacturers are contributing a new diet, containing 35 per cent protein, at half the cost price.

The FRDC and the Australian Seafood Cooperative Research Centre have also provided \$300,000 through the Australian Abalone Growers Association for the on-farm trials. Flinders University in SA and the University of Tasmania are also collaborating on the research.

“The clincher is that we have the feed companies participating with the farmers, so any improvements to feed will become available to all abalone farmers in SA, Victoria, Tasmania and Western Australia,” David Stone says.

On-farm trial

Overseeing one of the commercial trials is Anton Krsinich, chief executive officer of Great Southern Waters at Indented Head, about 110 kilometres south-west of Melbourne, Victoria. The business produces Jade Tiger Abalone®, a commercially bred cross between Greenlip Abalone (*Haliotis laevis*) and Blacklip Abalone (*Haliotis rubra*).

Great Southern Waters has dedicated 16 production raceways to the trials – each about 20 metres long and 2.5 metres wide. The raceways are used to grow out the abalone in dark conditions. They are covered with a few centimetres of water pumped from nearby Port Phillip Bay via pipes that extend 0.5 kilometres offshore, so the cultured abalone experience seasonal changes in water temperature.

Anton Krsinich says the trial began in October 2012 using a feed containing 35 per cent protein; weight data collected already indicates accelerated growth rates.

Growth reports are generated every three months and are based on 50 abalone

randomly selected and individually weighed and measured. Another 300 abalone are bulk weighed.

After three months, the individually weighed abalone in the trial showed a 3.5 per cent weight gain compared with abalone on standard commercial feed.

After six months the individually weighed abalone showed an additional eight per cent weight gain.

The findings of the six-month growth report based on bulk-weighing the abalone in the trial showed a 12 per cent increase in weight. This suggests the commercial trials are on track to achieve the 10 per cent productivity increase demonstrated in the laboratory work.

“Because we harvest our abalone at a size that is optimal for the market, the weight increase means we can reach that point eight per cent faster, so it shaves about 2.4 months off the production cycle that usually takes about 30 months,” Anton Krsinich says.

He estimates that this time-saving reduces overall production costs by about \$1.60 per kilogram, and could save the company \$320,000 per year for the 200 metric tonnes of Jade Tiger Abalone® that Great Southern Waters is forecast to produce in 2013.

Better efficiency in converting food into body mass also means there is less effluent in the water used to grow out the abalone, so less nitrogen is discharged into the environment.

Next steps

Although the commercial trials are due to finish in March 2014, Anton Krsinich is already looking to apply the research procedures, developed by David Stone in consultation with industry, to other areas likely to further improve abalone feed conversion rates and reduce production costs.

For example, Great Southern Waters staff

plan to explore a reduction in dietary protein for abalone larger than 60 grams to save on nitrogen inputs in the winter months when sea temperatures are cooler.

Such trials could allow abalone farmers to develop a precision-feeding strategy, pinpointing the exact amount of protein required at every stage of the abalone life cycle.

He says the new expertise in commercial trials also provides scope to experiment with heating water in the abalone nurseries to stimulate growth in juvenile stock. However, this tactic is said to be unviable on the raceways due to the large volume of water that would require heating.

As a committee member of the Australian Abalone Growers Association, Anton Krsinich says the faster growth rates using new feeding strategies could help the Australian abalone aquaculture industry increase its market share in high-value export markets, which return between 12 and 16 per cent more than domestic markets.

While Australia produces about 60 per cent of the world's wild-caught abalone, it has just 1.1 per cent of the global farmed abalone market.

The increased productivity could also help offset the high value of the Australian dollar in export markets, he says.

Species-specific feed

Meanwhile, David Stone has started a three-month trial to compare the protein needs of different abalone species, with a focus on Greenlip and Blacklip Abalone. These breeds attract a premium in both export and domestic markets.

Interbreeding between Blacklip Abalone females and Greenlip Abalone males is also used to develop hybrid breeds that are more productive in aquaculture systems and that satisfy the preferences of different export markets.

“We’re expecting to see the Greenlip Abalone perform better at higher temperatures of about 22°C, and the hybrids will probably be more productive at 18°C, but we’re about to find out whether that’s the case,” David Stone says.

Other research priorities at MISA include the development of diets for juvenile abalone in nurseries and abalone farming in

FIGURE 1 GREAT SOUTHERN WATERS BREEDING STRATEGY FOR JADE TIGER ABALONE®

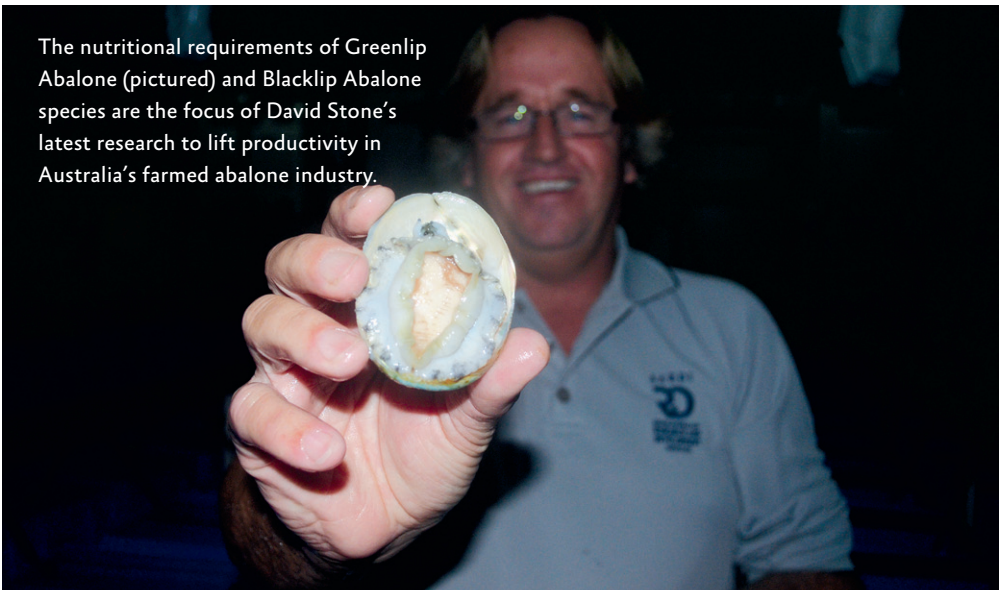
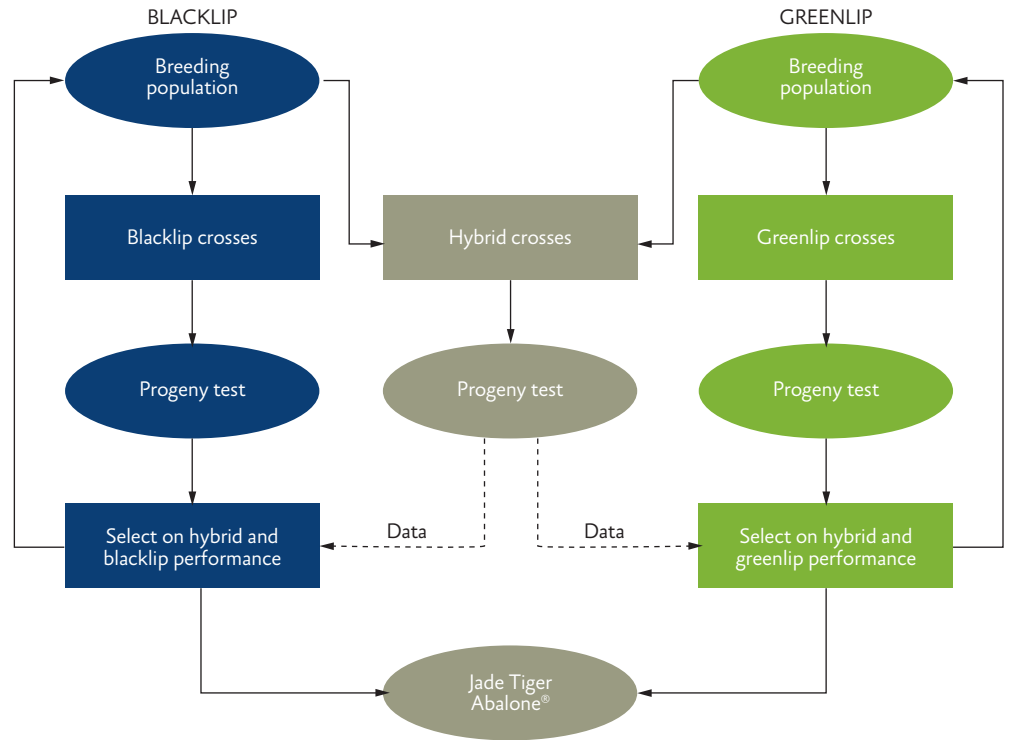


PHOTO: HEATHER RIDDELL/SARDI

The nutritional requirements of Greenlip Abalone (pictured) and Blacklip Abalone species are the focus of David Stone’s latest research to lift productivity in Australia’s farmed abalone industry.

offshore cages, possibly using a combination of commercial food and macroalgae in marine diets.

David Stone says there is a lot of interest around the world in using live food, such as cultured seaweed, in abalone feed. This is becoming a more cost-effective option as a by-product of increased seaweed

production for use in pharmaceutical and oil manufacturing.

In additional research to improve abalone productivity, four PhD students based at the South Australian Research and Development Institute and Flinders University are looking at the potential for live and dried macroalgae as feed ingredients. **F**

More information: Gustaaf Hallegraeff, gustaaf.hallegraeff@utas.edu.au

Monitoring under scrutiny in wake of algal outbreak

More than 200 leading international shellfish safety specialists gathered in Sydney for the 9th International Conference on Molluscan Shellfish Safety in March this year to discuss the latest industry research, management and policy issues.

Co-chair of the conference Gustaaf Hallegraeff from the University of Tasmania's Institute for Marine and Antarctic Studies (IMAS) says a diverse range of quality assurance, disease and toxicity issues were discussed, with almost 100 presentations at the conference.

Several presentations related to algae and the risk of accumulated toxins continues to grow, he says, as this becomes an increasingly significant issue for the industry.

"When the biennial conference was first held almost 20 years ago there were only one or two papers on algal issues. At this year's event, these represented about half the conference program," he says.

This included the opening keynote presentation from CSIRO's Anthony Richardson on marine plankton and climate change and a panel discussion on the 2012 toxic algal outbreak off Tasmania's east coast.

Global trend

Gustaaf Hallegraeff says the Tasmanian outbreak is part of a global pattern, with hazardous blooms occurring in new locations and caused by algae species that had not previously been problematic.

The Tasmanian outbreak of the toxic dinoflagellate *Alexandrium* algae during October 2012 was unprecedented and affected more than 200 kilometres of Tasmania's coastline. Shellfish accumulate toxins as they feed on the algae, which can make them dangerous, and potentially fatal, to eat. The algal bloom resulted in widespread closures of commercial and recreational bivalve growing areas. Rocklobster, scallop, abalone and crab fisheries were also temporarily closed.

As chair of the panel discussion, Gustaaf Hallegraeff says many aspects of the

Tasmanian algal outbreak were handled well. These included public and industry communication, availability of biotoxin testing facilities in Sydney and recall procedures implemented by the businesses involved. There were no confirmed cases of illness linked to the outbreak and more than 10,000 tonnes of potentially affected mussels were recalled from around Australia and overseas.

The most embarrassing aspect of the incident was that the alarm was first raised by the Japanese import testing system, Gustaaf Hallegraeff says. Japan identified levels of paralytic shellfish toxins (PST) in mussel meat from Spring Bay, Tasmania, that exceeded both Japanese and Australian health safety standards. This was later confirmed by testing in Australia.

The workshop identified inexperience with the *Alexandrium* species involved, monitoring schedules, delays in testing algal samples and an initial misidentification of the species as critical issues to be addressed.

Gustaaf Hallegraeff says it appears that the toxic bloom affected most of the east coast of Tasmania simultaneously, rather than seeding from one region to the next. The peak of the bloom was missed in fortnightly algal monitoring that the Tasmanian Shellfish Quality Assurance Program had in place. This frequency was based on the east-coast aquaculture zone being classed as a 'medium-risk' region.

Exports halted

The outbreak resulted in the suspension of all Australian bivalve exports for a brief time, until it could be confirmed that only Tasmanian products were affected. The total economic loss to the affected fisheries has been estimated at \$12 million. The Japanese market remains closed to Tasmanian mussel imports – requiring 100-per-cent, on-arrival testing for PST, a requirement that will remain in place for at least two years after the outbreak.

Much of the focus of the event has been on mussels and exports; however,

additional monitoring found "unacceptably high concentrations of toxins in other biota off the east coast of Tasmania", Gustaaf Hallegraeff says.

He says there was limited knowledge and experience in dealing with *Alexandrium* outbreaks in the Spring Bay area where the outbreak was first identified. Prior to 2012, there had been one *Alexandrium catenella* bloom in the aquaculture zone on Tasmania's east coast. The related *Alexandrium tamarense* responsible for the 2012 contamination had not previously been identified in bloom proportions in the region.

"Even with years of experience it is extremely difficult to identify these species from similar non-toxic ones by microscopic analysis. And while rapid DNA testing has been developed, this was not used by the laboratory responsible for processing of the samples," Gustaaf Hallegraeff says.

Information from the 2012 outbreak and a subsequent algal bloom have provided a greater understanding of how cell counts correlate with toxicity levels in shellfish. Mussels are perhaps the most sensitive species, based on meat tests during periods of high cell counts.

Gustaaf Hallegraeff says the algal bloom affected all of the shellfish growing areas on the east coast. Scallops, rocklobsters and giant crabs from depths to 300 metres off St Helens in north-east Tasmania were found to contain toxins. Other species tested and found to be unaffected included abalone, periwinkle, flathead, sea urchins, squid and Banded Morwong.

He says the bloom has created a paradigm shift in biotoxin management in Tasmania. The risk rating for hazardous algal blooms has been upgraded from medium to high, which will require increased levels of monitoring and testing.

The toxic nature of the species, widespread potential distribution of the algae from an offshore source and the high likelihood that cyst beds for the species have now been established have all contributed to the revised risk rating. **F**

More worms make for healthy lobster larvae

On a dark, new moon night in July 2010 when the sea was “glassy calm”, hundreds of phyllosoma – the larval phase of Western Rocklobster (*Panulirus cygnus*) – were captured in surface nets from the Leeuwin Current off the Western Australian coast north of Perth.

It was the first time phyllosoma of this species had been brought onboard alive for research purposes, and was a critical first step in a project led by Anya Waite, chief scientist in University of Western Australia’s School of Environmental Systems Engineering and at the university’s Oceans Institute.

The impetus for the study was the low number of puerulus, a late stage of larval development. This ‘low recruitment’ of puerulus and subsequent decline in recruitment of adult rocklobsters in the WA fishery persisted for several years.

An industry workshop identified a lack of knowledge regarding biological and oceanographic mechanisms affecting phyllosoma nutrition, growth and survival in Australia’s most economically valuable single-species fishery.

Anya Waite describes the way phyllosoma access their prey in the wild as a critical nexus for their survival. “Phyllosoma spend nine to 11 months floating in a planktonic prey field within the Leeuwin Current up to 1500 kilometres offshore. If they cannot source enough dietary lipids from their prey they will not metamorphose into puerulus and begin the journey across the current to settle in reefs along the coast,” she says.

In order to identify prey, research collaborators Richard O’Rorke and Andrew Jeffs, from the University of Auckland, New Zealand, developed a syringe-like device known colloquially as a ‘gut sucker’.

“When we removed phyllosoma gut contents using the sucker we discovered one-third had nothing in their gut, which means they might have been starving,” Anya Waite says.

“We used forensic-style DNA methods

on the gut contents and compared the DNA ‘fingerprints’ with those already known for other ocean-dwelling species, to identify what they were eating in the wild.” She says radiolarian DNA was found in gut contents. Radiolaria are tiny protozoa in zooplankton. “But we have not yet determined if this was a primary or secondary food source,” she says.

Fellow researcher Christin Säwström placed phyllosoma in tanks and hand-fed them different prey including ‘fake prey’ comprising agar gel incorporating krill, arrow worms (chaetognaths) and jellies (salps).

Of the fake prey, the preferred food was krill, but in the wild these are usually too fast for phyllosoma to catch. The most favoured ‘real food’ source was arrow worms whose long narrow bodies are easy to ingest. Arrow worms have lower nutrition than krill but are easier to catch, Anya Waite says.

The project, which will be completed mid-2013, has had several significant outcomes.

The first outcome is a better understanding of the feeding ecology of Western Rocklobster phyllosoma. “By identifying key prey we have opened up new research potential both in fisheries and aquaculture. We’ve assessed productivity of the Leeuwin Current water mass and evaluated the capacity of the plankton to provide food for feeding phyllosoma.

“Working with Lynnath Beckley from Murdoch University, we have identified an oceanographic feature – the Abrolhos Front – that appears to bring two contrasting water masses in close proximity, providing a shoreward flow pattern favourable to successful recruitment of puerulus.”

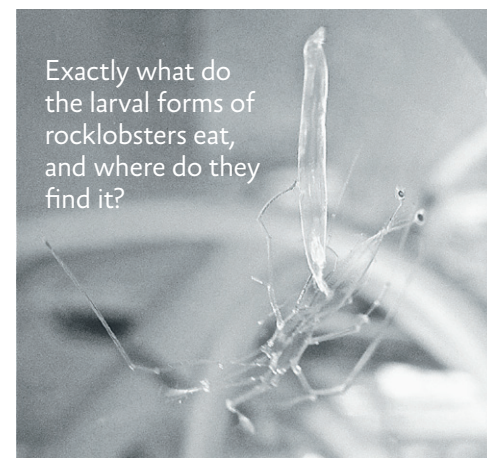
Anya Waite says the next step is to use an underwater video technique enabling the three-dimensional aspects of phyllosoma behaviour to be mapped in real time and provide a clearer picture of the relationship between phyllosoma and their prey field.

The research raises new questions. “The Leeuwin Current contains ‘eddies’, which are 100 to 200 kilometres in diameter, and we speculate that these may be feeding



PHOTOS: MEGAN SAUNDERS

Aboard the research vessel *Southern Surveyor* (from left) Nik Sachlikidis, Anya Waite and Joshua Dornan feed phyllosoma ‘fake prey’.



Exactly what do the larval forms of rocklobsters eat, and where do they find it?

A phyllosoma, the first larval stage of Western Rocklobster, grows up to two centimetres in length. The one pictured here is ingesting the cylindrical body of an arrow worm.

hotspots for phyllosoma prey as the waters in these eddies mix deeply and bring up nutrients from lower in the ocean that promote plant productivity when they come near the sea surface.”

She says it is possible that eddies are an uncomfortable environment for larger fish, which allows phyllosoma to exploit their prey field without fear of predation from larger species. “This is highly speculative and requires further investigation – for example, do we see bigger healthier phyllosoma in these areas?”

The study has been supported by the FRDC, providing research links between oceanography and fish ecology to support a fishery. **F**



New climate indicators for lobster recruitment

In the past seven years, scientists monitoring the Western Rocklobster (*Panulirus cygnus*) fishery off the coast of Western Australia have recorded low levels of the lobster's late-larval-stage juveniles, called puerulus.

Puerulus numbers are highly predictive of the recruitment of legal-sized rocklobsters in the following three to four years, and the lack of knowledge about the causes of low puerulus settlement was identified as a risk for the industry.

Nick Caputi at the Department of Fisheries WA says in the past ocean temperatures and wind patterns had successfully explained fluctuations in settlement.

"Historically, the strength of the Leeuwin Current and associated changes in water temperature during February were known to significantly affect puerulus settlement, but this relationship has broken down," he says.

Puerulus settlement in 2008-09 was the lowest in 40 years, and was not consistent

with the predictions that there would be average or better-than-average settlement.

New research by Department of Fisheries WA and CSIRO scientists found two new variables – breeding time and storms – that provide a possible explanation for fluctuations in settlement, including the most recent decline.

Rainfall was used as an index of storm activity affecting the lower west coast of WA because it is associated with oceanic conditions and westerly winds that may help bring larvae back to the coast.

"During May to October, rainfall, combined with the breeding time index, provides a good fit to the variation in puerulus settlement," Nick Caputi says. "The 2012-13 settlement provides a test of this relationship and indications are that it will be below average, which is what is predicted by storms and breeding times."

He says climate change may be a factor in low settlement because water temperature and storm activity, which affect both spawning and larval periods, are

demonstrating long-term trends.

"In recent years the spawning season has started earlier and appears to be caused by higher water temperatures near the onset of spawning in October. Higher temperatures since the mid-2000s coincide with below-average settlement and it is possible this earlier spawning time may result in a mismatch with other environmental factors such as peaks in ocean productivity or storms with westerly winds that assist the larvae to return to the coast," he says.

In 2009, breeding stock in the fishery's northern area was also identified as being relatively low. In response, Big Bank, north of the Abrolhos Islands, was closed to fishing. Ongoing monitoring has since shown a significant increase in breeding stock in the area.

A 50 to 70 per cent reduction in fishing effort in the past few years has also increased the migration of lobsters into deep water and contributed to an increase in breeding stock across the whole fishery.

Nick Caputi says the good news is that breeding stock is now at record-high levels in all other six areas monitored since the early 1990s. "While managers and fishers cannot control the environment, they can significantly influence the abundance of breeding stock," he says. **F**



Nick Caputi with a puerulus collector used to monitor settlement of Western Rocklobster juveniles off the coast of Western Australia.

People investment adds strength to industry

Leadership, innovation and industry professionalism are key themes for the continuation of the FRDC's people development program.

Following the success of the program's first five years, a two-year extension until 2015 has been approved, with more than \$500,000 of funding for specific initiatives including professional development awards, partnerships and commissioned training programs.

The FRDC's people development program manager Jo-Anne Ruscoe says rather than operating as a separate 'silo' program, investment will also be integrated into the FRDC's other program areas: environment; industry and communities; and extension and adoption.

The FRDC's people development program advisory committee will also be disbanded in favour of seeking broader advice, she says. "The committee has successfully raised the profile of the program and provided the FRDC with the direction to invest in projects that have made a real difference to individuals and associations. However, we now want to integrate people development within the FRDC's other planning structures, to ensure that human capability is being built to deliver on industry priorities. We still need a dedicated program, to ensure it has the national focus needed.

"People development is an 'enabling' program – it allows all the other programs to work more effectively. At a Fisheries Research Advisory Board level, people development is often a lower priority than other issues when resources are allocated, although we constantly hear that it is a high priority for industry." The FRDC aims to spend 10 per cent of its research budget on programs that will build the skills and capacity of people in the industry.

People development initiatives will target the specific research, development and extension priorities identified in the FRDC's *Research, Development and Extension Plan 2010–15*. The management of some People Development Awards will be also transferred to appropriate industry groups

PROGRAMS FOR PEOPLE

The following are among the initiatives the FRDC is planning to fund as part of its continuing people development program.

FRDC Development Awards

These awards include specific programs, scholarships and bursaries for training, workshops, conferences and exhibitions to build skills, expand knowledge and help establish industry networks. This includes funding for international exchanges and visiting experts. Activities to improve leadership and corporate governance activities are supported. Specific initiatives sponsored include the National Seafood Industry Leadership Program, Australian Rural Leadership Program, Nuffield Australia Farming Scholarships, Women's Governance Scholarships, Emerging Leader Governance Scholarships, Indigenous Development Scholarships, and the Women's Industry Network Seafood Community Professional Development Scholarships.

Primary Industries Education Foundation

To support the development of a skilled workforce for the industry, the FRDC is a partner in the Primary Industries Education Foundation, along with other research and development corporations. The foundation provides national leadership and coordination of initiatives to encourage primary industries education in schools through partnerships between industry, government and educators. It also aims to provide credible, quality information about primary industry research and development for schools and industry.

such as the FRDC's Indigenous Reference Group, which will take over the Indigenous Development Scholarships.

Raising the professionalism – and public perceptions of industry professionalism – is a high priority. Initiatives supported will include training in leadership, media engagement and good governance, in order to influence community perceptions.

New initiatives in the people development program include a greater focus on innovation. The FRDC will prepare a

Media training

This is a new activity within the people development strategy and builds on the well-received workshops held in 2012. At least one media training course will be held annually.

Environmental responsibility training

Another new initiative will engage a facilitator to build national collaboration in the delivery of environmental responsibility training.

Innovation and entrepreneurial capacity

The FRDC will seek assistance from an 'innovation adviser' to better understand what is needed to encourage and support innovation within the industry and within its own structures. It will also seek assistance to advise on the most appropriate training course or program to build innovation and entrepreneurial capacity within seafood enterprises and organisations.

Postgraduate scholarships

Top-up funding will be provided for three postgraduate scholarships annually for research that targets areas of current and emerging industry need.

formal innovation strategy and will invest in training to help industry members develop their capacity for innovation and adaptability, including responding to market changes and improving competitiveness. A scholarship program will nurture the next generation of innovators and researchers to help the industry find better ways to do things.

Jo-Anne Ruscoe says there will also be renewed efforts to ensure that the necessary skills are in place to transfer research and development findings to end users. **F**



More information: Daniel Gledhill, daniel.gledhill@csiro.au; the Atlas of Living Australia, <http://fish.ala.org.au>; RedMap, www.redmap.org.au

Daniel Gledhill examine slides archived in CSIRO's Australian National Fish Collection, which have been used in developing FishMap.

Find your fish online

Australia's marine diversity is among the richest in the world, but that richness creates challenges for anyone trying to identify and record marine organisms.

With these challenges in mind, CSIRO recently launched the free online tool FishMap (<http://fish.ala.org.au>), a searchable atlas of more than 4500 marine fishes. It can rapidly produce regional, illustrated lists of species occurring in the marine waters of Australia's continental shelf and slope, with distribution maps and current scientific and common names.

FishMap builds on more than a century of research by Australian marine scientists and on the work of museums and fisheries research and management agencies across Australia.

CSIRO researcher Daniel Gledhill led the project to collate existing identification and distribution information as part of a three-year project jointly funded by CSIRO's Wealth from Oceans Flagship and the Atlas of Living Australia.

Gathering history

Daniel Gledhill says FishMap incorporates data on Australian fishes dating back to European scientific expeditions undertaken around Australia in the early 1800s. Illustrations used in the tool date to at least the early 1900s and include line drawings, colour paintings and photographs.

"We scoured national and international image collections and have managed to track down illustrations for more than 90 per cent of the fish species listed. Most images are in colour, which can be very important in identifying one species from another."

Daniel Gledhill says the identification and distribution information used to create FishMap has come from a wide range of research and management agencies, but additional information is still needed for many species.

"Some fish may be known from only one or two specimens. New species are also still being identified on a regular basis. With new information, even common species – for example, a species found on both the east and west coast of Australia – are sometimes found to be two different species that have previously been confused."

He says FishMap is the only resource of its kind in the world that covers virtually all species of marine fish found in the marine waters of an entire continent.

"The sheer diversity of fish species can make it difficult for people to get a handle on anything that is a bit unusual. Things that we see regularly may be quite easy, but as soon as someone catches something that's a little off the beaten track, so to speak, it becomes very difficult to even find out what species might be in the local area.

"With FishMap you can search by depth,

you can search by whether you're fishing on the bottom or in the water column, and you can also search by individual families of fish. For example, there are more than 40 species of flathead in Australia; if you catch one you don't recognise, FishMap is a starting point to find what species may live in that location."

He cautions that FishMap is not a complete identification tool. At this stage it provides broad coverage of the fauna and will be updated regularly with more species and additional information.

For researchers undertaking fieldwork, FishMap can provide a list of species that might occur in the area of interest, with the current scientific name, common name and illustrations.

This could help reduce the amount of replication of out-of-date names, and also incorrect names that are used in some datasets. Simple guides or data can be downloaded into a spreadsheet to create templates for data collection.

Unidentified species

FishMap can provide a starting point for identifying unusual species. Fishers wanting to report unusual sightings will also be interested in RedMap (www.redmap.org.au), a website that aims to capture data on marine species whose ranges are extending in response to warming waters.

Daniel Gledhill says identification of what seems to be a new or rare species could require the expertise of the fisheries staff of a state museum.

"If you find something really unusual your state museum is also a good place to turn for assistance. Specimens should be photographed before being wrapped in plastic bags and frozen, and the photographs sent to the local museum. There are many species you can't identify from a photograph, so keeping the specimen can really help."

Once formally identified and named, any new species will make its way into FishMap, he says.

FishMap was co-developed by CSIRO's Wealth from Oceans National Research Flagship and the federally funded initiative The Atlas of Living Australia. The Atlas aims to bring the rich data from Australia's biological collections to the fingertips of everyone from scientists to the public. **F**

PHOTO: CARLIE DEVINE, CSIRO

GLOBAL FOCUS REVEALS SHELLFISH OPPORTUNITIES

Nuffield scholar Ian Duthie finds that the collective international intelligence of the shellfish industry will be needed to help overcome the production challenges of the future

Globally, the demand for shellfish is outstripping the combined supply capacity of the wild-caught and aquaculture industries, creating an opportunity for the Australian aquaculture industry to step into the gap.

FRDC-sponsored Nuffield Scholar Ian Duthie has completed a worldwide exploration of shellfish hatcheries as the focus of his scholarship and believes there is potential to develop export markets for the spat for oysters, clams and mussels.

He has also found that there is a significant “collective intelligence”, which he believes will be crucial in addressing major challenges to face the industry globally, including disease and climate change.

His travels have taken him to shellfish producers across the US, Canada, New Zealand, France, Spain, Portugal, Sweden, Norway, Guernsey and the UK.

“When you are working domestically, there is always an element of competition in what you do. But when you are overseas, people are more open to sharing information because they don’t see you as a direct competitor,” he says.

During his travels he was impressed with the potential of the shellfish industry’s collective intelligence to help solve problems. He says big-picture issues such as ocean acidification and disease will require the industry to work together cooperatively to find solutions through selective breeding, diagnostics or professional development.

Ian Duthie believes it is essential to have networks and relationships established to help identify potential problems and to be well prepared.

Back home in Tasmania, he is now considering how to most effectively combine his 18 years of experience working in hatcheries with the best practices he has seen overseas to meet the research challenges of the future. After helping Spring Bay Seafoods establish its hatchery at Triabunna, Tasmania, he is working as a consultant assisting the Tasmanian Shellfish Quality Assurance Program and several New Zealand clients.

Assessing market opportunities, he says there is a worldwide shortage of oyster seed. “Producers I spoke with, particularly in the US, would increase their production four-fold if only they could get hold of the spat. The clam market is also the fastest-growing and largest shellfish market in the world – faster than oysters or mussels.”

Overseas, demand is continuing to grow on the back of cultural influences and the industry’s ability to market the environmental credentials of shellfish. “They have developed the ‘story’ and experience around consuming shellfish – the ‘merroir’, emulating the wine industry’s development of the ‘terroir’, and telling positive stories about their industries,” Ian Duthie says. “Shellfish have a strong environmental tag; they are sustainable, renewable and they provide environmental benefits as filter feeders that remove nutrients from the water, and they also lay down carbon in their shells.”

As part of his travels Ian Duthie revisited New Zealand. A decade ago the industry there looked at hatchery production, having seen the gains that could be made in selective breeding. But the cost of production for wild catch at that time was so low that it did not make economic sense

to capitalise a high-risk venture when lower-risk, low-cost alternatives were available. Today, however, disease pressures and inconsistent wild catch have put hatchery production back on the agenda.

Ian Duthie says challenges for any new hatchery business will include managing government regulation, disease and translocation issues, as well as achieving the economies of scale needed to ensure viability.

He says it is possible to produce 220 million oyster spat in a single run, and this would meet the entire Australian demand for Pacific Oyster spat. Supplying export markets and producing spat for more than one species would allow for greater production and make economies of scale possible. He sees the Australian dairy industry as providing a business model for this kind of development, with a premium domestic product and discounted export supply.

As part of his Nuffield Scholarship, Ian Duthie spent time with primary producers from a wide range of industries during his six-week global-focus tour. He says it proved a valuable experience that has given him some new ideas for business structures and investment in capital.

“Aquaculture and agriculture have a lot in common. But aquaculture in Australia is only just entering its second generation, whereas agriculture already has several generations behind it – so it has already come up with ways to address things such as the use of assets and working capital, and how to bring new people into the industry and reward them for skills and experience with the opportunity to establish their own business.” **F**



Greenshell Mussels, produced at Marlborough Sounds, New Zealand. A hatchery cultivation of spat is being considered.



Juvenile clams in an upweller at Roger Williams University on the east coast of the US.



Pacific Oysters produced in France.

PHOTOS: IAN DUTHIE



Farming mussels (*Mytilus edulis*) at Bouchot, France. The mussels are on ropes wrapped around the posts.



Applications open

Applications for the 2014 Nuffield Scholarship program will close on 30 June 2013. Scholarships of up to \$30,000 are provided for primary producers aged 28 to 40 years, although applicants outside this age range may be considered. All scholars take part in a six-week Global Focus Program and up to 10 weeks of individual travel to investigate a topic of their choice.

Ian Duthie, pictured with the envelopes, or bags, used in oyster production in France.

MSC opens new market

Third party sustainability accreditation through the Marine Stewardship Council (MSC) has helped Australian prawns secure a place among the seafood offerings of the Japanese supermarket chain operated by Asia's largest retailer, the Aeon Company.

MSC-certified king prawns from Spencer Gulf have been on offer since December 2012 and the Northern Prawn Fishery Tiger Prawns were added in March 2013. Aeon supplies MSC-certified seafood as part of its biodiversity sourcing policy and aims to have 10 per cent of its wild-capture seafood MSC certified by 2017.

MSC manager for Australia and New Zealand Patrick Galeo says the launch of Aeon's MSC-certified prawn range was a win for fisheries that have demonstrated their sustainability credentials.

Spencer Gulf King Prawn Fishery, certified in November 2011, was Australia's first prawn fishery to be recognised for its first-rate management practices, which include effort restrictions, closed fishing periods, closed areas and harvest strategies to regulate the total catch. Representing the fishery, general manager of the South Australian Prawn Co-operative Terry Richardson says he is delighted the fishery is entering the Japanese market.

"The MSC certification provides a point of difference and confidence to the buyer. Supplying to a large player in the Japanese supermarket chain, and one that is focused on quality and customer satisfaction, is very important to the South Australian Prawn Co-operative and its members," Mr Richardson says.

The Northern Prawn Fishery has been exporting Tiger Prawns to Japan for more than 30 years. However, the relationship with Aeon is an important development for the fishery, as Aeon is looking at options to sell MSC-certified prawns from the fishery year round. **F**

The Board of the Western Rock Lobster Council has appointed a new chairman. **BASIL LENZO**, a rocklobster fisherman from Fremantle, Western Australia, takes over the chairman's role for 2013. The deputy chairman is **PETER BAILEY** from Geraldton, WA.

ERIC PEREZ has taken up the position of policy and research manager at the Australian Aluminium Council.

SCOTT WISEMAN is the new executive director of the Queensland Seafood Industry Association.

STEVE KENNELLY (former chief scientist of the New South Wales Department of Primary Industries, research director of Fisheries NSW and director of the Cronulla Fisheries Research Centre of Excellence) has joined **STEVE DUNN** (former chief executive of the NSW Maritime Authority, deputy director general of the Pacific Islands Forum Fisheries Agency, director general of NSW Fisheries and director of Fisheries Victoria) in a new company, IC Independent Consulting (www.icic.net.au).

BOB CREESE is the new director of research at NSW Fisheries.

The new managing director of Fisheries Queensland is **SCOTT SPENCER**.

TRICIA BEATTY is the new executive officer of the Professional Fishermen's Association.

The Marine Biodiversity and Biosecurity assistant secretary is **GEOFF RICHARDSON**.

KYLIE GILES will be leaving the FRDC in July for six months to pursue travel plans.

JENNIFER OVENDEN will take up a position of principal research fellow with the University of Queensland at the end of June. She is currently a 'visiting scientist' at the Museum National D'Histoire Naturelle in the Département Milieux et Peuplements aquatiques (Department of Environment and Aquatic Populations) in France.

MOVERS WE'VE MISSED?

INFO PLEASE TO

Julie Haldane, 02 6285 0415,
julie.haldane@frdc.com.au

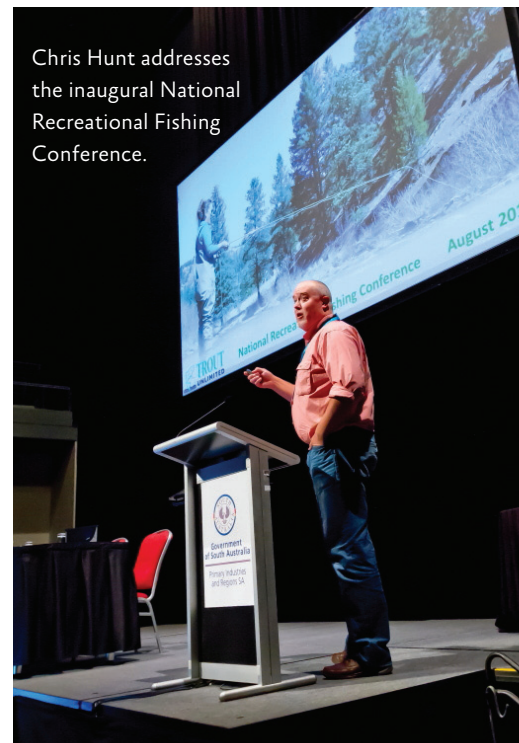


CALENDAR OF EVENTS

DATE	EVENT	MORE INFORMATION
5 to 6 June	FRDC Board Meeting, Perth, Western Australia	02 6285 0400
8 to 12 July	The Second Australasian Scientific Conference on Aquatic Animal Health, Cairns, Queensland	http://seek.hosting.exacttarget.com/EventManager/EventPage.aspx?ispbk=clear&SUBID=-1&JOBID=17580398&MID=84905
25 to 29 August	24th International Conference of the World Association for the Advancement of Veterinary Parasitology, Perth, Western Australia	www.waavp2013perth.com
28 August	FRDC Board Meeting, Canberra	02 6285 0400
28 September to 4 October	2013 World Seafood Congress, Newfoundland and Labrador, Canada	www.wsc2013.com
27 to 30 October	Seafood Directions 2013, Port Lincoln, South Australia	www.seafooddirections.net.au
19 to 21 November	FRDC Board Meeting, Canberra	02 6285 0400
10 to 13 December	The 5th International Oyster Symposium, Ho Chi Minh City, Vietnam	www.worldoyster.org/index_e.html



FRDC chairman Harry Woods (second from right) and FRDC executive director Patrick Hone (right) at the National Recreational Fishing Conference.



Chris Hunt addresses the inaugural National Recreational Fishing Conference.

TOUGH FISH MANAGEMENT

2010/207

This research confirmed that fish age is the primary driver of toughness in cooked Saddletail Snapper flesh. There was no apparent connection between toughness and seasonality or year-to-year conditions. Toughness through inappropriate chilling immediately post-capture was ruled out as contributing to tough fish syndrome (TFS).

Mechanisms for identifying tough fish, either onboard or during processing steps, were provided through non-invasive ultrasonic imaging and near-infra-red spectroscopy (NIRS). The authors proposed several alternative approaches to minimise the impact of TFS. These were considered at a stakeholder meeting (November 2011) and options reduced to two favoured by key members.

Additional work outside the project scope included an assessment of consumer perceptions of cooked Saddletail Snapper flesh toughness and 'proof-of-concept' trials with enzyme treatment of tough fillets.

More information: Sue Poole, 07 3276 6028, sue.poole@daff.qld.gov.au

STRATEGIES TO REDUCE SPOILAGE

2006/209

The spoilage and means to overcome that spoilage of six species of seafood – Sea Mullet, Goldband Snapper, octopus, Blue Swimmer Crabs, Atlantic Salmon and Blue Mussels – was investigated.

Each species had unique microbial populations and the impact of microorganisms on spoilage varied greatly between species. The use of sanitisers had a significant impact on the rate of spoilage of some species, and none on others. A one-size-fits-all approach to controlling spoilage of seafood does not appear to be applicable based on the findings of this study. Variation was not only found between major groups (for example, finfish, crustaceans, molluscs and cephalopods), but also within groups.

Sanitising and storage regimes have been optimised for the six species to

decrease the number of spoilage bacteria and enhance shelf life in selected finfish species and, where appropriate, changes are suggested.

This project has resulted in a culture collection of more than 5000 organisms, many of which have been identified. Many different techniques for the identification of bacteria have been developed including biochemical, cell-wall fatty acid and sequencing-based identification, which have already been used by other researchers. Short documents for each selected seafood line with results and recommendations to improve product quality and shelf life and/or develop new products will be produced.

More information: T.V. Riley, University of Western Australia, 08 9346 3690

NATIONAL RECREATIONAL FISHING CONFERENCE

2011/502

A world-class conference was held from 17 to 19 August 2012 at the Gold Coast Convention and Entertainment Centre, attended by 160 delegates, to address contemporary issues related to recreational fishing in Australia. The conference was a joint program of Recfish Australia and the Australian Fishing Trade Association with the support of Recfishing Research. The conference began with an ABT Pro-Am Fishing Tournament on 17 August and was followed by the AFTA Tackle Trade Show from 20 to 22 August. Formal and informal feedback indicated delegates thought that the conference was very successful.

An excellent mix of delegates covering industry, government, managers, researchers, fishing media and recreational fishers (both old and young) was exposed to a wide range of good news and challenging projects from around Australia. Several strategic actions were identified for progress following the conference. The achievements of recreational fishers in several categories were recognised through the Recreational Fishing Awards.

More information: Bill Sawynok, Recfishing Research, 07 4928 6133, bill@info-fish.net

SOUTHERN SHARK STEWARDSHIP 2011/408

This project has successfully developed and delivered a customised training program to improve the environmental management and stewardship among operators in the Southern Shark Fishery. The program was based on one prepared for skippers in the Commonwealth Trawl Sector, by the South East Trawl Fishing Industry Association, and customised for shark fishers operating in South Australia, Tasmania and Victoria.

Training was delivered in three sessions, one in each state, to improve reporting of and reduce interactions with protected species and encourage greater compliance with area closures. An improved understanding of other compliance activities, reporting requirements, stock assessments and management strategies is expected to improve the data collected by industry members and acceptance of and compliance with management decisions. The overall aim is to improve environmental practices and improve community perceptions of fishing practices.

More information: Richard Owen, Seamec Maritime Education Centre, 03 5152 0700

FISH BIOLOGY CONFERENCES 2010/316

The Australian Society for Fish Biology (ASFB) has held successful annual conferences in 2011 and 2012, with about 220 participants at each.

The primary outcomes include knowledge transfer, building of research partnerships and recognition and promotion of research achievements, particularly among early career researchers.

The conferences have attracted high-quality keynote presenters, including world leaders in their fields of endeavour, with more than 100 diverse scientific presentations. Research achievements were actively recognised and promoted through a range of awards targeting students and early career researchers, with several award recipients taking on active roles on the ASFB Executive Council.

More information: Jeremy Lyle, Institute for Marine and Antarctic Studies, 03 6227 7255

CLIMATE ADAPTATION TOOLS 2009/055

This project has developed a framework and associated tools to implement an adaptation framework for the impact on fisheries and aquaculture arising from climate change in south-east Australia. The framework and tools are applicable across other regions of Australia and further testing is recommended to refine and extend the tools developed here, as well as to provide a consistent national assessment of vulnerabilities and adaptation.

The framework is a hierarchical scheme for assessing regional vulnerabilities and regional adaptation needs that cascade to provide context for vulnerable fisheries/local impact and adaptation needs at this scale. Adaptations at both scales are linked through agreed targets and indicators for the intended adaptation outcomes – which include fisheries/ecosystem outcomes as well as socioeconomic ones and those related to management/operational adaptation performance.

More information: Vincent Lyne, CSIRO, 03 6232 5333, vincent.lyne@csiro.au

TUBEWORM CONTROL FOR MUSSELS 2011/241

The major outcome achieved in this project was the development of a commercially and scientifically effective thermal treatment method for the mitigation of the Australian native tubeworm (*Pomatoceros taeniata*). This resulted in the design and exploitation of a commercial-scale biofouling



A thermal treatment has been developed to mitigate tubeworms affecting Blue Mussels.

thermal treatment system. The system, which is a closed, circulated-seawater heating system, has proved to be highly efficient in treating soft shell and hard shell biofouling at offshore longline mussel and oyster farms.

A final technical report describes in detail the laboratory and commercial scale tubeworm treatment on offshore Blue Mussel farms. A brief standard operating procedure (SOP) and fact sheet for the tubeworm biofouling thermal treatment at commercial scale have been prepared and will be available on the SeaBounty website (www.seabounty.com.au). The results of the project will be presented at a half-day workshop at the Victorian Department of Primary Industries in Queenscliff.

More information: L. Asgari, AUSNIK Company, 0438 006 436, sam@ausnik.com.au

HARVEST DATA ANALYSED 2009/019

This project developed and explored methodology intended to enable more reliable estimates of fishing efficiency increases and harvest rate in order to improve the quality of the management decisions and facilitate the sustainable management of the Western Rocklobster Fishery.

If the approach had proved successful, the production of more robust measures of efficiency increase and harvest rate for use as inputs into the integrated stock assessment model would have improved the reliability of management strategy evaluations and model predictions.

However, the analyses conducted in this study demonstrated that trends within the fishing season of estimates of exploitation rates derived by applying change-in-ratio and index-removal methods to logbook data from the Western Rocklobster Fishery in different depth zones and regions were inconsistent and, for much of the fishing season, clearly biased (negative estimates). These results were attributed to moulting into and between the undersized and legally retainable categories of lobsters and changes in catchability within the fishing season.

Additional information on such moulting events and changes in catchability is required to allow robust estimation of exploitation rates. As an index of harvest rate is a key measure in the decision rules framework for this

fishery, the acquisition of such information would enhance the accuracy of stock assessments obtained using the integrated fishery model. The resulting increase in the reliability of stock assessments would directly benefit the fishery through improved decision-making outcomes.

More information: Simon de Lestang, Western Australian Fisheries and Marine Research Laboratories, 08 9203 0174, simon.delestang@fish.wa.gov.au

GLOBAL OUTLOOK FOR SCHOLARS 2007/315

Through FRDC scholarships, Nuffield Australia aims to provide a significant boost to the fishing and aquaculture industry's understanding of the international forces affecting the industry and the need to adopt new technology and management practices to continue to maintain productivity growth.

The following FRDC scholarships were awarded:

- 2008 – Lester Marshall, Port Lincoln;
- 2009 – Adam Butterworth, Port Lincoln; and
- 2010 – Ian Duthie, Tasmania.

In addition, and largely as a result of promotion of Nuffield Scholarships within the industry, South Australian Ben Tyley was awarded a Sidney Myer scholarship in 2010.

Outcomes include: encouragement of greater participation by younger primary producers in the fishing and aquaculture industry; nurturing of a global perspective of their enterprises; encouraging an ethos of lifelong learning; and membership of an elite group of farmers around the world – an invaluable lifelong network of contacts and information transfer.

More information: Jim Geltch, 03 5480 0755, jimgeltch@nuffield.com.au



Discarded scallops caught by prawn trawlers in Shark Bay.

SCALLOP ASSESSMENT IN SHARK BAY 2007/051

The mortality rates of discarded scallops caught by prawn trawlers in Shark Bay are higher in summer than in winter, a finding from this research project that has led to a review of bycatch management in this fishery. A trial of 60-millimetre square mesh codend nets showed it was more effective in catching larger scallops, with fewer small scallops and other bycatch retained than the standard 100-millimetre diamond mesh codend used in the Shark Bay Scallop Fishery.

Recent changes to trawl management in Shark Bay do not appear to have been a significant influence on changes to the recruitment of scallops in the bay, a finding that does not support a spatial closure of the central scallop grounds

Hydrodynamic modelling of larval movement has shown fishing grounds close to the mouth of the bay are subject to flushing, and that while there may be connectivity between some scallop grounds, others have independent populations. This has resulted in changes to management practices to maintain healthy spawning stocks at each fishing grounds.

More information: Mervi Kangas, 08 9203 0199, mervi.kangas@fish.wa.gov.au

NNV DETECTION TECHNOLOGY 2008/041

This project has successfully developed and transferred technology to industry to accurately identify nervous necrosis virus (NNV) infection in Barramundi and Australian Bass.

This technology can also help to accurately identify the main means of infection of hatcheries, reducing the impact of disease in hatcheries and lowering the risk of spread of disease to natural ecosystems, and recreational and commercial fisheries. The project has also helped to increase awareness of NNV within the industry and among government biosecurity agencies.

Management approaches can now be aligned more strongly with scientific evidence, with improved tools to make sound risk-based decisions for NNV management and control, and for animal movements.

More information: Richard Whittington, 02 9351 1619, richard.whittington@sydney.edu.au



Nuffield Scholar
Adam Butterworth.

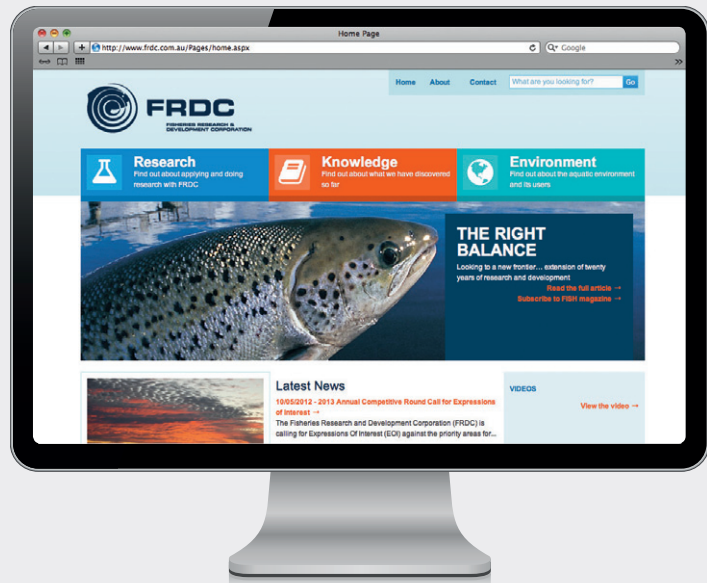
PHOTO: CATHERINE NORWOOD



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