FISH

FISHERIES RESEARCH & DEVELOPMENT CORPORATION **NEWS**

VOLUME 25
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JUNE 2017

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Preliminary program information available at: www.seafooddirectionsconference.com

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JUNE 2017

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REGULAR

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Mix 'n' match

Fisher experiences will play a crucial role in extending the use of new gear designed to reduce prawn trawl bycatch and improve fleet efficiency

By **Catherine Norwood**

After more than 20 years of research, Australian prawn trawl fisheries already have an extensive 'toolbox' at their disposal to improve efficiency and reduce environmental impact. Trawl nets are the only way to catch Australian prawns so these innovations are vital if we want to continue to eat Australian wild-catch prawns. But the adoption of different gear modifications and operational strategies has varied considerably between fisheries.

To help industry better match and modify existing solutions to suit specific prawn fisheries, the Australian Council of Prawn Fisheries (ACPF) is developing a plan to take the existing 'toolbox' of developments to ports around the country.

This follows a two-day workshop in Sydney in February, attended by industry representatives from all prawn trawl fishing states, as well as fisheries managers, researchers and gear modification experts. The aim of the workshop was to identify further research needs, particularly those related to reducing bycatch and improving fuel efficiency.

At the workshop, an overview of work already undertaken and discussions of industry issues, state by state, identified that extension of existing bycatch mitigation measures and their suitability should be the priority, rather than new projects. The workshop report is available on the FRDC website: http://frdc.com.au/research/final-reports/Pages/2016-057-DLD.aspx

Shared experiences

The ACPF and the FRDC hosted the workshop and ACPF executive officer Rachel King says it proved a good opportunity to exchange ideas between fisheries, and between researchers and industry. "We found the fishers attending were keen to share their experiences and learn from each other," she says.

Workshop participants were also keen to get a better understanding of research being done overseas which might have applications in Australia. This included initiatives in Europe as a result of the implementation of the Landing Obligation (often referred to as the "Discard Ban" involving the phasing-out of discarding of certain species).

The ACPF is planning portside presentations of the prawn trawl research to help fisheries "gear match" existing tools to address specific operational issues. Dates are in the process of being finalised.

"It's important that these aren't just 'talk and leave' events," Rachel King says of the proposed presentations, for which dates are still being finalised. "We need co-investment from industry and research agencies to help evaluate the onboard performance to ensure the solution fits the need and to increase adoption where appropriate".

One such project has been undertaken in the Northern Prawn Fishery (NPF) where industry aims to reduce bycatch by 30 per cent. The NPF Industry recently trialled a number of innovations aimed at reducing bycatch and worked with the Australian Fisheries Management Authority and CSIRO to ensure scientific validation of the results.

Among the designs trialled is a new bycatch reduction device (BRD) known as the Kon's Covered Fish Eyes (KCF) device. The CSIRO analysis of the data collected during the scientific trials showed the KCF BRD reduces small fish bycatch by an average 36.7 per cent compared to the Square Mesh Panel BRD, with no prawn loss.

In spite of the success in the NPF, these results may not translate directly to the same level of effectiveness in other prawn fisheries. The KCF BRD could be trialled in other fisheries but further modification of this and other BRD designs may be required to suit different fishery conditions.

The sharing of the onboard experiences between fishers can provide valuable information to improve adoption of new gears – what worked, what didn't and any tweaks which

Trawlers fishing the Clarence River near Maclean, NSW, for prawns. Photo: Wade Labe

might have been made, which is all often undocumented. Greater networking between fishers and fisheries is expected to be an important part of these future extension efforts.

FRDC program manager Crispian Ashby says there have already been significant reductions in bycatch and improved fuel efficiency in prawn trawl fisheries over the years. BRDs for a wide range of species are already widely used although, as the NPF project indicates, further improvements can be made.

Escape options

Crispian Ashby says most modifications have focused on the cod-end of the net and helping non-target species to escape. Prawn nets use smaller mesh than general fish trawl nets, because prawns are generally much smaller than fish.

"The unintended consequence is that the nets retain small fish that might be in the same area as the prawn trawl's path, and we end up with fish that are not targeted, but which are brought onboard.

"The public perception of this – fish that are discarded – is one of a potential protein source being wasted. There are also other potential ecosystem impacts that might come from reducing quantities of fish.

"We have done a lot of research looking at the back end of the net, the codend where the catch aggregates. BRDs – fisheyes, radial escape sections, square mesh panels, square mesh cod-ends, grids, turtle excluder devices – they are all about trying to sort the catch as it starts to collect towards the back of the net.

"This is sometimes achieved by manipulating water flow characteristics in the net. As the net is towed through the water, the way the net displaces water creates areas of high and low velocity. By understanding how fish behave in the net, and swim differently to prawns, you can use water flow to encourage fish to move toward the exits."

Front end strategies

More recent work has focused on modifications to the anterior trawl – the front of the net – looking at the trawl boards, foot ropes and headlines to reduce drag and disturbance of the sea floor.

This includes modifying the net spreading mechanisms, the positioning of boards used to hold the nets open, the number of nets,

→

net tapers, hanging ratios, twine size, knot orientation, sweeps and ground gears.

The more drag, the more power the trawlers need and the more fuel they use. Strategies to reduce drag include using a finer twine, increasing the mesh size, changing the net mesh orientation and even using different knot configurations.

Research in NSW has found that combinations of many smaller nets rather than one larger net can reduce drag and fuel use, while maintaining the same 'swept area' of each trawl and therefore the same potential catch.

The trawl or otter boards used to hold open the nets are essentially solid objects being towed through the water. The larger the net, the larger the boards and the greater the drag they create. Reducing the time the net is towed through water has also been shown to reduce bycatch. Less bycatch reduces the potential damage to the targeted prawn catch and increases the value of the catch.

"There is a lot of knowledge about what can be done," says Crispian Ashby. "Now the issue is getting that out to the industry, and helping to trial modifications that will work for them."

To be properly tested, gear and BRD trials need to happen during actual fishing periods. The trials need to be well designed and scientifically robust to make best use of fisher's time and investment. F

More is less

Research by the NSW Department of Primary Industries suggests that using more, smaller rigs in prawn trawling can improve fuel efficiency and reduce bycatch.

It evaluated the fuel efficiency of a single trawl rig at 2.88 litres per hectare, which was reduced to 2.44 litres per hectare for a double rig, and even further to 2.13 litres per hectare for a triple rig.

Bycatch in the double rig was reduced by 26 per cent compared to the single rig, and by 44 per cent in a triple rig.

Triple rig

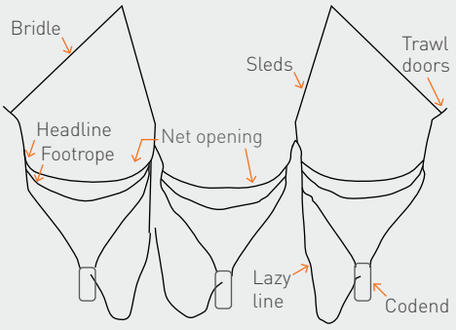


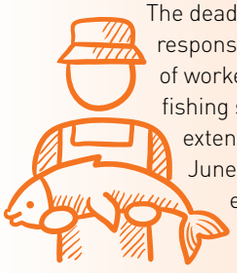
Table 1: Summary of gear modifications for Australian prawn trawl fisheries

MODIFICATIONS AT OR NEAR THE CODEND OF NETS		
MODIFICATION	**DESCRIPTION**	**PURPOSE**
Physical and behavioural type bycatch reduction devices	Grids, square mesh panels, full square mesh cod ends, funnels, super-shooters, T45, T90.	Provides a physical stimulus to induce an escape response by an animal.
Turtle exclusion devices (TEDs)	Modifications to TEDs to increase water turbulence and help fish, turtles and other creatures escape via the TED.	Originally designed as a physical stimulus to guide turtles out of the net, these devices are also useful for sharks, rays and fishes. TEDs are a form of grid.
Fisheyes	Including new design from the Northern Prawn Trawl, Kon's Covered Fisheyes.	Creates areas of high and low water flow, as well as an opening to stimulate fish to swim out of the opening.
Adjusting tow speed (and water flow)	Improves the effectiveness of TEDS and bycatch reduction devices (BRDs).	Increasing or decreasing the speed that the gear is towed at can improve the performance of the BRDs and trawl net by keeping nets open.
Visual clues to promote fish escapes	In clearer water different contrast of nets can be used to visually stimulate animals to escape. At night lights could be used.	
MODIFICATIONS TO THE NET OPENING OF THE TRAWL		
Overall trawl design	Single, double, dual, triple, quad and penta-rigs, beam trawls, W trawls and tongue trawls.	The trawl net can come in many different styles and configurations, such as single (one trawl net) to penta-rig (five smaller trawl nets). These can reduce drag, open meshes and potentially improve water flow.
Otter board design to improve efficiencies	Multi-foil doors, batwing boards, Bisons, cambered doors.	Otter boards are used to spread the mouth of the net. They come in several different shapes and sizes that can reduce drag and bottom contact.
Ground gear	The possible use of wheels and sleds on boards.	Ground gear is placed on the trawl to help the stability of multi-trawl nets (such as penta-rig) and also stimulates prawns to move into the trawl. Different types of ground gear can have different footprints on the bottom – the aim is to minimise disturbance.
	Improved performance by using fewer boards, and more sleds etc. Different ground gears including different-sized chains, soft-brush gear, and so on.	
Net construction	Simple lines at the mouth of the trawl (the simple anterior fish excluder).	Different types of trawl net construction can change the way the net operates and can reduce drag or reduce the amount of unwanted catch in the net. Things such as twine size, twine type and tapers can influence this.
	The role of twine size, net length, sweep length, low-drag netting, etc. in reducing drag and bycatch Wing mesh height and orientation (T45 and T90), and Trawl body taper, mesh size, seam number, and hanging ratios. Trawl body taper, mesh size, seam number, and hanging ratios.	

Access trade data

Import and export seafood trade data is now publicly available on the FRDC's website, via its seafood trade dashboards, at frdc.com.au/trade/pages/default.aspx. It includes export and import trade data, updated monthly from data that ABARES sources from the Australian Bureau of Statistics. It also includes production data and can be filtered by commodity type (edible, non-edible), import or export, financial year, state, country and commodity description (abalone, anchovies, etc).

More time for fisher health survey



The deadline has been extended for responses to the first national survey of workers in Australia's commercial fishing sector. The survey has been extended by a month, until 30 June 2017. It can be filled out either online or by mail. It takes approximately 20 minutes to complete.

Deakin University researcher Tanya King is leading the project, funded by the FRDC, to learn more about the stress and mental health challenges affecting the industry's workforce. "A lot of focus is given to the health of our fisheries – and they're in good shape – but we've tended to overlook the value of the people within the industry who keep everything ticking over," Tanya King says.

The survey is open to all Australians with a commercial interest in the seafood harvesting industry, including licence holders and business partners. It takes approximately 20 minutes to complete. Deckhands and women who are the business partners of active fishers are particularly encouraged to complete the survey as they are often overlooked in studies of the fishing industry. Hard copies of the survey can be requested via email (tanya.king@deakin.edu.au) and an online version is also available at **www.surveymonkey.com/r/fisherhealth**.

Nominations open for industry awards

Nominations for the National Seafood Industry Awards are now open, with the winners to be announced during a gala dinner as part of the national industry conference Seafood Directions in Sydney in September. Award categories include: Primary Producer; Business (large); Business (small); Research, Development and Extension; Environment; People Development; Promotion; Restaurant; Take-away Fish and Chips; Young Achiever; and Industry Ambassador.

An additional national category this year is the Safety Award, sponsored by the Australian Maritime Safety Authority. The FRDC is also coordinating the national Fish and Chips Awards, adding a People's Choice category (see story page 10). Nominations are also open for the Seafood Hall of Fame. Award nominations will close on Friday 25 August 2017. Seafood Directions will be held at the International Convention Centre in Sydney from 27–29 September 2017, with the gala dinner and award presentations at the centre's grand ballroom on Thursday 28 September.

Nominees for the national awards must be the winner of a similar award category at the state/territory awards, with there being only one nomination from each state/territory peak body.

Dates for state/territory awards

NSW and Australian Capital Territory: 20 July 2017
Queensland: 30 June 2017
South Australia: 12 August 2017
Victoria: 21 July 2017
Western Australia: 3 August 2017
Tasmania: 1 July 2017
Northern Territory: 12 August 2017

More information:
www.seafooddirectionsconference.com

NEW PEAK BODY FOR SEAFOOD SECTOR

The inaugural board of directors for the fisheries sector's new, national peak body, Seafood Industry Australia (SIA), has been formed, with Veronica Papacosta of Sydney Fresh Seafood elected as the inaugural chair. The Australian Government provided $535,000 to support the formation of a peak body and has welcomed the formation of the SIA. Assistant Minister for Agriculture and Water Resources Senator Anne Ruston says when industry speaks with one voice to government it has a greater impact. "Importantly, the SIA has widespread industry support, with more than 100 organisations and individuals pledging their financial support," she says. "I am confident that the SIA will be a strong advocate for Australia's $2.8 billion seafood industry."

Together with the Commonwealth Fisheries Association and state-based organisations, the SIA will provide governments at every level with a united voice to advocate on behalf of the Australian seafood industry. Other board members are: Chauncey Hammond (deputy chair), Belinda Wilson (company secretary), Marshall Betzel, Dennis Holder, Mark Ryan and Marcus Stehr. The expertise of directors encompasses wild-catch, aquaculture and post-harvest sectors, including retailers and exporters.

More information:
www.unitedseafoodindustries.com.au

DISCOVERY

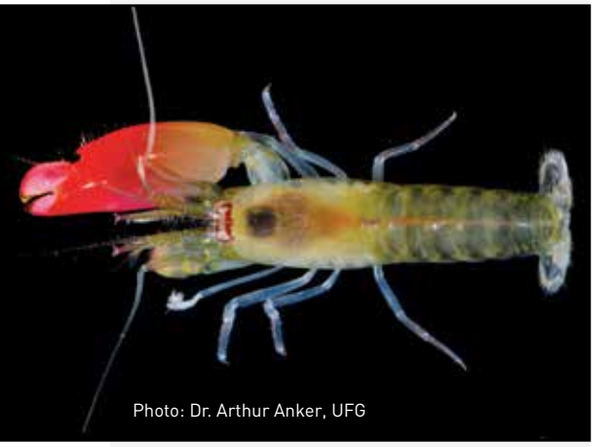


Photo: Dr. Arthur Anker, UFG

SHRIMP, YOU ARE HERE

A pink-clawed shrimp that makes noise loud enough to kill small fish has been named in honour of British band Pink Floyd.

Synalpheus pinkfloydi was discovered by a group of analysts from the UK, Brazil and the US, off the coast of Panama and named by Sammy De Grave, head of research at Oxford University Museum of National History in the UK. He told the BBC he and his team had long ago undertaken to honour their rock heroes if they discovered a new species of pink shrimp.

The Pink Floyd shrimp is part of the Alpheidae family, more commonly known as snapping or pistol shrimp. Their name comes from their ability to generate lethal sonic energy by closing an enlarged claw at rapid speed, creating a cavitation bubble.

The bubble's implosion momentarily creates temperatures of 4400°C – about as hot as the surface of the sun – and generates noise levels of up to 210 decibels – one of the loudest sounds found in the ocean and almost twice as loud as the average rock concert (100 to 120 decibels).
Source: BBC

WORD WISE

Each issue we will try to clarify the meaning and use of some commonly misunderstood words in fisheries science, beginning with the basics.

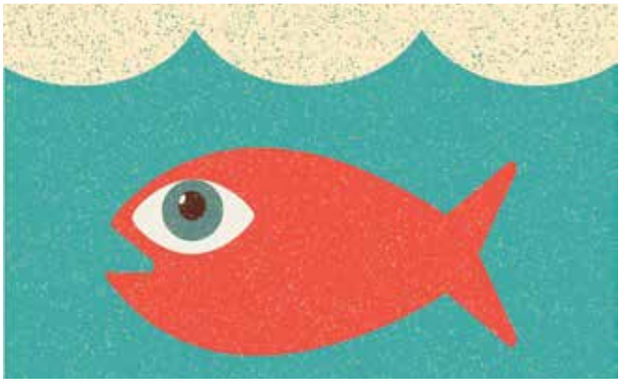
WHAT IS A 'FISH STOCK'?

A litre of water and a fish carcass or two, boil for a few hours and you have ...

A stock is another way of saying population or sub-population. Use of the term *fish stock* usually implies that the particular population is more or less isolated from other stocks of the same species and hence self-sustaining.

The *Status of Australian Fish Stocks (SAFS) Reports* uses the term 'stock' generically for populations of fish defined at any of three levels – biological, management units and populations assessed at the jurisdictional level.

A biological stock is a discrete genetic population or a population of fish that is not interacting with other fish populations of the same species. That means this population size can be treated as relatively constant and changes to its structure and size can be measured. It is not always practical to measure an entire biological population, so the unit may be defined in other ways such as who manages it or where it is. A key aim of fisheries management is to ensure that biological stocks are maintained at sustainable levels.



TECHNOLOGY

Fish passage mapped

Updated maps of Queensland waterways determining their importance for the passage of fish are now available free online.

The Queensland Waterways for Waterway Barrier Works data is designed for developers, government agencies and landholders planning works that may affect fish movement. This work could include new dams or crossings such as bridges and culverts.

Fisheries Queensland biologist Ian Draper says the colour-coded maps clarify whether properties contain waterways and help to determine what type of development approval is required for waterway barrier works to proceed.

The updated data also highlights the importance of smaller coastal streams that flow directly out to estuaries.

"These are valuable fish-breeding and nursery areas for Queensland's commercial, recreational and indigenous fishers," Ian Draper says.

The mapping is available online – without the need for specialist geographic information system software – at: http://www.arcgis.com/home/item.html?id=03653d9c6d674d5ebdc772d4b61ec400

DOWNLOAD WHAT DISEASE IS THAT?

Australia's latest field guide on aquatic diseases is now available to download.
The Aquatic Disease Field Guide app, produced by the Australian Department of Agriculture and Water Resources provides comprehensive information on 48 diseases from Australia's National List of Reportable Diseases of Aquatic Animals.

The FRDC has invested in the revision and expansion of several versions of the field guide. It helps commercial and recreational fishers, aquaculture workers, biosecurity staff, seafood processors, retailers, scientists and students to recognise diseases of significance in finfish, crustaceans, molluscs and, for the first time, amphibians.

This easily accessible biosecurity information will allow faster reporting of incidents to relevant authorities and help to protect Australia's $2.8 billion fishing industry from disease threats.

The Aquatic Disease Field Guide app is available from iTunes, Google Play and Microsoft Store.

More information: www.agriculture.gov.au/aquatic-disease-field-guide

MORE INFORMATION
www.freo2.org
FRDC RESEARCH CODE: 2008-339

Left to right Dr Kim Ritman (Chief Scientist, ABARES), Dr Patrick Hone (Executive Director, FRDC), Mr Kevin Rassool, Anne Ruston (Senator for South Australia and Assistant Minister for Agriculture and Water Resources), Ron Boswell (Chairman of the Board, FRDC). **Photo:** Steve Keough

Oxygen engineer wins FRDC award

An innovation award recognises potential uses in aquaculture for new oxygen generation technology

By **Tom Bicknell**

What does a child suffering pneumonia in Uganda have in common with a Barramundi raised in a tank in Western Sydney? They both need concentrated oxygen, preferably without a big electricity bill.

Addressing that common need has been the focus of the FREO2 Foundation, a company that evolved from research at the University of Melbourne to develop a water-powered oxygen concentrator called the Siphon.

In recognition of the promise of this work for aquaculture, FREO2 engineer Kevin Rassool won the FRDC-sponsored award at the 2017 Science and Innovation Awards for Young People in Agriculture, Fisheries and Forestry. The award was presented at the Australian Bureau of Agricultural and Resource Economics and Sciences Outlook conference in March and includes funding to assist his research.

Kevin Rassool is in charge of the Siphon's expansion into the aquaculture industry, but the technology was initially developed to treat pneumonia in developing nations with support from partner organisation Saving Lives at Birth. Pneumonia is the leading killer of children in much of the developing world, in large part because of unreliable supplies of concentrated oxygen, which is the primary treatment method.

"The Siphon was conceptualised to provide oxygen to communities that don't have electricity," says Kevin Rassool. "Ninety-five per cent of pneumonia deaths are in developing countries. They often don't have electricity, but they do often have a stream."

By directing running water through a raised pipe the Siphon creates a vacuum, which is the power source used to concentrate the atmospheric air into oxygen. The vacuum 'squeezes' air through a molecular sieve, effectively trapping all the nitrogen and removing it from the air. The resultant gas is up to 95 per cent pure oxygen. It uses no electricity, and the only ongoing cost is replacement or refurbishment of the cheap molecular sieve after five to 10 years.

Closer to home, the technology is of interest to aquaculture operators.

Dissolved oxygen level in water is one of the key limiting factors for intensive aquaculture, and many operations use concentrated oxygen diffusers. Concentrated oxygen is sourced either bottled from industrial suppliers, or produced on-site using an oxygen generator. But traditional oxygen generators use a large amount of electricity and are subject to power outages.

Kevin Rassool at Green Camel's facility in Sydney.

In 2016, the FREO2 Foundation formed a partnership with Green Camel, an aquaponics farm in Western Sydney that produces Barramundi. Kevin Rassool, who manages the partnership, says the Siphon offers Green Camel a cost-efficient and reliable alternative to the traditional oxygen supply options.

"Green Camel currently gets liquid oxygen produced off-site. It's an ongoing cost, and it's quite expensive," he says.

The Siphon system, which FREO2 is installing in 2017 at Green Camel's facility at the University of Sydney, will be powered by 'salvaged' energy from Green Camel's wastewater system, meaning minimal ongoing costs.

The expanded use into aquaculture is expected to help drive the Siphon's future development. "We were really happy when we started speaking to people in aquaculture, because we see it as complementary to our work on the medical side," says Kevin Rassool. "From a technical perspective the system is almost identical, so any innovation or advancement we have in aquaculture can be directly related back to our medical system, and vice versa."

For an engineer driven by health outcomes in the developing world, Kevin Rassool sees more productive aquaculture as part of a broader systems approach to health. "If we can increase food security, especially protein in developing countries, we can reduce sickness rates. It's the same goal, but one step back – prevention, rather than cure," he says. F

MORE INFORMATION
www.fishandchipsawards.com.au
FRDC RESEARCH CODE: 2016-136

People's choice for fish and chips awards

There's a new look to the National Fish and Chips Awards in 2017 as the FRDC promotes a new people's choice category, which will run in conjunction with the National Seafood Industry Awards in September.

Each state and territory fishing industry council has historically run individual industry awards, of which the Fish and Chips Award is just one category. This year, however, the FRDC is coordinating two Fish and Chips Award categories – people's choice and judge's choice – across all state, territory and national awards.

All fish and chips entrants will be rated against five criteria – taste, service, choice, information and labelling. The FRDC's communications, trade and marketing manager Peter Horvat says the decision to include a people's choice award this year will help the seafood sector engage with consumers in an accessible way.

"Everyone has almost iconic memories of eating fish and chips at the beach, feeling that connection to the ocean. We want to build on that. Those memories can help build connections between the public and producers – those fishers working to source the best products for consumers in Australia."

Through the awards the FRDC aims to engage with consumers and deliver key messages related to the science that underpins Australia's fisheries and their management. The FRDC will also use this opportunity to better educate and inform consumers on the sustainability of Australia's fisheries and the wide range of seafood options on offer.

The National Fish and Chips Awards will be presented as part of the National Seafood Industry Awards on Thursday, 28 September, 2017 at the Seafood Directions Conference in Sydney. F

To vote or for more details visit wwww.fishandchipsawards.com.au or www.facebook.com/catchoftheyear.

Memories made with the right ingredients

Fresh, local, high-quality seafood has helped create a successful formula for the most recent winner of the National Fish and Chips Award

By **Rebecca Thyer**

A salty breeze, the sound of the ocean and pesky seagulls wanting to be included in a delicious meal of fresh, battered fish and hot, crispy chips form an enduring memory for Kelly Morgan. Her earliest fish and chips recollection involves Sydney's Manly beach and her grandfather.

Memories can be powerful connections to our past and to our present communities.

When love and opportunity saw her open her own fish and chips shop in central Queensland years later, she wanted to offer her customers the same quality and freshness she remembered from her childhood. "It needed to taste fresh and like it came from the ocean," she says.

For Kelly Morgan, who won the National 2015 Fish and Chips Award, her earliest recollections have not only helped to create a successful business, but are helping to build links between professional fishers and the public.

Her journey to becoming an award-winning operator began when she met and fell for a third-generation commercial reef fisher, Andrew Morgan, 15 years ago.

Although a registered nurse with a 17-year career, she saw a demand in her new local area – Mackay, north Queensland – for freshly caught seafood and decided to take a chance. So in 2006, with an esky and some ice, she took a break from nursing and started selling Andrew's catch from the back of her LandCruiser – with the motto 'Fresh from the fisherman's wife'. That catchphrase helped her spell out the link between professional fishers and the public. "I felt I had a responsibility to promote the industry in a positive way and I still do. I have always been proud to be a part of the Queensland fishing industry and promoting it in a positive way to the public is important to me. We can educate and involve the public by giving them the ability to make informed choices about the seafood they are eating, doing the best to make Australian seafood a prominent choice to consumers." She soon found the LandCruiser was not big enough; nor was the refrigerated truck that followed.

"The business snowballed," she says. "I started our first shop, but we soon outgrew that and moved to larger premises." Now the Morgans have three retail fish and chips and fresh seafood stores in Mackay, employing 40 staff, in addition to Andrew's commercial reef line business.

As a relative newcomer to the industry, Kelly Morgan knew what she wanted her business to emulate: "We had access to a fresh, quality product and I wanted our retail outlets, staff and professionalism to match those attributes."

As well as Andrew's catch, Kelly Morgan also sources seafood from other local boats and relies heavily on a local wholesaler to provide her with enough fish to meet ever-increasing demand.

Left The Morgans' crumbed fish uses a breaded crumb to give a nice crunchy texture. **Far left** Kelly Morgan with her award.

Photos: Sally Morgan

The fish sold is seasonal. When Barramundi and reef closures are in place, stock needs are assessed and snap-frozen product is used.

The most popular fish tend to be Red Throat Emperor or Barramundi. "We sell Spanish Mackerel as our fish of the day and it is popular with locals," Kelly Morgan says.

The most popular way to cook it is hard to gauge; locals are keen on both crumbed and battered options, she says.

"Crumbed fish is very popular and we use a coarse, breaded crumb, which gives a nice crunchy texture. That said, battered is a favourite as well and I think the lighter and crunchier the texture the better it tastes and the less oil it holds."

Constant experimentation has led them to batter perfection. "After numerous batter trials we have found one that works and we make it daily instore. It's light and it's crispy – basically just self-raising flour, water, egg and food colouring that is well-mixed and kept refrigerated."

The trick, she says, is to keep batters cold – it helps make the fish really crunchy.

Chips and potato scallops, also known as potato cakes, are equally important offerings. Potato scallops are made instore using an extra-large Golden Delight variety of potato. "We slice them skin-on, then pre-cook in batter, refrigerate, then cook again to order. We have been accused of having potato scallops bigger than our pieces of fish," she jokes.

Combined, the retail outlets sell about 4000 kilograms of potato scallops a year.

An 11-millimetre cut product is used for chips and 1000 kilograms are sold in an average week.

The key to the crispiness of both potato products is the oil used, Kelly Morgan says.

Although cottonseed oil is used for fish and other products, the potatoes are cooked in animal fat, which she says gives the chips a better depth of flavour and crunchiness.

For those customers wanting another seafood option or a gluten-free choice, an extensive range of fresh fish, salads, prawn cocktails and garlic prawn skewers are also on offer.

All fish is filleted and prepared daily instore in open, clean kitchens, where local prawns are peeled and crumbed for prawn cutlets, calamari is sliced and crumbed, and homemade fishcakes prepared.

"Freshness and quality are two of the most important things in my businesses and I know that is one of the main reasons our stores are so popular with the locals and tourists.

"We are proactive in complying with standard labelling and providence labelling so our customers really know what they are getting. Promoting wild-caught and locally sourced sustainable seafood increases consumer confidence in the industry." F

Kelly Morgan sits on the Queensland Seafood Industry Association Board and various committees and is a participant in the FRDC's National Seafood Industry Leadership Program 2017.

FAST FACTS

- Kelly Morgan is the managing director of Morgans Fish, which operates three retail fresh seafood and fish and chips businesses in Mackay – Morgans Fish Market, Morgans Fish Bar and Morgans Northern Beaches.
- Together, the businesses chop and serve 90 kilograms of lemon a week, serve one tonne of chips a week and four tonnes of handmade potato scallops a year. About 450 kilograms of fresh fish a week is prepared instore.
- The most popular fish choices for their customers are Red Throat Emperor, Barramundi and Spanish Mackerel.

FAVOURITE COMPANIONS

Kelly Morgan's favourite fish is Barramundi, served lightly grilled with lots of lemon. "Oysters and champagne are one of my favourite mixes as well, but you can't go past a big barbecue seafood feast with a nice crisp craft beer."

KELLY MORGAN'S HOMEMADE FISHCAKE RECIPE

Makes about 50

INGREDIENTS

2 kilograms fresh-cooked potato, roughly mashed with butter
2 kilograms poached white fish fillets (we use Spanish Mackerel)
2 large onions, finely chopped
6 eggs
1 cup of breadcrumbs
Fresh parsley and dill, roughly chopped
Salt and onion salt for seasoning

METHOD

- Mix all ingredients together well.
- Scoop out balls of mixture into a ¾ cup measure.
- Mould into shape and coat in extra breadcrumbs.
- Refrigerate to firm before cooking.
- Deep or shallow fry until golden brown.

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FRDC RESEARCH CODE: 2016-266

Road map for prawn recovery

International experience is helping Australia's prawn farmers rebuild from the recent white spot disease outbreak

By **Wayne Hutchinson**

Francois Brenta visiting a Queensland prawn farm to assess potential biosecurity improvements. Photo: Gold Coast Marine Aquaculture

The detection and spread of the highly contagious white spot disease (a viral disease affecting crustaceans including prawns, lobsters and crabs) in Australia late last year has devastated prawn farmers in the Logan River region, south-eastern Queensland. Since the confirmation of white spot disease in late 2016, the FRDC has provided support to the prawn industry by helping document the disease as it spreads and the response by government and industry, and assessing the financial cost to aquaculture and fisheries. While the outbreak is devastating, there is a wealth of international experience with the disease that is providing guidance to help the industry recover and rebuild, while also helping to improve its defences against other disease threats. This knowledge has been used to develop a response plan, including the assistance the industry needs in order to recover.

In March, prawn farmers, government representatives, researchers and industry suppliers attended a workshop in Brisbane to hear how industries overseas have responded when confronted with white spot disease. The event was an initiative of the Australian Prawn Farmers Association (APFA) and supported by the FRDC and the Department of Agriculture and Water Resources.

International lessons

Case studies from Brazil, Ecuador and Saudi Arabia were presented at the workshop. All are countries where significant outbreaks of white spot disease have occurred and where prawn farming industries subsequently recovered production to levels similar to, or greater than, pre-outbreak levels. The case studies outlined the impact of the initial outbreak and the responses used to achieve business continuity.

Marcell Boaventura from Ridley Australia described the chronology and impact of white spot disease in Brazil, where it spread along 4300 kilometres of coast over 12 years, progressively affecting Brazil's entire industry. He highlighted the need to maintain environmental controls and to commit to biosecure procedures, particularly when production systems have been intensified as a means to recover production.

Francois Brenta, an expert in prawn farming and biosecurity, has worked in Brazil, Ecuador and Saudi Arabia. He told the workshop that Ecuador's production dropped from 114,000 tonnes in 1998 to 40,000 tonnes in 2000, following the initial disease outbreak. Production recovered during the next decade to 148,000 tonnes, which was made possible by several factors.

He highlighted the use of domesticated disease-free broodstock to supply post-larvae for farms, adoption of more rigorous biosecurity-focused management practices and support from government to reinforce disease control measures. He described a similar scenario for the disease impact and recovery in Saudi Arabia.

Key messages

The message to industry from the workshop was that disease is an ongoing business risk and must be managed accordingly. White spot is only one of several serious disease threats, and the Australian industry must remain vigilant.

Detailed approaches used in other countries to manage this risk at each stage of the production chain from broodstock to on-growing systems were presented. These included the:

- filtration and disinfection of pond water to eradicate virus carriers before stocking disease-free prawn larvae;
- establishment of a disease-free and disease-resistant broodstock breeding program;
- incorporation of high biosecurity standards across all parts of the production chain;
- greatly reduced water usage to minimise risk; and
- development of culture systems and methods to create a more stable and optimal growing environment to minimise stress.

Ongoing response

In the weeks following the workshop, Francois Brenta travelled to prawn farms in northern areas of Queensland to meet key staff, inspect production systems and discuss methods to improve biosecurity infrastructure and management approaches to reduce disease risk.

He then visited affected farmers in the Logan River region. From these visits and discussions, he is developing a report for the APFA that will provide practical recommendations to industry and government for managing the outbreak of white spot disease in Australia and a proposal for long-term solutions. F

For more information on white spot disease and details of FRDC research visit: frdc.com.au/research/final-reports/Pages/2016-057-DLD.aspx

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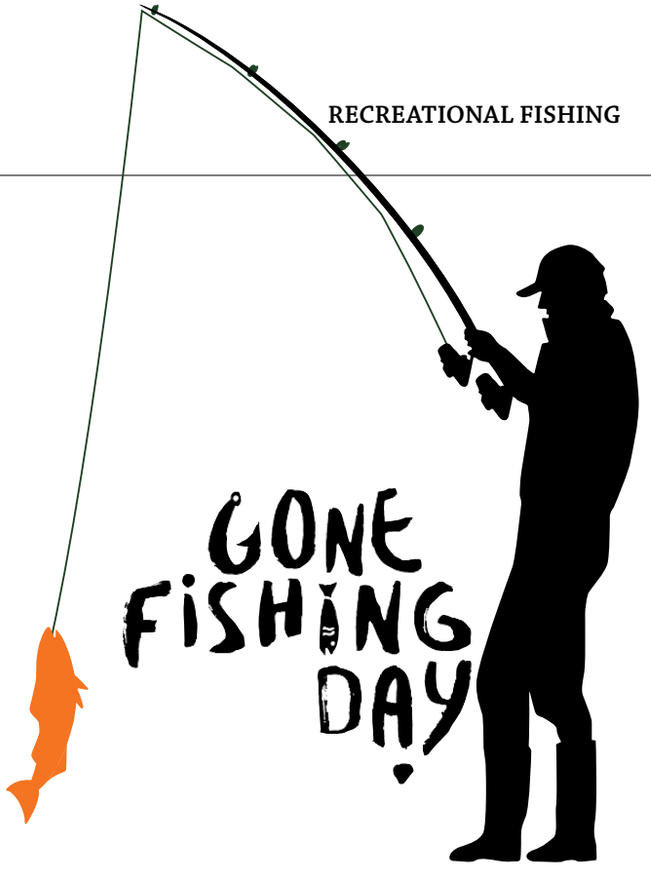
Best practice the focus of national 'Gone Fishing' campaign



In the recreational fishing sector, there is increased emphasis on the 'responsible' behaviour of participants to underpin continuing access to the nation's fisheries resources

By **Catherine Norwood**

The first national Gone Fishing Day, held in October 2016, has been hailed a great success, with NSW leading the way with six major events that attracted 15,000 registered participants.

The event provided a platform for the launch of the Australian Recreational Fishing Foundation's (ARFF) new National Recreational Fishing Code of Practice, which promotes best practice by recreational fishers. Assistant Agriculture and Water Resources Minister Anne Ruston, assisted by NSW Fisheries Minister Niall Blair, officially launched the code on Gone Fishing Day.

"What's in the code is common sense, and most fishers do it anyway," says Allan Hansard, managing director of ARFF, which was one of the partner organisations behind the event. "But we want to get a message to the broader community that recreational fishers are responsible members of the community and stewards of the fish resources they access."

The key principle that underpins the code of practice is respect, he says: respect for the fish being caught, whether they are released or kept for the table; respect for the environment; and respect for fishers themselves, including personal safety, when they venture out.

The new code of practice is an update on the national code first developed almost a decade ago by Recfish Australia. Funding from the federal Department of Agriculture and Water Resources assisted its redevelopment.

Allan Hansard says the revised code gives the ARFF the opportunity to launch a revitalised communications campaign. Different versions of the code will be prepared for different audiences – for example, versions specifically for children and for recreational fishers in migrant communities.

He says high-profile recreational fishers in the media already personify and model best practice in the way they fish. "But we hope they can be more explicit about the code of practice, and that it is something recreational fishers follow. It's not just about getting the message to recreational fishers, but also to the broader community, including government."

He says government support for the recreational sector is already strong, with the NSW Department of Fisheries providing grants to help clubs run Gone Fishing Day events. But the recreational sector, like the commercial sector, faces the challenge of access to the resource. A well-defined, widely acknowledged and adopted code of practice is part of securing support for access to fisheries.

National Gone Fishing Day is part of a larger agenda for the ARFF, which aims to raise community awareness about the value of recreational fishing and improve fishing opportunities for recreational fishers. Across Australia, 130 official Gone Fishing activities were reported, which would have attracted many thousands of people, Allan Hansard says. "And there would have been many others who just took the opportunity to go fishing with their family or friends on the day, without being part of any particular event," he says. F

- The National Recreational Fishing Code of Practice can be downloaded from recreationalfishing.com.au/images/ARFF-code-of-practice.pdf.
- The 2017 National Gone Fishing Day will be held on Sunday 15 October.

NATIONAL RECREATIONAL FISHING CODE OF PRACTICE: FOUNDING PRINCIPLES

Fishing	**I**nteractions	**S**tewardship	**H**abitats
I will respect and appreciate the fish that I catch.	I will respect other fishers and members of our community.	I will demonstrate care for fish and the environment I fish in through my actions.	I will respect, protect and restore wildlife habitats.

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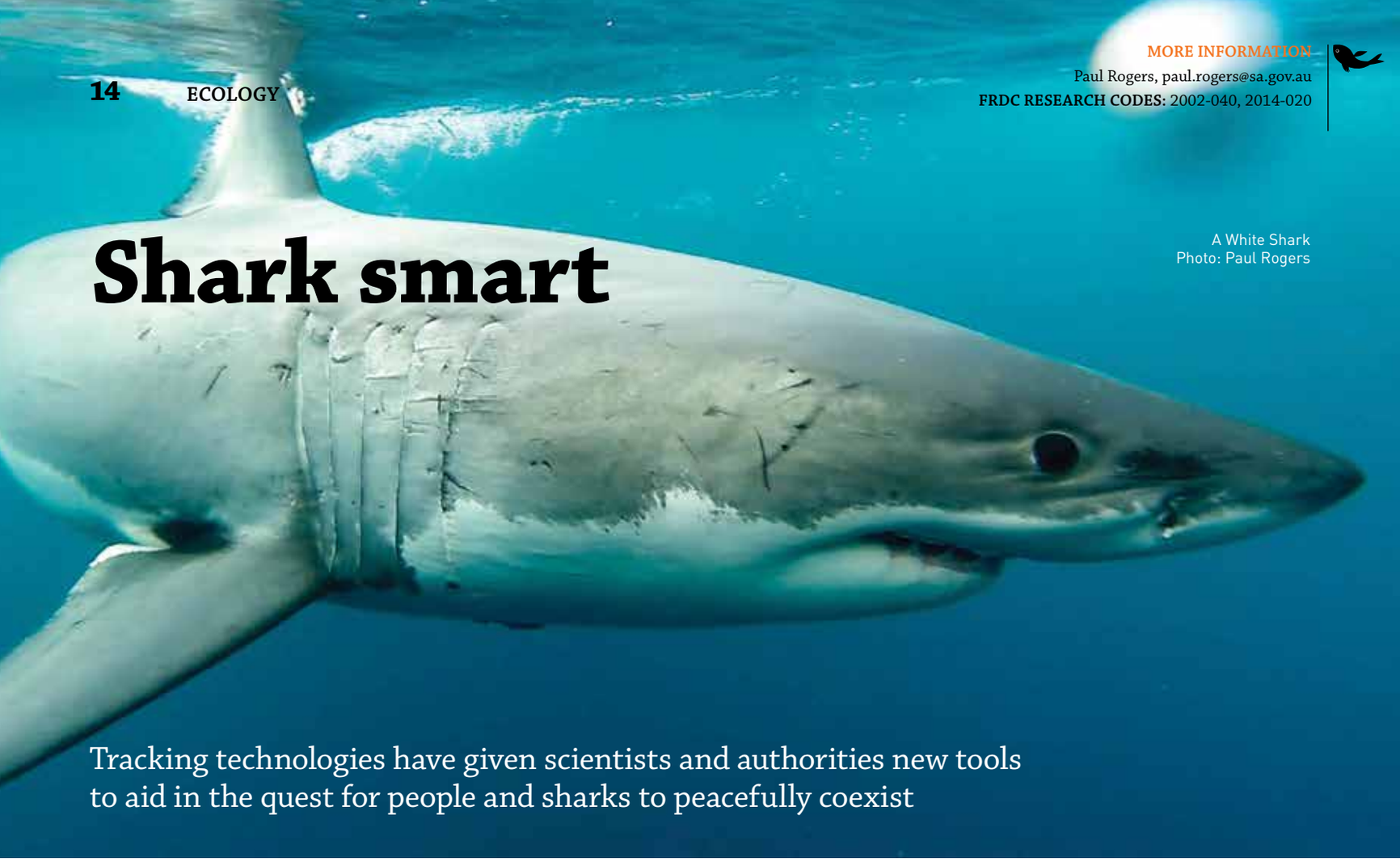
FRDC RESEARCH CODES: 2002-040, 2014-020

Shark smart



A White Shark
Photo: Paul Rogers

Tracking technologies have given scientists and authorities new tools to aid in the quest for people and sharks to peacefully coexist

By **Annabel Boyer**

The need to prevent shark attacks on swimmers and surfers while also protecting these top-order predators has led researchers and authorities to try a new approach. The emphasis has moved from deterring sharks to detecting, to inform people of their whereabouts. These measures are being used in concert with more traditional deterrents such as enclosures and barriers. The logic is that if people know where sharks are, they can stay out of the way – leading to better protection of both people and vulnerable shark populations.

Sharks are high-profile inhabitants of the marine environment, yet much about their movements is unknown. Research into the movement patterns of dangerous species of sharks – where they swim and why – is providing valuable information on how to minimise interactions between sharks and humans.

Recent projects have focused on two key areas: interactions with ocean-based activities including aquaculture and fishery operations in South Australia, and interactions with recreational beach users in NSW.

Sharks and aquaculture

In 2003, an FRDC-funded workshop with South Australian aquaculture operators and a broad range of other stakeholders identified the White Shark *(Carcharodon carcharias)* and Bronze Whaler *(Carcharhinus brachyurus)* as the species of greatest concern to operators.

A more recent FRDC project, led by Paul Rogers at the South Australian Institute of Research and Development (SARDI), is mapping the movements and whereabouts of White Sharks and Bronze Whalers in and around South Australia's Spencer Gulf and the eastern Great Australian Bight. The results of the project will inform discussions around the use of marine areas and aquaculture zoning regulations.

The Australian Southern Bluefin Tuna Industry Association (ASBTIA) ranches Southern Bluefin Tuna (SBT) in the waters off Port Lincoln on the Eyre Peninsula. It has supported research into shark movement patterns to better evaluate and address concerns from the broader community about the potential whereabouts of dangerous shark species. A key concern has been whether activities such as aquaculture draw more sharks to an area.

Claire Webber, research and liaison officer with the ASBTIA, has assisted on the project. She says interactions with sharks do happen in the aquaculture leases in the Lower Spencer Gulf, although not often.

By mapping how the movements and habitats of these species overlap with human activities such as swimming, surfing, fishing, aquaculture and diving, researchers hope to learn whether human activities attract sharks or if the patterns observed are part of typical seasonal and ecologically driven movement phases.

Tracking sharks

The tracking project has used data from previous satellite and acoustic tracking of White Sharks and Bronze Whalers, combined with anecdotal information from fishers and aquaculture operators, to identify the best locations to set up acoustic receiver arrays.

The arrays detect the passing of sharks fitted with acoustic tracking devices, which is then linked with information about the individual shark detected, such as size, sex, residency and movement patterns.

Chosen locations included Australian

Sea Lion and Long-nosed Fur Seal breeding colonies, Snapper habitats, possible deep-water migration pathways and offshore reefs, as well as selected inshore and offshore fish farm sites and inactive aquaculture sites.

As well as acoustic transmitters and acoustic-release receivers, dorsal fin-mounted satellite tags and miniature pop-up satellite archival tags were used to track sharks over large distances, including migrations across the Great Australian Bight to the Indian Ocean.

Paul Rogers says advances in the durability and sophistication of these technologies is making remote research into these highly mobile pelagic predators more feasible and provides clear direction for future research. GPS technologies coupled with oceanographic sensors help to understand more about how sharks use their habitats.

For example, pop-up satellite archival tags can be pre-programmed before deployment to monitor water temperature, depth and light intensity, latitude and longitude and time of day, for up to six months. This in turn provides researchers with the ability to understand the behaviours of these animals over time frames that were previously not possible.

Data matching

When a shark is detected by an acoustic receiver or satellite, coinciding environmental information is also logged, including time of day, month, water temperature, depth and ocean colour, which gives researchers an indication of things such as the presence of nutrients in the water column or the presence of warm or cold eddies.

Much of the environmental data comes from the Integrated Marine Observing System (IMOS), which collects information on water temperatures, ocean chemistry and other variables (see breakout).

"Once we have collected the tracking data we match it up to these valuable environmental data streams to explain why the sharks are likely be using those areas," Paul Rogers says.

This information is being used to unpick patterns that explain when and where apex predators, including sharks, tuna and their prey are likely to be at certain times, and this can be incorporated into predictive modelling. These types of models can help predict the potential impacts that multiple marine users in relatively small areas can have on sharks and, in some cases, the reverse impact of sharks on other users.

The project involved deployment of 66 electronic tags on White Sharks up to five metres in length and 24 Bronze Whalers up to 2.5 metres in length between 2013 and 2015. Paul Rogers says there were some surprising results.

"One of the key findings was that more White Sharks stayed longer in the Neptune Islands Group Marine Park than any other site or site type they visited," he says. Activities such as cage diving and fishing occur in the marine park and the area also has a significant Long-nosed Fur Seal colony, where more than 3000 pups are born every year.

He says at most other sites and site types, including seal colonies, Snapper habitats and deep-water contours, tagged White Sharks visited briefly and then moved on quickly

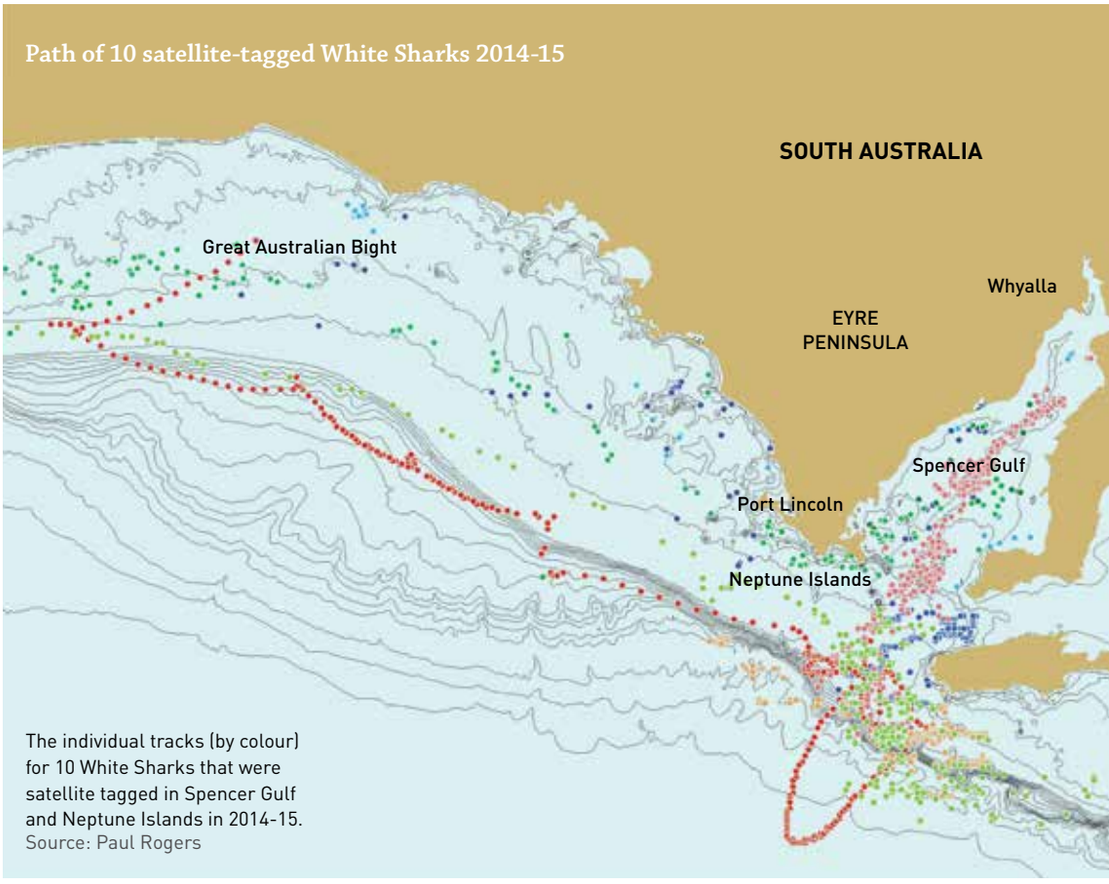
"This latter movement strategy was what we expected from these highly migratory predators, given their need to keep moving in order to feed their large appetites," Paul Rogers says.

Seasonal travel

The project also identified temperature and seasonal patterns linked to the movement of sharks in and around the Spencer Gulf.

Bronze Whalers were recorded in the Spencer Gulf in summer and autumn but moved offshore for winter. White Sharks, which are endotherms and can regulate their own body temperature, preferred to use the cooler waters in the Gulf through autumn, winter and spring and rarely visited the Gulf in summer.

The project also found that most aquaculture operations in the Spencer Gulf were not in the main shark travel



The individual tracks (by colour) for 10 White Sharks that were satellite tagged in Spencer Gulf and Neptune Islands in 2014-15.
Source: Paul Rogers

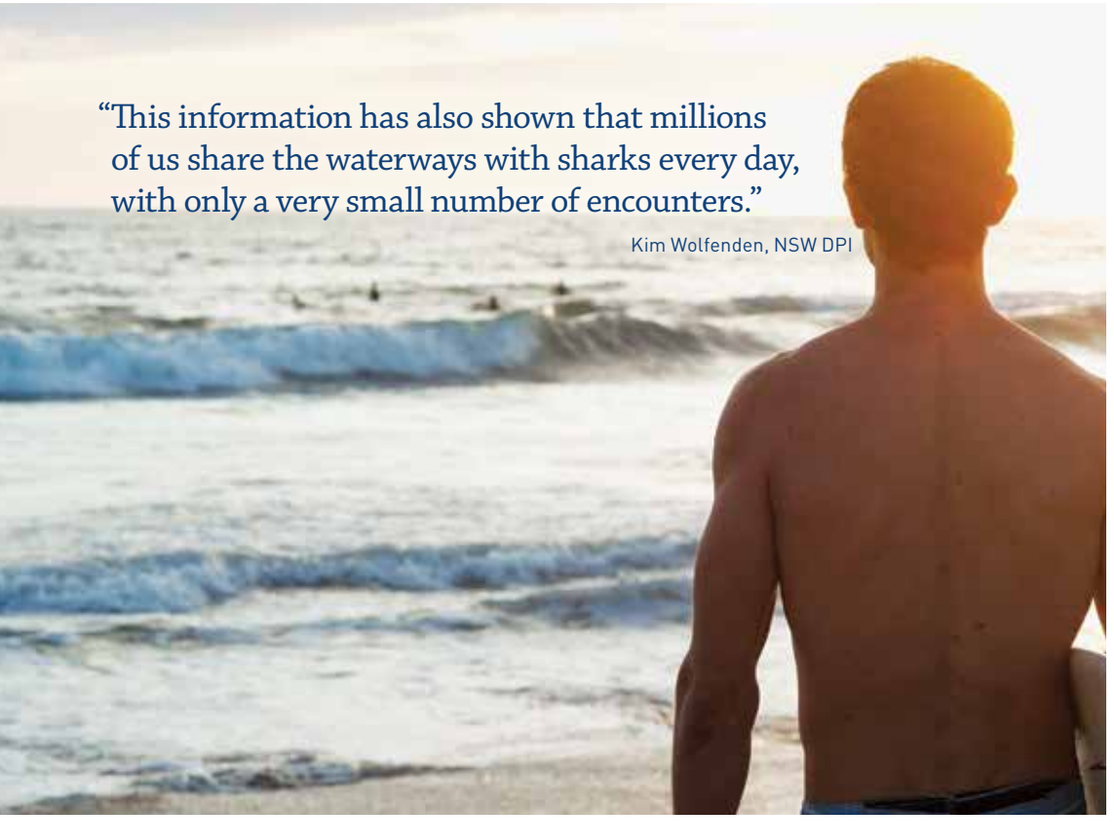
Integrated Marine Observing System

The Integrated Marine Observing System (IMOS) provides national research infrastructure and facilities around Australia to improve understanding of our ocean territories.

Its animal tracking facility has deployed a large number of surveillance arrays around the country to track sharks and other creatures. There are 16 arrays deployed by IMOS in collaboration with several partner organisations, with more than 2000 receiver stations.

The animal tracking database has already accumulated more than 65 million detections and is used in collaborative research that has involved more than 170 Australian and international researchers to date.

www. imos.org.au



"This information has also shown that millions of us share the waterways with sharks every day, with only a very small number of encounters."

Kim Wolfenden, NSW DPI

pathways, which were identified for White Sharks as deep-water Gulf and shelf habitats.

Paul Rogers says the findings are a positive result for aquaculture operators. "The data indicated low shark residency in natural foraging areas and regions used by that industry. White Sharks are regular visitors to deep-water offshore island habitats that are also valuable abalone fishing areas. We are currently working with the abalone industry to develop innovative safety solutions for their divers."

Claire Webber says the SBT industry has worked hard to improve its practices over the past 20 years, including efforts to reduce any likely attractions for sharks. For example, any dead fish in pontoons are removed daily and pontoon nets are well maintained to keep the SBT in – and other marine animals out.

To help operators on those very rare occasions when they encounter a shark in a SBT pontoon, the SA project developed best practice guidelines with industry in order to safely release the animal.

Stakeholder survey

In addition to mapping and managing shark interactions, the SA project also included a stakeholder survey on attitudes to aquaculture and other marine issues, and analysis of media reports.

Respondents included stakeholders likely to have an interest in aquaculture zoning discussions: natural resource managers, local government, surfing, recreational and commercial fishing and aquaculture. The survey included semi-structured interviews and media analysis, and found no strong link in the perceptions of those surveyed between sharks and aquaculture. Seals and marine protected areas were issues of greater concern.

Those surveyed were, overall, supportive of new aquaculture developments, and the survey findings will be used to develop communications materials and build confidence in the process around aquaculture zoning discussions in SA.

Real-time shark alerts

In NSW, the Department of Primary Industries (DPI) has developed SharkSmart, a program designed to reduce the number of interactions between people and sharks, specifically White Sharks, Tiger Sharks (*Galeocerdo cuvier*) and Bull Sharks (*Carcharhinus leucas*). The focus is on detection and deterrence – increased awareness that changes the behaviour of swimmers and surfers.

In 2013, the NSW DPI first released SharkSmart as a free smartphone app to provide the public with information about the location of sharks and beach safety information. In 2015, a major upgrade to the app included dynamic, real-time information about the location of tagged sharks. This generates alerts from area surveillance about potentially dangerous sharks near swimmers and surfers. It also provides maps of shark sensor locations and shark barriers and enclosures along the NSW coast.

Shark alerts are also provided on the @NSWSharkSmart Twitter account.

A community engagement officer with NSW DPI, Kim Wolfenden, says the app is being continually improved. The most recent upgrades allow users to filter alerts to specific beaches and set the times they would like to receive them. The app has already been downloaded more than 20,000 times.

"We receive a lot of positive feedback that people can access this real-time data. This information has also shown that millions of us share the waterways with sharks every day, with only a very small number of encounters," she says.

Surveillance network

The locations of tracking receivers are strategic, taking in some of the state's most popular beaches. Other surveillance methods include aerial surveillance using helicopters and drones.

Twenty sensors or listening stations along the NSW coast are part of the IMOS national array and they can detect sharks that swim within 500 metres. Once a shark has been detected, information is relayed to DPI shark scientists, validated and then sent to beach authorities and the public.

Twenty-five SMART (Shark Management Alert in Real Time) drumlines are also set up, designed to catch but not kill sharks. Once a shark has been caught it can be relocated.

"During the recent NSW summer school holidays, 525 potentially dangerous sharks were seen and reported by helicopter crews and 46 shark sightings were made by drones, of which 26 were considered as potentially dangerous," Kim Wolfenden says.

An important function of the community engagement program is to improve awareness about shark movements, recognising that sharks are migratory and do not always appear at the same place and the same time every year.

The data gathered from tagging sharks is also allowing DPI scientists to review shark movements over the longer term to help develop a predictive tool for places and times of increased shark numbers. F

The NSW DPI SharkSmart app can be downloaded at dpi.nsw.gov.au/fishing/sharks/sharksmart.

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FRDC CODE: 2016-417

Fisheries in the school zone

An online education resource is helping teachers to equip their students with knowledge about primary production in Australia

By **Melissa Marino**

Australia's food and fibre industries – including fisheries – are being highlighted in schools thanks to Primezone, a web-based resource that provides teachers with a range of primary industry-based materials.

Relaunched in July 2016, this 'one-stop shop' features resources such as videos, fact sheets and activities developed around agriculture, forestry and fisheries, as well as specific education units and assessment tasks developed by the Primary Industries Education Foundation Australia (PIEFA).

The FRDC has supported PIEFA through its People Development Program since 2010, as have other partners including the Australian Government, other research and development corporations and agricultural organisations.

Materials covered include aquaculture, sustainable fishing, topography and life as a professional fisher. There are also units on exploring the production and marketing of seafood and investigating Australian approaches to producing fish, seafood and meat.

"The resource positions industry as sustainable, science-driven producers heavily reliant on innovation and IT," says Ben Stockwin, chief executive officer of PIEFA, which manages Primezone.

"Our work connects people with the source of their food and fibre production, and being part of an initiative that reverses the divorce between society and the very thing that sustains it is particularly gratifying," he says.

Greater representation

PIEFA has worked to build the resource since 2010 – to increase the representation of primary industries in education – after a review by the Australian Curriculum, Assessment and Reporting Authority (ACARA) of a draft national curriculum found just two units relating to primary production. First launched in 2011, Primezone was established to bring together a range of disparate resources on education around food production.

Student survey

Ben Stockwin says the need for the resource became clear through a 2012 Australian Council of Education Research survey showing a significant lack of knowledge about food and fibre production among students. One-quarter of Year 6 students surveyed thought yoghurt was a plant product, three-quarters thought cotton socks were an animal product and most Year 10 students believed Atlantic Salmon was wild-caught, he says.

"There was also some very dim perceptions about sustainability, with 40 per cent of Year 10 students believing farming damaged the environment, while half didn't link primary production to scientific research – and 45 per cent didn't link it to innovation."

Ben Stockwin says the website – along with other PIEFA activities such as running professional development sessions and presenting at national curriculum and teacher conferences – is redressing this. Through ongoing collaboration between PIEFA and ACARA, the number of resources has increased to 168, with related teaching resources found on the Primezone website. All materials are vetted and categorised by PIEFA.

FRDC program manager Jo-Anne Ruscoe says PIEFA has been instrumental in getting food and fibre recognised in the national curriculum and raising awareness about fisheries and aquaculture.

"Primezone is a good platform to provide teachers and schools with evidence-based resources on food and fibre production," she says. "Industry stakeholders have told us how important it is to them that children are provided with fair and engaging information about how seafood is produced and sustainably managed. They may even be encouraged to consider a career in the industry."

As well as allowing students to learn about different primary industries, the materials enable teachers to use primary production to educate students about big picture issues such as sustainability, food security, innovation and biosecurity. F

100%
of teachers providing feedback through the Primezone website said they would recommend it to a colleague.

100%
of teachers reported their students found the subject matter engaging.

1100
unique users access the Primezone website per month.

60%
of users each month are new visitors.

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FRDC RESEARCH CODES: 2014-235, 2006-071.20

The measure of success

Australia's fisheries sector has improved its performance over the course of a decade, with a new analytical framework helping to target further gains

By **Catherine Norwood**

Sustainably making the most of Australia's fisheries is the long-term aim of a new process designed to evaluate fisheries' performance and to quantify the benefits being delivered. This includes identifying the 'performance gap' – the difference between the potential value of benefits and the actual value of the benefits gained. The analysis incorporates not just the value of fish caught and farmed, but also the flow-on economic and social benefits from commercial, recreational and Indigenous fishing.

Over the past eight years, the FRDC has been developing a 'Performance and Use' analysis tool, with evaluations undertaken in 2009 and in 2014, that have included a retrospective evaluation of 2003 data.

Industry experts scored the overall performance of Australian fisheries in 2003 at just 2.8 out of 10. This rose to 5.8 in 2009, before a slight drop to 5.6 in 2014.

Table 1: Overall performance and use scores since 2003

Score out of 10	Management	Environment	Economy	Social and engagement[1]	Total
2003	1.6	5.0	1.2	3.1	2.8
2009	5.5	7.7	6.5	4.6	5.8
2014	6.1	6.5	5.6	4.0	5.6
Wild-catch commercial	6.6	6.8	5.9	4.1	5.9
Recreational	5.2	5.8	4.7	3.7	4.9
Indigenous customary	4.0	4.7	3.6	2.5	3.7
Aquaculture	6.1	7.1	6.5	4.2	6.1

1. The social and engagement measure has been refined based on feedback from experts over the past five years. Experts' feedback identified the central role played by human engagement, education and training in the performance of fisheries.

FRDC research projects manager Josh Fielding says each of the four fishing sectors – commercial wild-catch, Indigenous, recreational and aquaculture – is scored separately across four topics: social and engagement, economy, environment and management.

The results from all sectors and topics are combined to provide an overall performance score. However, aquaculture data was only added in 2014 and there are still gaps in the information available for recreational and Indigenous customary fisheries, he says.

The most comprehensive and consistent analysis across the three periods has been for the commercial wild-catch sector, which has improved its performance score from 2.8 in 2003 to 5.9 in 2014. The greatest improvement has been reported in wild-catch fisheries management, which increased from 1.6 in 2003 to 6.6 in 2014 (see Table 1).

The research methodology being used is known as the Delphi technique. It relies on input from experts involved in the fisheries sector. In 2014, 132 experts contributed, representing commercial fishers, fish farmers, recreational fishers, Indigenous fishers, researchers and fisheries managers.

A total of 34 criteria are used to score the performance of each sector against the four performance categories (see Figure 1).

Detailed analysis of some specific fisheries or regional data has been extrapolated to provide state and national results, and to fill data gaps.

Josh Fielding says issues such as the global financial crisis, media events related to seafood and fluctuations in the Australian dollar all have the potential to change perceptions and thus influence the scores the experts give.

"For instance, an increase in community concerns about bycatch in wild-catch fisheries might produce a lower score in future evaluations against the social engagement criteria, although there may be no change, or even a reduction in actual volumes of bycatch," he says. "We're using a qualitative approach, rather than a quantitative approach based purely on numbers."

He says the value of fisheries to the Australian community and what constitutes best use also changes over time and influences the allocation of resources to achieve the greatest benefits. There was strong support from participants for the research methodology, which they felt was both sound and flexible enough to deal with changes in community values, fishing practices and new data.

Next survey

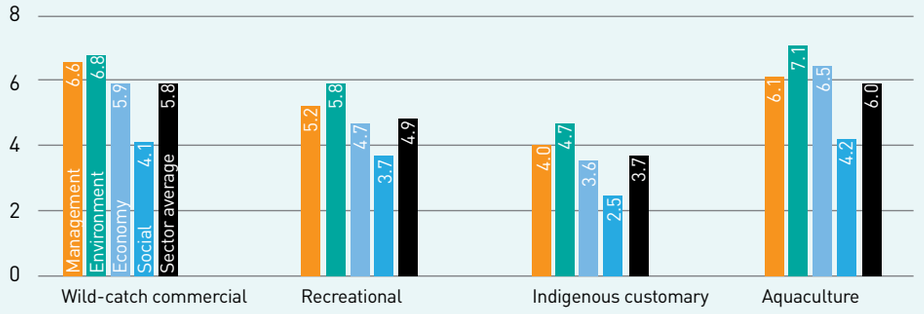
Josh Fielding says another 'Performance and Use' evaluation is planned for 2019. He expects new data collected during the next few years will help to inform performance scoring. This includes the continuing evolution of the *Status of Australian fish stocks* (SAFS) *reports*, first published in 2014, as well as projects such as the planned national social and economic survey on recreational fishing.

"The alignment of state-based recreational fishing surveys may also improve our catch and effort data for this sector, but there's more we need to do to better understand the extent and the value of Indigenous customary fishing.

"As well as more data, we would like to broaden the number of experts involved in the next study, as well as the diversity of expertise they bring."

He says this project will also help to quantify the value of fisheries to the community, including flow-on benefits, to serve as both a measure of success and a measure of a resource worth protecting. F

Figure 1: High-level performance by sector, 2014



"The alignment of state-based recreational fishing surveys may also improve our catch and effort data for this sector, but there's more we need to do to better understand the extent and the value of Indigenous customary fishing."

Josh Fielding

Industry trends

The 2014 project identified several trends that have affected the performance of fisheries between 2009 and 2013. These include:

- changes in government, resulting in a more complex landscape, and fewer government resources for fisheries management. Despite these changes there has been and continues to be a focus on reducing red and green tape while improving performance outcomes, including increased use of management control measures;
- increased focus on co-management, collaboration and resource sharing;
- increased focus on accountability of commercial fishers in the fishery versus management of the group;
- increased focus on third-party certification – market and consumer expectations were driving change with more focus on value versus tonnage output;
- perceived growth in recreational fishing and more catch and release in recreational fishing; and
- new marine parks announced.

Key areas for action

The combined analysis of trends and performance has identified areas for action, in order to maximise community benefits, which include:

- the development of management arrangements that are more flexible and reduce regulatory inefficiencies, such as harmonising regulations for fishers targeting the same species, often using the same method, across jurisdictional boundaries. In addition the inclusion of co-management arrangements would see greater impact of management arrangements;
- well-developed harvest and management strategies which incorporate ecosystem-wide effects and processes and allow for long-term sustainability of fisheries, underpinned by comprehensive and accurate data from all users;
- well-informed and transparent allocation of shares into fishing resources across all interested parties;
- better engagement with the community on the performance of fishing and aquaculture, and introduction of a measure for community support; and
- a greater awareness and use of economic analysis and return on investment in the operation of fisheries and fishing businesses. This would help businesses to operate on longer time periods and sustain through lower catch years.

MORE INFORMATION
Petuna, petuna.com.au; Tasmanian Salmonid Growers Association, www.tsga.com.au

On the Atlantic salmon trail

An opportunity to investigate the supply chain of Atlantic Salmon with Tasmanian producer Petuna offers insight into the many players needed to bring Australia's favourite fresh fish to our tables

By **Catherine Norwood**

Viewed from the outside, there is barely a hint of the fervent activity underway within the walls of Skretting Australia's aquafeeds plant, which lies on the eastern outskirts of Hobart. Inside staff are busy with the mixing and milling, pressing and pelleting of various animal and fishmeals, oils and grains, preparing more than 90,000 tonnes of feed to exacting formulations for Australia's burgeoning aquaculture sector.

Most of the ingredients come from Australian producers – grain from our farms and animal byproducts sourced from domestic meat processors.

As a lab technician at Skretting for more than two years, 23-year-old Georgia Eastburn has become accustomed to the smell. This is her first "real job", she says, after completing her Bachelor of Applied Science with a major in aquaculture. She is one of 76 staff onsite.

She is responsible for testing each batch of aquafeed to make sure it meets the specified nutritional content, and providing quality control for the various formulations that cater for different fish species and various stages in fish life cycles.

Tasmania's Atlantic Salmon and Ocean Trout producers take by far the largest share of Skretting's product. Petuna, along with Tassal and Huon Aquaculture, accounts for almost 60,000 tonnes of the feed, also buying from other manufacturers. Bulk deliveries head by the semitrailer load to hatcheries and fish farms from the top of the state to the bottom.

Building boom

Across the River Derwent, south-west of Hobart, is the deep-water port of Margate, which is the base for the shipbuilding operations of Haywards Steel Fabrication and Construction.

Preparing feed for fish from hatchery to marine farm, Skretting Australia's Georgia Eastburn (above) tests the aquafeed samples for quality and nutritional content.

Petuna's team at its Macquarie Harbour marine farm includes Michael O'Malley, Wayne McDermott and Danny Jango (middle left). Tim Richards (below) provides commercial dive services including underwater monitoring and maintenance for Petuna.
As aquaculture has expanded, apprentice boilermaker Clint Riley (below left) is taking advantage of the boat building boom it has generated.

Sparks fly in the workshop as two giant skeletons take on a boat-like shape – the latest in an ongoing stream of orders for new vessels from the three salmon producers. The vessels range from 25 to 35 metres and cater for live-in staff who provide around-the-clock monitoring of operations, as well as controlling the feed distribution for fish at sea.

The managing director of Haywards, Steve Edmunds, says the expansion of the aquaculture industry has allowed the business to double its shipbuilding staff in the past three years, adding tradesmen, apprentices, naval architects and project managers. The firm has 280 staff members, a quarter of whom are involved in shipbuilding and maintenance.

He says only three or four new vessels are completed each year, depending on the size, and the additional staff capacity is expected to cater for the aquaculture sector's long-term plan to double Atlantic Salmon production from almost 50,000 tonnes in 2014-15 to 100,000 tonnes by 2030.

At Haywards, 28-year-old Clint Riley is among those benefiting from the shipbuilding boom. The former printing machinist is retraining in a career he sees as having a better future. He began working at Haywards's Wynyard workshop, near Burnie, as a trade assistant more than two years ago, but in January became an apprentice boilermaker and welder at the shipyard.

Local value

It is not far from Margate to the fish farms of Tassal and Huon Aquaculture in the D'Entrecasteaux Channel. The two firms also have farms at Macquarie Harbour on the south-east coast, although Petuna is the longest-standing and the largest leaseholder at Macquarie Harbour, which is serviced by the remote community of Strahan, population 660. Aquaculture has provided a lifeline for the town, which has suffered from downturns in the mining and forestry sectors.

Petuna has 53 staff at its fish farms on the harbour, 46 of whom are based in Strahan. Then there are the contract service providers such as Strahan Dive. Dive operator Tim Richards, 51, is a former miner who made a career change more than a decade ago, with aquaculture in his sights. Strahan Dive now has 12 employees, providing commercial dive services that include underwater inspection and maintenance for Petuna.

As part of a four-person dive team that includes a diver, standby diver, supervisor and dive attendant, he heads out on to the harbour to inspect the nets on Macquarie Harbour. The team checks for holes, removes dead fish, inspects the hulls of vessels and casts a critical eye over the underwater environment and seabed.

Tim Richards says Macquarie Harbour is a unique environment, with a layer of black freshwater overlaid on seawater, which can make diving a challenge. It can be pitch black below the surface, and in winter pockets of freshwater along the shore can freeze. Sometimes the team members have to break their boat free of ice before heading out to the leases, where the water will be a comparatively warm 10ºC or, in summer, a balmy 20ºC.

The freshwater layer is also what makes the harbour so attractive for fish farming. The potentially fatal amoebic gill disease is one of the most significant health issues for the industry in Tasmania. Bathing fish in fresh water cures the condition and, as a 'self-treating' environment, the harbour is free of the disease.

Monitoring of fish health and research into disease control is ongoing, with the Tasmanian Government's Animal Health Laboratory (AHL) at Launceston leading the way. The AHL tests an average of 3000 fish a year, conducting approximately 10,000 tests for the Tasmanian Salmonid Health Surveillance Program, which is funded jointly by industry members and the Tasmanian Government.

The AHL has 22 full-time staff. While it provides diagnostic services to all primary production sectors in Tasmania, about half of its work is tied to aquaculture. Research microbiologist Emily Spencer, 32, has been working at the AHL for two years and recently joined a new three-year, $3 million research program funded by the FRDC, developing vaccines to counter emerging Atlantic Salmon viruses. The research team includes nine full-time staff.

Hatchery

At Petuna's hatchery, based in Cressy in northern Tasmania, the success of AHL programs to develop vaccines against a range of fish diseases has significantly improved fish welfare, according to site manager Shaun Slevec. From as many as six baths for disease control, fish might now undergo only one or two treatments during their life cycle.

The Cressy hatchery is where production officially begins for Petuna, which has its own broodstock but also sources some from Saltas, a hatchery jointly established by Atlantic Salmon producers and the Tasmania Government.

Microbiologist Emily Spencer is working on new vaccines to protect Atlantic Salmon from emerging disease issues.

New recirculation systems give site manager Shaun Slevec (right) greater control over water quality at the Cressy hatchery.

Water temperature and light influence the hatching rate of eggs waiting for fertilisation (centre right).

"Light and temperature controls are used to stagger hatching and growth rates to provide consecutive waves of maturing fish, for year-round production of a consistent product, because the market wants the same fish, every day."

Shaun Slevec

Alan Holden (above) coordinates the transport of smolt to sea (left), and the harvested fish directly from pens on Macquarie Harbour (above left).

Shaun Slevec says light and temperature controls are used to stagger hatching and growth rates to provide consecutive waves of maturing fish, for year-round production of a consistent product, "because the market wants the same fish, every day".

Feed is the major input, but at the hatchery there are also significant water and power inputs. The fresh water supplies that provide a home for hatchlings for the first 12 to 18 months of their lives come from the Great Lake in the heart of Tasmania's Central Plateau. It is delivered via the same gravity-fed irrigation system that supplies district farms, and faces similar restrictions in the event of drought.

Petuna has cut its fresh water use by 95 per cent with its recent investment in new recirculating aquaculture systems (RAS) at the hatchery that help to manage the drought risk. However, six-figure power bills are the norm, with energy required to run the RAS and keep water clean and control water temperatures for the fish (between 2.5°C and 10°C).

It takes up to 18 months from the production of eggs for the fish to reach 'smoltification'. This is the physiological process that allows fish to process and eliminate salt from their bodies and signals their readiness to move from the freshwater hatchery to estuarine or ocean waters.

Migration to sea

As winter approaches and fish become physically ready, an "assisted" migration process begins. For Petuna, mid-April marks the start of this process, and specially fitted, oxygenated tanker trucks begin transferring live smolt cargo from the hatchery to Petuna's fish farm on the Tamar River. In July, transfers begin heading south-west from Cressy to the Macquarie Harbour leases, until the stocking window closes in September.

The challenge, says contractor G&D Transport's Tony Dyke, is to deliver all the smolt within the required timeframe, particularly through the mountainous trek from Cressy to Strahan. Of his 15 staff, 10 work almost full-time making deliveries for Petuna, including feed deliveries.

His company has five 25,000-litre tanker

Overall, it is estimated that as many as 5000 jobs are directly related to Tasmania's Atlantic Salmon industry, which contributed $1.2 billion to Tasmania's economy . . . with additional value further afield.

trucks for smolt, as well as four 30,000-litre tankers for harvested fish. The smolt tankers carry 1.8 tonnes of fish at a time, moving up to three million smolt each year for grow-out. The harvest tankers can carry up to 13 tonnes of fish at a time from the marine farms to the factory for processing.

At Macquarie Harbour, G&D's tankers are a common sight out on the water, on board Petuna's barges, where they deliver smolt directly to their new homes. Water from the harbour is mixed into the tankers to help acclimatise the smolt before they are transferred directly into the floating pens, where they will spend the next 12 to 18 months.

Petuna targets an average size of 3.8 kilograms for its Atlantic Salmon. Harvesting is essentially the reverse of the tanker system that delivers the smolt, although it occurs continuously throughout the year, with peaks at Christmas and Easter.

Harvest tankers are driven onto barges at Strahan, sometimes two abreast, and shipped out to the pens, where the fish are taken straight from the water and killed quickly with a single blow direct to the back of the head. They are transferred to the tankers and, in fewer than 40 seconds, chilled in ice slurry to below 3°C for the three-hour trip to Devonport for processing. (The Australian design for the tanker transfer system has since been patented and sold to Norway.)

From the processing to the packing lines, Trent Madden (above) has helped design and manufacture equipment to streamline Petuna's operations. Quality control stations (far right) along the processing line check temperature and product weights.

Processing

Petuna has recently upgraded its Devonport processing facility with a $9 million expansion that has doubled its previous processing capacity and provided more employment. There are now 110 full-time staff at the site, in production, maintenance, quality and administration.

The upgrade includes investment in new European-built automated gutting and filleting equipment, but local expertise plays a major role in ongoing refinements to improve the connections and workflow efficiencies for staff and equipment.

As the manufacturing and design manager of the fabrication division of Tasmanian company Degree C, Trent Madden is a regular visitor to Petuna's processing plant, fine-tuning everything from the supply of cleaning water to the fabrication and operation of conveyor belts carrying the fillets between machines and out to dispatch.

After 15 years working with Petuna, he says the evolution of its operations means there is almost more superseded equipment in the company's 'graveyard' than there is in the processing plant.

Also in Devonport, James Wescombe of MGP Tas Pty Ltd is part of the support team for the processing plants of Petuna and Huon Aquaculture. Thankfully, late-night calls are rare, he says, but they are part of the 24-hour service he offers for the maintenance and replacement of electric motors to keep processing on track.

At Petuna's factory, for instance, he estimates there are more than 100 motors that keep pumps supplying water and the conveyor belts turning on the processing and packing lines. The company's operations are based on processing fish within 24 hours of being harvested.

"If something breaks down late in the day, which can be 9pm or 10pm during the busy periods, it needs to be fixed overnight, so processing can begin again for the morning shift, which might start at 5am or so," he says. Aquaculture is not the only sector that uses MGP's services, but James Wescombe says the sector's support was important when he went out on his own to establish the business three years ago, with a staff of three.

To market

Petuna sells about 20 per cent of its fish wholesale, head on and gutted (HOG), and 80 per cent are further processed in some way into ready-to-use products such as fillet portions. Recent contracts with supermarkets have increased the proportion of higher-value consumer ready-to-eat products over the wholesale HOG products.

Petuna also has a traditional smokehouse onsite, using both hot and cold smoking

James Wescombe (centre left) repairs and replaces the electric motors that help keep Petuna's newly upgraded factory operational. Leanne Black (left) prepares Atlantic Salmon fillets for sale at Hill Street Grocer, where they are an increasingly popular choice for home chefs.

techniques to further value-add, a process that can take up to 36 hours to produce a finished product.

In the Devonport deli of the gourmet grocery chain Hill Street Grocer, Petuna's products are prominently displayed. Store manager Trudi Beveridge says it is sometimes difficult to get regular supplies of the wild-catch fish her customers like, such as Pink Ling and Blue-eye Trevalla. "But the Atlantic Salmon is always a popular choice, because it's a consistent, quality product, and it's always available. And there's also a perception of freshness," she says.

These are key factors behind the consistent, double-digit growth in consumer demand for Atlantic Salmon across Australia. From his base in Melbourne, where he is general manager of Fresh Freight Tasmania, Michael Leonard and his team oversee the distribution of much of Petuna's product. He coordinates transport from the Devonport processing plant via the *Spirit of Tasmania* or SeaRoad shipping to Melbourne, and on to further destinations.

He calculates total aquaculture sector sea freight might be worth more than $25 million a year. For his company alone, it underpins the jobs of 93 employees and another 60 contractors in Tasmania and Melbourne.

Overall, it is estimated that as many as 5000 jobs are directly related to Tasmania's Atlantic Salmon industry, which contributes $1.2 billion to Tasmania's economy, according to a 2015 report from accounting firm KPMG, with additional value further afield. Not only is it sold in every supermarket and hundreds of seafood specialty stores, it also features somewhere on the menu of many a restaurant and cafe.

In terms of fisheries, the aquaculture industry has made Tasmania the nation's most-valuable producer of fish and aquaculture products. In 2014-15 salmonids (both Atlantic Salmon and Ocean Trout) represented 30 per cent of total Australian seafood production, both farmed and wild caught.

That figure is only expected to grow as the industry increases production capacity and as consumers turn to Atlantic Salmon in increasing numbers. In May this year, Woolworths managing director and chief executive officer Brad Banducci suggested more customers were opting for salmon as an alternative to red meat, given high beef and lamb prices this year. "We are seeing a movement in protein from red to white and pink meat – chicken and salmon – because they are more affordable," he said.

It seems clear that the ripples of salmonid influence are steadily changing both the economic fortunes of Tasmania and the dining habits of the nation. F

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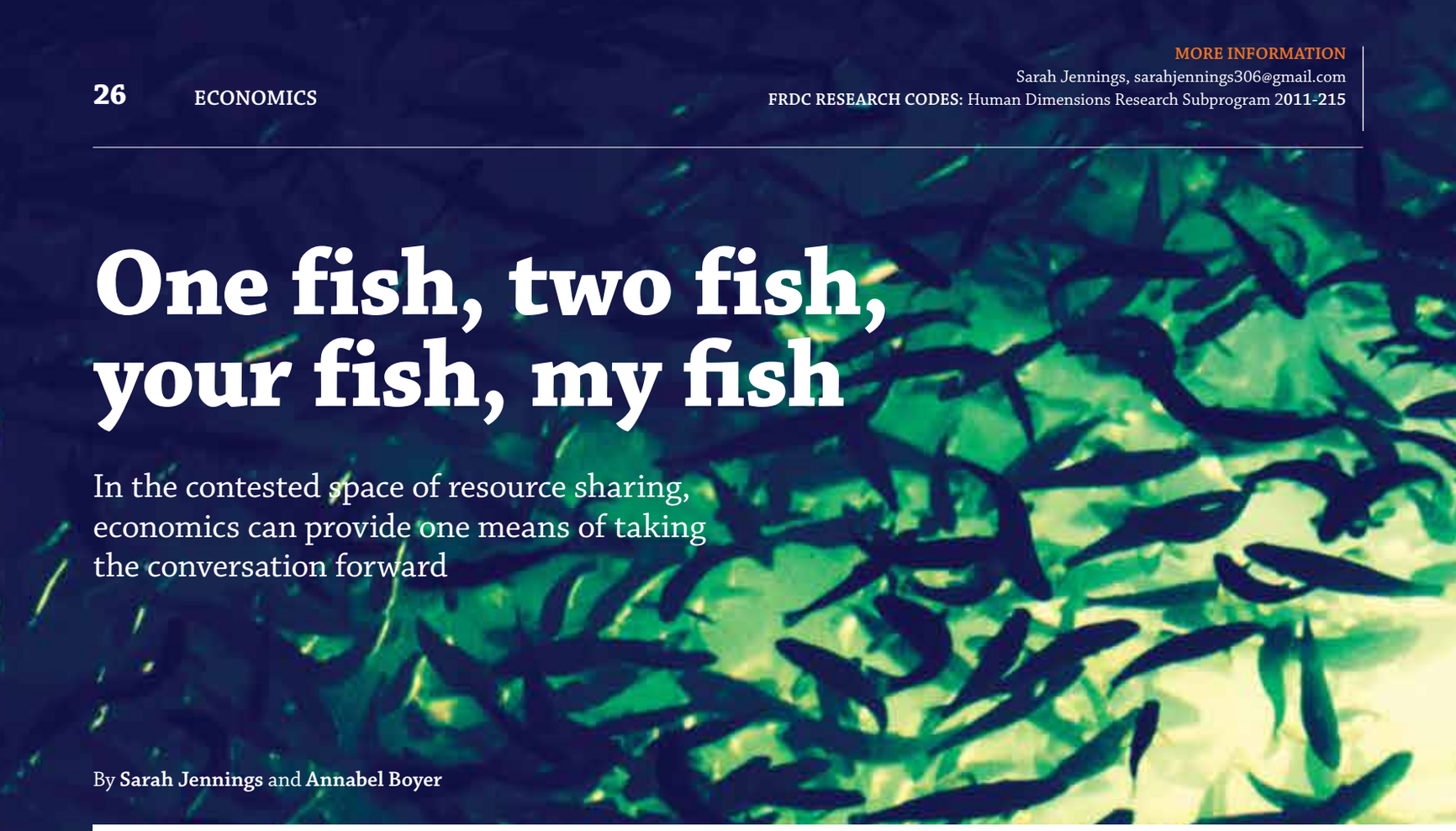
FRDC RESEARCH CODES: Human Dimensions Research Subprogram 2011-215

One fish, two fish, your fish, my fish



In the contested space of resource sharing, economics can provide one means of taking the conversation forward

By **Sarah Jennings** and **Annabel Boyer**

Access to fish underpins myriad different benefits to people – food, income, employment, recreation and cultural identity to name a few. As our society increasingly looks to the blue (ocean) economy to deliver food and energy solutions for a growing population, our coasts and oceans will become more crowded, competitive and contested spaces – keeping issues of marine resource allocation and reallocation on centre stage.

When swimming freely in Australian waters, fish are a publicly owned resource, which makes it important to manage them to ensure that society as a whole gets as much benefit as possible.

In some cases, this maximum benefit might mean letting one group of users have sole access, but more often than not maximising benefits – whether social, economic or cultural – requires sharing the resource across different users or groups of users.

Conflicts over the right to use natural resources have been important human issues throughout history. Fish are no exception. Access to fish stocks was the prize in the notorious Cod Wars in the North Atlantic Ocean during the 1950s, '60s and '70s, and more recently this has been a flashpoint in territorial disputes over the South China Sea.

Having a transparent, evidence-based process for determining allocation is valuable as a means to confer legitimacy on allocation decisions, as well as ensuring that we are making the most of this precious resource.

Possible approaches come down to two broad alternatives – administrative models or market/economic valuation-based models. In a market/economic valuation-based model the driver is either the trading of shares in an established market or the application (by administrative decision) of economic valuations to competing uses of a resource.

To date, variations of an administrative model, with the government ultimately making the final decisions, have been the preferred approach in Australia and internationally.

Economic framework

Economics can provide a clear framework for the allocation of resources using the logic of the 'equi-marginal rule', which can be illustrated by asking what happens when users have different marginal benefits.

Suppose that, after deducting costs, a fisher gets a benefit of $5 from landing the last kilogram of fish in their allocation, while a second fisher enjoys a net benefit of $10 from their last kilogram of landed catch. Reallocating the marginal kilogram of catch in favour of the second fisher effectively increases the total benefit created from the resource.

Applying the equi-marginal rule to the initial allocation of a resource makes sure that each unit of the resource (cubic metre of wood, litre of water or kilogram of fish) goes to the user who values it most; or equivalently, for a given allocation, that the last unit allocated to each user is worth the same amount. Whenever there is a gap between the marginal value for different users, reallocation can improve efficiency or make the economic pie bigger.

An advantage of a market-based approach, wherein fishing rights are exchanged in an established market, is that – under ideal conditions – people reveal all the information needed about marginal values when they signal their intentions to buy and sell goods.

Market forces make sure that things end up in the hands of those who value them most. Markets can also do away with the need for costly surveys, resource-heavy administrative processes and excessive lobbying activities.

Challenges in practice

Harnessing market forces to apply the equi-marginal rule by creating a market for harvest shares can be challenging. While allocating harvest shares within a single sector, such as a commercial fishery, using individual transferable quota has worked quite well; extending the market-based model to inter-sectoral allocations raises new issues.

Photo: Catherine Norwood

For example, for sectors such as recreational fishing there would need to be an organisation with authority to hold the sector's total allocation, raise money and buy and sell fishing rights on behalf of individual fishers. Fisheries Victoria is trialling a system in which it will be mandatory to tag Rock Lobster in the recreational sector. Based on FRDC research on the Shark Bay Pink Snapper fishery in Western Australia, the tags provide a means of measuring catch as well as allocating fishing rights within an overall catch limit.

The alternative of using the equi-marginal rule to guide allocation decisions administratively is also not simple. Even in the most straightforward of cases, such as where a total allowable catch is to be shared across two commercial fishing fleets, you would need information on the prices and costs of each additional kilogram of fish caught by each fleet to work out the best initial allocation. You would then need to check this information regularly to see if the best allocation had changed.

This becomes even more difficult when that extra (kilogram of) fish could swim into either a commercial fishers' net or hook itself on the line of a recreational or customary fisher. For fish caught by these other sectors, we do not have the convenience of being able to draw on information about market prices to calculate marginal values, and other valuation methods are needed.

The emergence of new fisheries based on previously underutilised species or on species that have changed their distribution due to climate change provides potential opportunities to trial different ways of making initial allocations and of allowing for reallocation of rights, including using the market.

But most fisheries have been fished for a long time, and history matters. Sometimes this spans generations and, in the case of Indigenous fisheries, there can be continuous traditions going back thousands of years. Indigenous title to marine resources is often recognised through judicial and legislative systems. Historical catches also often provide the basis for allocations between recreational and commercial fishers.

Other values

In determining how fisheries resources are shared, stakeholders care about both the final outcome and the process used to determine the shares. They want to have a voice in decisions that affect them. Allocation policies that include strong participatory processes can help move the process from one of conflict to one of compromise.

Markets work best where there are many buyers and sellers, rights are clearly defined across all users and economic efficiency is the goal. Administrative processes, including those that apply economic valuations to competing uses, may be preferred where there is a need to be more responsive to goals other than economic efficiency. This includes distribution – where the 'currencies' for expressing value of different user groups are not easily translatable to a common metric (dollar or otherwise). Administrative processes may also be preferred where the market fails to give voice to the interests of some legitimate stakeholder groups. What is clear is that there is no one-size-fits-all approach.

Regardless of the approach adopted, the spirit of the economists' equi-marginal rule can play a pivotal role in guiding fish onto the hook or into the net of those who value them most. When values and priorities change or conflicts arise in relation to fisheries resources it can provide a clear path forward.

The FRDC's Human Dimensions Research Subprogram (previously the Social Sciences and Economics Research Coordination Program) has identified resource allocation in its draft 2017–2020 RD&E Plan as a priority area for investment. It will be looking for opportunities to co-invest in projects that contribute to the development and testing of resource allocation and benefit-sharing mechanisms that strike a balance between economic efficiency and distributional and procedural fairness, while ensuring sustainability. F

Native priorities in river clean-up campaign

A range of measures in concert with the eradication of carp from waterways could provide the key to the restoration of Australia's inland fisheries

By **Bianca Nogrady**

They might be prized as a source of protein in some parts of the world, but in Australia carp remain defiantly among the nation's four most disliked vertebrate pests. Since it was launched in May 2016, the headlines surrounding the FRDC-led National Carp Control Plan (NCCP) have focused on the eradication of carp. But ultimately, according to NCCP coordinator Matt Barwick, it is not actually about carp.

"It's a program about recovering our native fisheries and waterway health. It just so happens that controlling carp is the tool through which we think we can do that," he says.

Over a three-year period, with $15 million of funding from the Australian Government, the NCCP will address a range of knowledge gaps to better understand and manage the risks should the carp virus, known as CyHV-3, be released. In that vein, the NCCP will support a raft of research, incorporating risk analysis, analysis of benefits and costs, synergistic carp control measures and, importantly, how to deal with the clean-up.

Habitat restoration

Since the mid-19th century, carp have spread through Australia's fresh waterways like a virus. They now make up 80 per cent of the total fish biomass in some Australian waterways, and up to 93 per cent in some highly infested areas.

These populations took off at a time when Australia's waterways and native fish communities were at their lowest ebb. "Our waterways were in a really poor state of health back in the 1960s and '70s and, for carp, it was the perfect storm for them to really take off," Matt Barwick says. Combined with their bottom-feeding habit, which stirs up sediments, increases nutrient levels and reduces sunlight penetration, their numbers represent an ecological disaster.

Fortunately, over the past decade there has been increasing investment in the restoration of native fish habitat and migratory pathways, improvement of water quality and delivery of more natural flow regimes.

Matt Barwick says there are clear opportunities provided by controlling carp impacts, while also working with community groups, natural resource management groups and state agencies, who are doing great things to recover native fish communities by restoring environmental flows and riparian vegetation, restocking and 're-snagging'.

Snags – large dead trees and branches sunk into waterways – were once the curse of paddle steamers and irrigators, so over the course of nearly a century they were removed from many river systems. According to Jarod Lyon, principal research scientist at the Arthur Rylah Institute for Environmental Research, this had devastating consequences for native fish species such as Murray Cod and Golden Perch.

"Those snags are where fish live, so there are a lot of areas that were pretty denuded of fish just because their habitat and homes were gone," he says.

One project to re-snag a section of the Murray River involved dragging about 5000 large snags, each weighing at least one tonne, back into the river. Other research through innovative projects such as the Victorian Environmental Flow Monitoring and Assessment Program is exploring how best to use environmental flows to help beleaguered native fish populations recover.

"There's been a lot of work done over the last 10 to 15 years exploring how to deliver flows and manage rivers in a way that provides conditions that native fish need to spawn," Jarod Lyon says. "Now we have that part of the equation worked out; we're also looking at the importance of using river flows to promote connectivity between rivers."

Recent research around the Goulburn River in Victoria found that some of the Golden and Silver Perch captured there were actually coming to the river from hundreds of kilometres away.

Managing risk

While understanding and restoring the complex ecology of inland waterways is an important piece of the puzzle, another significant aspect of the NCCP's remit is to explore the potential risks inherent in releasing the carp virus.

"We need to understand all those dimensions of risk and ensure that we can manage them," Matt Barwick says.

The ecological dimension of risk is a complex one. For all the damage that carp have wrought in Australia's river systems, it's worth remembering

MORE INFORMATION
www.frdc.com.au/carp
FRDC RESEARCH CODE:
National Carp Control Plan

Left
Large dead trees can provide habitat for native fish species.

Above
Murray Cod being released after capture in the Murrumbidgee River.

Photos:
Jasmin Forbes

they have been in Australian waterways for decades, and some other species eat them. What happens when that food source diminishes?

To date, research has shown that for key predatory native species such as Murray Cod and Golden Perch, native prey is the preferred diet; carp are a less palatable option.

"There is really interesting research that shows if you can significantly reduce carp numbers, it can result in up to a fourfold increase in important food items such as zooplankton and small-bodied native fish species," Toby Piddocke, project manager of research under the NCCP says. "Importantly, increases in small native fish – little gudgeons, rainbowfish and things like that – could add more biomass than that of the carp removed, which means there could be even more food available for native predatory species if carp numbers are reduced."

However, the sheer biomass of carp clogging Australia's waterways adds up to a lot of decomposing fish in the event of the virus's release. This makes the risk to water quality for humans and animals a high priority. Consequently, this issue is the focus of careful investigation to understand how different carp biomass levels affect water quality, odour, taste and bacteria levels.

Opportunities to stage the release of the virus using natural and man-made barriers to fish migration will also be explored, along with improving estimates of carp biomass levels within affected catchments, exploring the most efficient methods for harvesting dead carp and resolving options for use or disposal.

Additional control measures

In the eight years since it was first understood that this virus might be used as a biocontrol measure in Australia, a huge amount of research has gone into understanding its potential and how to exploit it. Toby Piddocke says the carp virus attacks the gills, skin and kidneys of carp of all ages, with a mortality rate of 70 to 90 per cent.

But even the most optimistic estimates of the initial kill rate can not ignore the fact that resistance may develop. Modelling from CSIRO suggests that carp populations might recover to about 30 to 40 per cent of their original levels in just 10 years unless followed up with additional control measures.

"The evidence we have shows that the carp virus will be very effective on common carp. However, examples of pest control for other species really highlight the need to consider secondary control measures, possibly in the form of a sex-biasing construct," Toby Piddocke says.

This refers to a genetic modification introduced into carp populations so they produce offspring of only one sex, or all the offspring of one sex die at an early age, before they have the chance to breed. Sex-specific control methods are used for other pests such as mosquitoes, so one of the NCCP's areas of focus will be to explore these other options.

Carp eradication will be a vital part of the effort needed to recover Australia's inland fisheries and waterways. A lot is riding on the NCCP and, while some previous biological control measures have not gone as well as hoped, Matt Barwick is optimistic.

"The very fact that we are here now, with funding from the Australian Government, to do this careful planning and research over the next two years is due to the fact that the benefits that carp control would deliver are significant." F

"There is really interesting research that shows if you can significantly reduce carp numbers, it can result in up to a fourfold increase in important food items such as zooplankton and small-bodied native fish species."

Toby Piddocke, project manager of research under the NCCP

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FRDC RESEARCH CODE: 2015-205

Indigenous fishing values

Going fishing provides many benefits to Indigenous communities, including strengthening the bonds of shared identity

By **Anne Crawford**

Indigenous peoples have fished the waters of Australia for millennia, yet little has been documented about the values and importance they ascribe to fishing.

A study overseen by the FRDC's Indigenous Reference Group (IRG) has found that the pursuit goes way beyond a simple pastime and documents how fishing is regarded within different Indigenous communities. Researchers for the 'Livelihood values of Indigenous customary fishing' study are working with a range of Aboriginal people, including rangers and community members from the three communities being studied: the NSW south coast, far west South Australia and the Crocodile Islands in north-east Arnhem Land in the Northern Territory.

The director of native title, land and water research at the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS), Rod Kennett, and research officer Luke Smyth are overseeing the study, which is still in progress. "Looking at it from a value perspective has helped to unravel how tightly tied up fishing is with all sorts of different things in these communities," says Rod Kennett, the principal investigator on the project.

"It's much more than enjoying it or eating it. It's wrapped up in culture, especially when people identify themselves as 'salt water people', as quite a few family groups in all three regions do – they say 'we need it; we can't not eat it'."

Focus on values

IRG executive officer Chris Calogeras says identifying values is a key area of the IRG's research and development focus. "There needs to be a shift in understanding the values Aboriginal and Torres Strait Island peoples have, so non-economic values can be put on the table as part of conversations about resource use," he says.

To that end, the IRG developed a scope for the study and put out an 'open call' to research groups to propose how they would approach it. A research group from AIATSIS was chosen to undertake the project because it was considered the group had a good track record in conducting effective and culturally appropriate research with Indigenous people.

The benefits from the broader fishing sector often extend far beyond the value of the actual catch. A recent FRDC-funded study conducted by the University of Technology in Sydney (FRDC research code: 2014-301) found that wild-catch fishing is important to the social as well as the economic lives of NSW coastal communities. Recreational fishers also derive a range of non-economic benefits such as relaxation and enjoyment from the practice of catching fish.

Understanding how Indigenous communities value fishing resources and fishing access is a key component to achieving greater participation of Indigenous people in commercial fishing. Uncovering these values means there can be an evidence base for allocation and resource-use decisions that take account of these values. The findings will help to facilitate the development of policy and regulations to enable greater indigenous engagement in the fishing sector by incorporating values held by Indigenous people in relation to fishing.

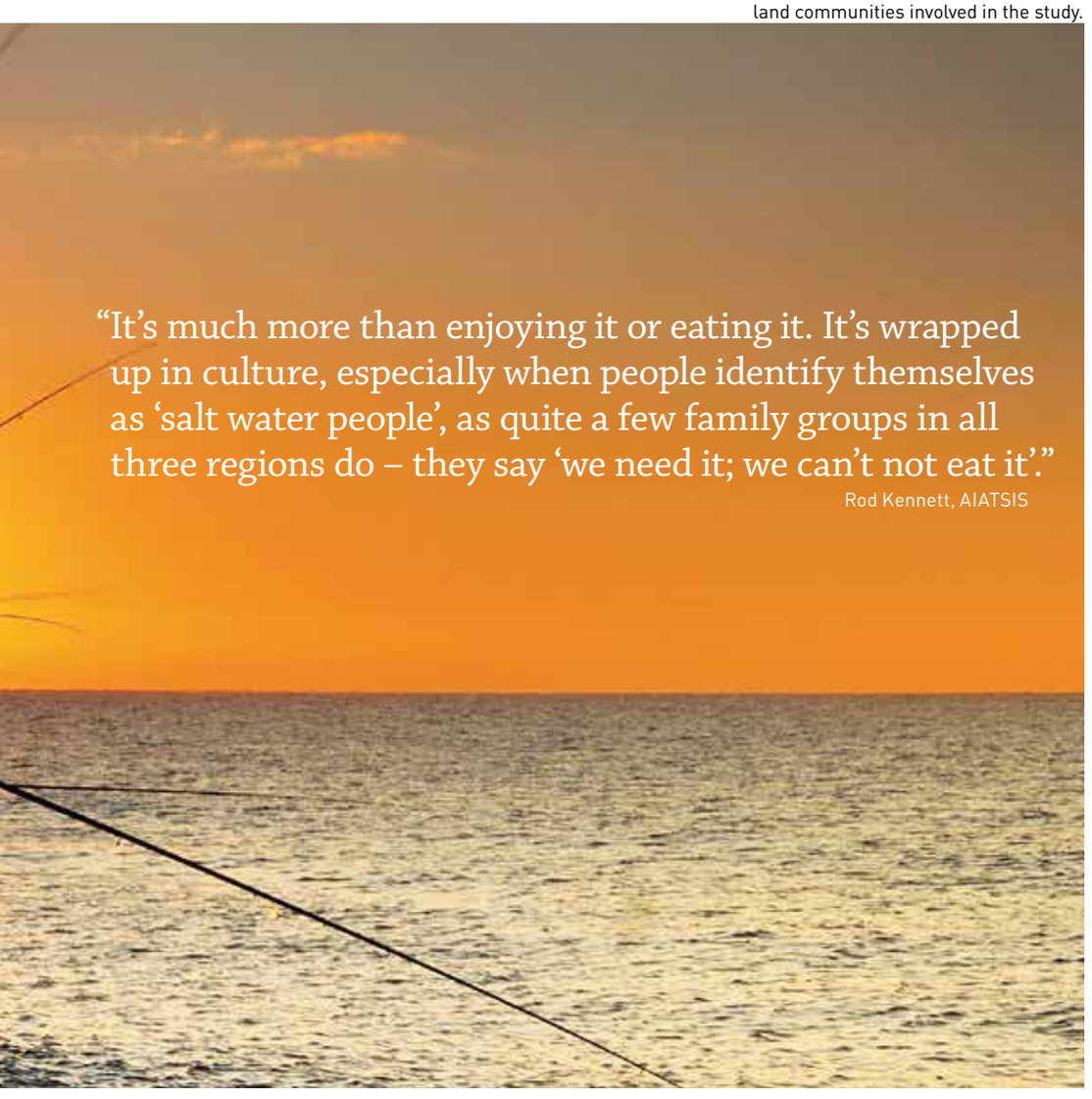
Local protocols

To conduct the study, researchers enlisted culturally appropriate ways of eliciting information. First, they developed a tailored interview process, consulting with the IRG and then those in the field, to refine survey methods suited to the study.

They drew on the knowledge of researcher Hayley Egan, who had been engaged in previous research commissioned by the FRDC into Indigenous Australians' use of and access to fisheries resources. The study was then passed through the AIATSIS ethics committee.

The community-focused approach took into account considerations such as literacy levels, the language spoken, the need for translators and the cultural appropriateness of the questions, the way in which they were asked and who they were asked by.

People on Milingimbi Island and in other Crocodile Islands communities were



"It's much more than enjoying it or eating it. It's wrapped up in culture, especially when people identify themselves as 'salt water people', as quite a few family groups in all three regions do – they say 'we need it; we can't not eat it'."

Rod Kennett, AIATSIS

Right Researcher Rod Kennett (far right at back) with researchers and delegates from the southern NSW coast and north-east Arnhem land communities involved in the study.

interviewed, using assistance from Crocodile Islands rangers, with project materials translated into Djambarrpuyngu, the dominant local dialect of Yolngu Matha.

"We realised you can't just make the questions the same for everyone or we'd miss out on some really important things. We talk to people first to get a sense of the big issues, then try to sort out what we needed to ask to tease out the best information," Rod Kennett says. "We also give a verbal explanation of what it is we want to ask about so it's clear, and also why we are conducting the interview and what the community might get back, so the benefits are two-way."

The team made research agreements with each of the three communities to ensure that local people were employed for the project. Dozens of interviews were carried out across the communities. "People were really keen to have their stories heard and their values understood by the wider Australian community," Rod Kennett says. "Quite a few people enjoyed being part of the interview process because they felt they had a story to tell that hadn't been told before."

He says the elderly fishers on the NSW south coast in particular loved talking about 'the good old days' when fish were so plentiful that you didn't have to dive for abalone, you could just pick them off the rocks.

Community wellbeing

Rod Kennett says interim findings in the study identified several ways in which community wellbeing is connected to the ability to fish. For example, health is a big concern. "People talked about the nutritional benefits of eating fresh fish, particularly the elderly, young people or if you were disabled or sick," he says.

They mentioned the health and physical values involved in fishing, and believed their health suffered if they were prevented from doing this. The importance of going out fishing 'on country' resonated. There were also social values attached to the activity. "Fishing promotes community wellbeing and cohesion. People are able to follow traditional rules about sharing, and pass down a whole body of knowledge and laws about fishing," Rod Kennett says.

Sharing is an intrinsic part of the culture. Fishing is often a family affair and the catch could be distributed between 30 or 40 people – family first and elders, the ill, disabled or anyone not able to fish themselves.

"It's important too for people to be able to take the kids out. They talk about young people being engaged in a productive activity."

Community access

The survey has also helped galvanise people involved in the study to act on plans to gain greater access to fishing areas. For example, the Yuin people are making a case to the NSW Government to establish a fishing co-operative, possibly to catch abalone.

Under their proposed model, the co-op – rather than an individual – would hold a licence and would employ a number of young people.

The study is due for completion at the end of the year, with interim results being presented at conferences throughout 2017.

An exhibition of photos will be launched in June to support it, including pictures of fishing from the AIATSIS collection, those taken in the field during the project and as part of a competition designed to engage local people. F

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FRDC RESEARCH CODE: 2016-800

Resistance warranted

The Pacific Oyster industry's determination to fight back after the incursion of POMS has received a funding boost

By **Gio Braidotti**

Sarah Ugalde, research officer on Future Oysters CRC-P, inspects oysters placed on farms to investigate the period of infection for POMS.

In 2016 Tasmanian oyster farmers joined those from NSW facing the new reality of life with the ongoing threat of Pacific Oyster Mortality Syndrome (POMS). The exotic virus OsHV-1, which causes POMS, killed up to 95 per cent of Pacific Oysters during an epidemic in some parts of Tasmania early last year.

Since then, a new coordinated and collaborative research and development network has been established to help secure the productivity and profitability of the oyster industry – the $5 million Future Oysters Cooperative Research Centre Project (CRC-P).

The CRC-P includes $3 million from the Commonwealth Department of Industry, Innovation and Science. Through an existing industry partnership agreement, Oysters Australia, the FRDC and other partners have collectively invested another $2 million.

Research programs

Managing the CRC-P are Graham Mair (Flinders University and Australian Seafood Industries) and Wayne Hutchinson (Oysters Australia). "We have seven research projects under way, structured into three programs," Wayne Hutchinson says. The CRC-P's three programs are:

- 'Better oysters', which deals mainly with breeding disease-tolerant oysters and developing advanced breeding methods;
- 'Healthy oysters', which seeks better understanding of oyster diseases, how to manage disease risks and is developing advanced disease surveillance technology; and
- 'More oysters', a smaller program working mainly to improve production methods of Native Oysters and testing the feasibility of farming Sydney Rock Oysters in South Australia.

A key CRC-P goal is to breed POMS-resistant Pacific Oysters and to manage the supply of disease-resistant broodstock to hatcheries in NSW, Tasmania and South Australia, which have different biosecurity and risk-management requirements.

Playing a key role is Australian Seafood Industries (ASI), managed by Matt Cunningham, a company established in 2004 in part to selectively breed oysters. "Having a Pacific Oyster breeding program in place in Australia meant that within a month of the POMS incursion in NSW seven years ago, we had family lines growing in the affected sites so we could test their level of genetic resistance," Matt Cunningham says. "Commercial hatcheries now have access to Pacific Oyster broodstock that display 70 to 80 per cent POMS survival when they are one year old."

Biosecurity restrictions that prevent the movement of oysters bred in Tasmania to South Australia have left oyster growers in SA with difficulties sourcing enough spat. Funding from the Future Oysters CRC-P has made it possible to establish a breeding hub at the South Australian Aquatic Science Centre.

Using ASI broodstock, maintained in South Australia, senior researcher Xiaoxu Li has begun to replicate the ASI's breeding program to secure future supplies of POMS-resistant spat for South Australian oyster farmers.

Detect and manage

Other CRC-P funding through the 'Healthy Oysters' program allows researchers, led by Christine Crawford from the University of Tasmania, to work closely with oyster growers on farms in POMS-affected areas in Tasmania.

Key research issues include understanding the POMS window of infection and how the virus spreads. It is also developing fast and cost-effective techniques to detect the POMS virus, and management practices that allow industry to operate in the presence of the disease.

The data being collected will eventually be used to develop a predictive model to help the oyster industry forecast POMS danger periods.

In the meantime, Christine Crawford, together with John Preston from Biosecurity Tasmania, provide a monthly newsletter (www.imas.utas.edu.au/research/fisheries-and-aquaculture/publications-and-resources) to oyster farmers, available on the University of Tasmania's website.

While OsHV-1 virus causes mortality in oysters, the disease cannot be transmitted to humans and there are no health implications from consuming Pacific Oysters from POMS-affected regions. F

Scholar discovers new value in consumer perspectives

An international study tour has helped put Australia's seafood marketing in perspective for Abby McKibben

By **Catherine Norwood**

As she searched for strategies to more successfully brand Australian seafood as a luxury product during her recent Nuffield Scholarship studies, Tasmania's Abby McKibben identified several approaches applicable to the seafood sector as a whole.

These include making the consumer experience central to the marketing of the product and having other people – independent third parties – endorse the product or tell its story.

Abby McKibben is the brand manager for Huon Aquaculture, one of Australia's largest Atlantic Salmon producers. The initial impetus for her Nuffield Scholarship was 'luxury' seafood branding and the importance of provenance for products such as Huon's Atlantic Salmon caviar.

During her scholarship she travelled through the food-producing regions of Europe and the UK, visiting leading producers and investigating their marketing strategies – everything from the Guinness factory in Ireland to the Terra Madre food festival in Italy. However, she says a presentation from one of Coca-Cola's senior marketers during the North American Seafood Expo in Boston most effectively consolidated what she had learned during her study tour. Principally, this involved highlighting the consumer experience.

"I realised, for instance, that we had been focused on selling Atlantic Salmon farming, not the experience of eating salmon. We had photos of our production pens, but we didn't have images of people eating salmon." Abby McKibben believes it's something that the seafood sector as a whole can take on board.

The importance of provenance was also clear, particularly throughout Europe and the UK, where products were widely branded by the point of origin.

Above Abbey McKibben
Photo: supplied by Abbey McKibben

"In Australia we produce some of the highest-quality seafood in the world, in extremely pristine and environmentally sound locations such as Tasmania. This provenance story will become more important for the success of our industry, with increasing competition from lower-quality imports," she says.

The successful marketing of a provenance has the ability to confer a 'halo effect' on other products from the same region. However, she says most Australian provenance marketing does not have a real supporting quality assurance framework to increase consumer confidence in the associated product quality – something she believes will become more and more important.

Abby McKibben says third-party endorsements have also become an increasingly influential marketing strategy – recommendations from people who genuinely appreciate your product. This provides real engagement with consumers and more creative opportunities than traditional marketing strategies such as supermarket tastings and advertising.

She says Huon was lucky to have been tagged on social media by leading international road cyclist Richie Porte, a Tasmanian who is a fan of the company's hot smoked salmon products. As an athlete (and one of the favourites for the 2017 Tour de France), he frequently talks about his diet; his endorsement of their product is authentic and he has officially become an ambassador for the Huon brand.

"Consumers see through the spin," Abby McKibben says. "Having others who endorse your product, whether that's medals at fine food awards, or consumers who love your product, those independent endorsements have far more power."

She says the Nuffield Scholarship program was an extremely valuable experience, both professionally and personally. Interactions with other scholars involved in primary production from around the world, all with different mindsets and perspectives, challenged her views and perceptions. "It's the kind of experience you just can't buy," she says.

Her scholarship was sponsored by Blundstone Australia, Robert Gatenby Memorial Trust, Roberts Limited and Tasmanian Alkaloids.

The FRDC is also a long-term supporter of the Nuffield Scholarship program. Recent scholars sponsored include Stacey Loftus (oyster production and marketing, 2015); Dennis Holder (marine and vessel technologies, 2016) and Steven Davies (sustainable aquaculture, 2016); Glenn Wormald (prawn aquaculture, 2017) and Jonas Woolford (natural resource and fisheries management, 2017).

The 2018 Nuffield Scholarship program provides a $30,000 bursary that allows primary producers to research an issue of their choice, assisting with up to 16 weeks of international travel, including a six-week Nuffield global focus tour. F

Applications for 2018 Nuffield Scholarships close on 16 June, 2017. To apply or for more information visit www.nuffield.com.au

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Fisheries in global push for sustainable development

The efforts of Australian researchers are helping to underpin the sustainable development and use of fisheries resources internationally and at home

By **Gio Braidotti**

Australian-led projects are helping to improve the sustainability of fisheries and marine resources, which are recognised as crucial to addressing extreme poverty, hunger and social disadvantage around the world.

It has been estimated that more than three billion people depend on marine and coastal biodiversity for their livelihoods and their primary source of protein. Globally, the market value of marine and coastal resources and industries is estimated at US$3 trillion (A$4 trillion) per year, or about five per cent of global GDP.

In 2015, the United Nations introduced *Transforming our World: the 2030 Agenda for Sustainable Development*, which has 17 Sustainable Development Goals (SDGs), including one focused solely on marine resources.

The new SDGs supersede the previous Millennium Development Goals, which primarily targeted change in developing countries. The new goals apply equally in developed countries and reflect the changing view that substantial, ongoing and resilient change must be underpinned by sustainable practices.

SDG 14 deals with oceans, marine biodiversity, fisheries and the livelihoods that depend on these vast, globally significant resources (see panel).

It has 10 fisheries-oriented targets, including eight that specify an increase in scientific knowledge, research capacity and the transfer of sustainable marine technology among the UN's 193 member states.

The FRDC is one of two organisations in Australia that has long been active in building research capacity to help solve issues facing fisheries and the sustainable management of fisheries-related resources.

The other is the Australian Centre for International Agricultural Research (ACIAR), which has a 35-year history of funding Australian agricultural scientists to help solve food security and resource management challenges that affect developing countries.

ACIAR brokers collaborative partnerships that allow Australian researchers to work with communities and research organisations in developing countries. Gains in agricultural productivity are known to improve resilience and drive greater economic development.

ACIAR's research program manager for fisheries is Chris Barlow. He says that ACIAR projects intrinsically build scientific capacity in the partner country, and Australian researchers acquire knowledge and expertise that ultimately benefits Australia – especially regarding biosecurity issues. The participating Australian laboratories are often also funded to work on a parallel problem affecting Australian producers.

"ACIAR's research-based approach to development delivers mutual benefits and these projects already have sustainability built into them," Chris Barlow says.

Tuna management

One such ACIAR project aims to improve Indonesia's capacity to assess and manage Yellowfin Tuna *(Thunnus albacares)* and Bigeye Tuna *(Thunnus obesus)*. Bigeye Tuna is classified as sustainable in the Indian Ocean and overfished in the Pacific Ocean, while Yellowfin Tuna is classified as sustainable in the western and central Pacific Ocean and transitional depleting in the Indian Ocean.

The Western and Central Pacific Fisheries Commission and the Indian Ocean Tuna Commission are responsible for managing the world's tropical tuna catch, which includes these two species. In managing Australia's share of the catch, the Australian Fisheries Management Authority follows the decisions of both commissions.

Chris Barlow says that tuna, like all migratory fish species, pose particular management challenges. "The regional fisheries management organisations for migratory fish species have made national fishing quotas contingent on the implementation of strong monitoring and evaluation protocols," he says.

"These protocols, however, require sophisticated scientific capability. Australia has that capability and it is in the national interest for us to assist in developing sustainable fish management capability in Indonesia."

This capability is now being tapped to help Indonesia as its government moves to develop a harvest strategy for tuna fisheries as a key component of its National Tuna Management Plan. The project is led by CSIRO's Craig Proctor and in Indonesia by Hari Eko Irianto from the Center for Fisheries Research and Development.

Oyster benefits

Often, the researchers and laboratories that participate in ACIAR projects are also tapped by the FRDC, with the investment provided by these two organisations creating synergistic benefits for fisheries, as in the case of efforts by Australia to diversify and expand aquaculture enterprises.

Wayne O'Connor is the aquaculture research leader at the Port Stephens Fisheries Institute within the NSW Department of Primary Industries. He has played many important roles developing production techniques for molluscs over 30 years, including the iconic Sydney Rock Oyster, and has also led an ACIAR project undertaken with Vietnam.

Above Oyster raft off Cat Ba Island in Ha Long Bay, northern Vietnam.
Photo: Wayne O'Connor

This project used bivalve hatchery and grow-out expertise to provide a new source of income for poor coastal communities in northern Vietnam's Ha Long Bay. Today, 28 provinces produce about 15,000 tonnes of Portuguese Oysters a year for local Vietnamese markets, helping to lift many small-scale producers out of poverty.

At the same time, the partnership with Vietnam helped to expose Australian team members to aquaculture technology for species that are new to Australia.

That ACIAR investment subsequently had a bearing on the Australian production of Sydney Rock Oysters, allowing for research that improved the efficacy of the Sydney Rock Oyster breeding program. The investment also improved the reliability of Native Oyster production through enhancing knowledge of these oysters' reproductive behaviour, and on pipi ecology and culture by demonstrating the possibility for hatchery production of pipi juveniles. It also led to the discovery, in the wild, of a previously unknown pipi parasite and the development of appropriate biosecurity measures.

"The researchers that receive financial support from ACIAR overlap a great deal with the teams used by the FRDC for research work," Chris Barlow says. "ACIAR has a mandate to benefit both developing countries and Australia. We are quite overt about that. Everything we do has capacity-building aspects for Australian people and sometimes it has direct benefits to Australia, as in the case of tuna and oysters." F

> "Everything we do has capacity-building aspects for Australian people and sometimes it has direct benefits to Australia, as in the case of tuna and oysters."
>
> Chris Barlow

SUSTAINABLE DEVELOPMENT GOAL 14

The 10 targets to conserve and sustainably use the oceans, seas and marine resources

1. By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.
2. By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans.
3. Minimise and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels.
4. By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics.
5. By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information.
6. By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognising that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation.
7. By 2030, increase the economic benefits to small island developing states and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism.
8. Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing states and least developed countries.
9. Provide access for small-scale artisanal fishers to marine resources and markets.
10. Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in United Nations Convention on the Law of the Sea, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of *The Future We Want*.

Source: United Nations Sustainable Development Goals, www.un.org/sustainabledevelopment/oceans

MORE INFORMATION
www.frdc.com.au
FRDC RESEARCH CODE: 2014-009

Quality assurance for fisheries science

Ensuring the quality of scientific information used to manage Australia's fisheries and marine ecosystems is important in earning the trust of stakeholders and the community in the decision-making process

By **Andrew Penney**

During the past 30 years or more there has been growing public mistrust of government decision-making, particularly in relation to the management of threats to human health and ecosystems, including fisheries.

For fisheries management decisions to be based on evidence that is trusted, government, stakeholders and the public need to have confidence and trust in the research and scientific information used to inform these decisions.

In response to this need, Australia has become one of a growing number of countries to adopt quality control guidelines for scientific research.

Objective assessment

Scientific methods are designed to produce objective and reliable information and to document how that information has been derived so that the results can be validated and checked for reproducibility. Scientific conclusions are typically based on a long history of evidence collection, experimentation, testing of hypotheses and rigorous evaluation of conclusions.

As a result, scientific information is usually reliable. A key purpose of scientific quality assurance guidelines is to specify the key principles used to ensure this reliability.

However, the complexity and variability of natural systems results in inevitable uncertainty around results. Advocacy or interest groups may use this inherent uncertainty to discredit, challenge, bias or confuse scientific findings for their own benefit. A further key purpose of scientific quality assurance is to ensure that scientific evidence-based truth is not biased, misinterpreted or selectively used by such advocacy interests.

Australian guidelines

Research and Science Information Guidelines for Australian Fisheries outlines what constitutes best-practice, high-quality and reliable scientific information. The guidelines are intended to be applied to research on wild-capture fisheries and their impact on the marine environment, but hold relevance to scientific research generally. The guidelines establish high-level key principles for science information quality, supported by definitions for clarity and describe the responsibilities of research purchasers and research providers. They also provide criteria for effective peer review (Figure 1).

PRIOR principles

The quality of research and scientific information relates primarily to relevance, reliability, objectivity and integrity, and the internationally accepted mechanism for evaluating this is peer review. These have emerged as the key principles for ensuring quality of scientific information in guidelines and standards developed over the past two decades in the UK, European Union, Canada and the US. The Australian guidelines are built around these 'PRIOR' principles, which are also the basis for a similar New Zealand fisheries science standard.

Peer review – is an internationally accepted mechanism for evaluating the quality of scientific and research information. It is the evaluation of research or scientific information by one or more experts in the appropriate field, either with similar competence or in the same occupation, profession or industry as the producers of the work. Peer review is intended to ensure that the work meets appropriate or applicable standards of quality.

Reliability – relates to the accuracy and reproducibility of information. Research and scientific information must be accurate, reflecting the true value of the results being reported, within an acceptable level of precision or uncertainty. Information should not be statistically biased or suffer from such a degree of imprecision that the results and conclusions are rendered unreliable.

Integrity – refers to the security of information, and to the protection of information from inappropriate alteration, selective interpretation or presentation, including with regard to uncertainty in that information. Scientific information should remain complete throughout the science-to-decision process. It must be ensured that the information and associated uncertainty is not selectively reported in a way that introduces bias into the interpretation of such information.

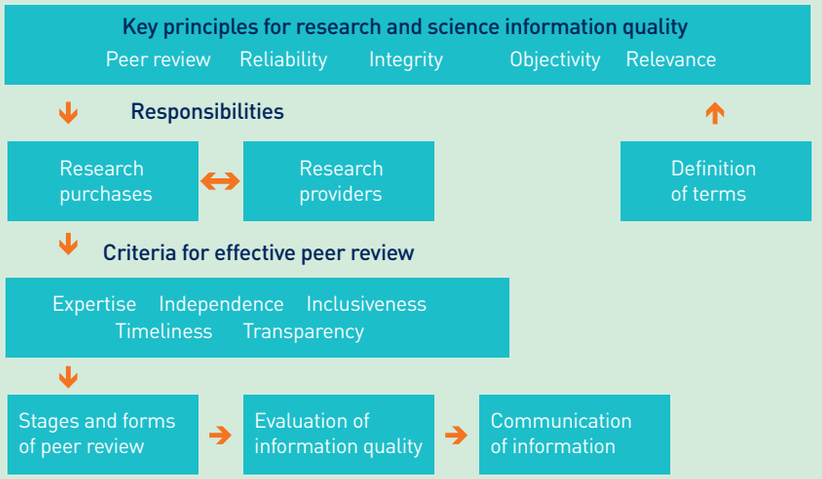
Objectivity – refers to whether the information presented is impartial and free of personal bias. Objective interpretations or conclusions do not depend upon the personal assumptions, prejudices, viewpoints or values of the person presenting or reviewing the information.

Relevance – research and scientific information must be relevant to the fisheries management objectives and associated key questions for the fishery concerned, contributing directly to answering those questions and addressing management objectives for that fishery.

Roles and responsibilities

Meeting the requirements of these guidelines will primarily be the responsibility of those who "buy research" (research purchasers) and those who "supply the research" (research providers). These two roles may rest within the single organisation (buying and doing by different areas), or under separate organisations.

Figure 1. *Research and Science Information Guidelines for Australian Fisheries* components and linkages



Responsibilities of research purchasers

- Establish, maintain or support appropriate quality assurance and peer review processes, and ensure that research and scientific information is subjected to effective peer review against the provisions of these guidelines;
- Ensure that research proposals are evaluated against the requirements for research and scientific information quality established by these guidelines relating to relevance, project design and proposed methodology;
- Where necessary to ensure the quality of scientific information produced by substantial or complex projects, provide for staged technical guidance or peer review at appropriate stages in the project, ensuring that such guidance is appropriate to the cost, novelty, complexity or contentiousness of research and scientific information;
- Ensure that research providers comply with relevant provisions of these guidelines;
- Require research providers to establish, maintain or support databases to manage and securely store any raw data sets and final data sets, analyses and research reports, to enable subsequent verification of the repeatability and reliability of the results.

Responsibilities of research providers

- Qualifications and capabilities
- Project management and quality management
- Data management and provision
- Certification of laboratories and equipment
- Data collection
- Data analysis and synthesis
- Experimental studies
- Technical protocols
- Internal and external peer review
- Research reports

Implementation and reporting

Research purchasers and providers intending to implement the provisions of these guidelines to ensure the quality of scientific information should develop and maintain implementation plans appropriate to their particular circumstances. Implementation plans should include:

- A statement of intention to implement these guidelines to inform management decisions for wild capture fisheries and their impact on the marine environment;
- Identification of roles and responsibilities within the organisation for implementation of processes relating to requirements under these guidelines;
- Description of peer review processes that will be implemented, specifying the requirement that scientific information be submitted for peer review and provisions for the manner in which that should occur; and
- Annual reporting requirements on the implementation of peer review processes to evaluate the quality of scientific information used to inform fisheries management decisions.

Public reporting on the details and results of implementation of scientific quality assurance and peer review processes is important for ensuring transparency and increasing government, stakeholder and public trust in the quality of scientific information used to inform fisheries management decisions.

Application

The provisions of these guidelines are intended to apply to all stages of the research process, including aspects of research planning processes and the appropriateness of the proposed methodology, to ensure the reliability and objectivity of resulting scientific information.

The guidelines are non-prescriptive and provide for enough flexibility to ensure they are relevant across the wide range of research activities informing policy and management decisions for Australian wild capture fisheries and their impact on the marine environment.

Processes related to how research and scientific information is subsequently combined at policy or management level with other sources of information to inform fisheries management decisions, are not within scope of these Guidelines.

Research and Science Information Guidelines for Australian Fisheries and the international review used to inform the development of these guidelines can be downloaded from the FRDC website (www.frdc.com.au). The FRDC will establish the guidelines to guide and certify all research in which it invests. The guidelines are being considered for implementation by the Australian Fisheries Management Authorities. F

"Peer review is an internationally accepted mechanism for evaluating the quality of scientific and research information."

MORE INFORMATION
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On common ground

A multi-faceted career helps Chris Calogeras represent a diverse range of fishery perspectives and ensure every voice has a chance to be heard

By **Annabel Boyer**

Chris Calogeras has made a 30-year career of bringing people with disparate interests together to foster connections, fruitful negotiations and, ultimately, seafood success.

"There are times, at big meetings for example, when the challenge of working with groups with multiple interests sitting at the same table can get difficult," he says. "It might be about economic priorities for Barramundi or access for wild-catch fishers. For the Indigenous sector it is about engagement and recognition; their objectives don't always match up.

"But I think if I believe in all of those aims, I can ensure that each side's view is properly considered and we can address any perceived conflicts of interest."

Chris Calogeras has engaged with different parts of the fisheries sector from many vantage points: as a fisheries manager with the Northern Territory Government, a business operator, a researcher and an industry consultant. These diverse roles have given him the experience to relate to the broad spectrum of stakeholders involved in fisheries.

He has also seen fisheries management evolve from a simple production approach focused on target species, to the incorporation of complex ecological, economic and social dimensions, recognising multiple stakeholders.

He says that by its very nature, the fisheries sector needs people who can engage and negotiate on behalf of its stakeholders. "Many people in the sector have difficulty or a limited capacity to engage with others: fishers, processors or Indigenous Australians who often only spend time by themselves or with their peers. Put them in a room full of other stakeholders or agency people (government or research) for a day or more, it kills them; they are like fish out of water," he says. It has often been his role to assist with this engagement.

He has represented diverse organisations including the FRDC, the former Seafood Cooperative Research Centre and industry groups such as the Australian Barramundi Farmers Association, the Northern Territory Seafood Council and Indigenous Australian groups. This, in turn, has taken him from some of the most remote parts of Australia to the major cities, and abroad to destinations including Madagascar and Malaysia.

Mud crab lessons

He says one of his most valuable learning experiences about the complexity of the fisheries sector came while taking a break from his position with the Northern Territory Government after 17 years there. He had been approached by a group of mud crabbers in Darwin looking to refine the operation of their business, Sea King Seafoods, to break into new markets, build product quality protocols and identify new areas for development.

"I learnt that the industry is not just catching fish. There is catching, but also processing, transporting, distributing, supplying the logistics, transport operators, opportunities to work with recreational fishers and of course Indigenous Australians.

"The industry is so broad and diverse and seeing the connections and opportunities means that there is always a whole range of areas to work with."

He loved the way a hard day's work of packing, sorting and delivering crabs would end with a clean warehouse, a job finished and a sense of achievement with invoices sent off. His enjoyment of this project-based work set him on course as a consultant, rather than returning to the public sector. The focus of his business was to bridge the gaps between policy and practice.

"There was a lack of connection between industry and agency, research and management and I'm actually quite good at that," he says. "In the department I learnt the value of good preparation and when I went to Sea King Seafoods I learnt the value of selling your ideas and thinking big and engaging with people."

Bridging worlds

Much of his most recent work has focused on working with Indigenous communities. When the Northern Territory's Northern Land Council was looking to engage with the commercial fishing sector in the mid-2000s, Chris Calogeras took on a role to help make this happen.

Then, as part of an FRDC project, he travelled to New Zealand with a group that included government staff, traditional owners and commercial and recreational fishers to learn about changes to Maori ownership of commercial fisheries. This had gone from almost zero to a 50 per cent share of New Zealand's commercial fisheries following the settlement of claims for breaches of the Treaty of Waitangi, the 1840 agreement between Maori leaders and the British Crown which established British sovereignty over New Zealand.

On his return to Australia several events took place that led to greater engagement with Indigenous groups in the fishing and aquaculture sectors. A 2008 decision by the High Court called the Blue Mud Bay decision had given Indigenous land councils in the Northern Territory the authority to grant or deny access to waters over their lands as far as the low-water mark. Chris Calogeras says the decision led to numerous negotiations that required Indigenous input – but there was no real mechanism for achieving that.

"I learnt that the industry is not just catching fish. There is catching, but also processing, transporting, distributing, supplying the logistics, transport operators, opportunities to work with recreational fishers and of course Indigenous Australians".

Chris Calogeras

Chris Calogeras in Moreton Bay, where he worked with Tunnel Net fishers to develop a code of conduct. Photo: Chris Calogeras

At the same time, the FRDC identified an under-investment in the Indigenous part of its portfolio and established its Indigenous Reference Group (IRG). As someone with experience dealing with both the fishing sector and Indigenous groups, Chris Calogeras was appointed as the IRG's executive officer.

His own heritage is Greek and Polish, although he is sometimes assumed to have Indigenous Australian origins due to the role he holds. He is adamant that he cannot speak for Indigenous Australians. Rather, it is his role to help make connections between Indigenous groups and others.

"I get a bit upset sometimes because people think that by having me there they have an Indigenous voice. They haven't; far from it. But I can provide high-level strategic information that the IRG has developed."

He says his ultimate aim is to make sure that he is no longer needed in the role. "It is part of my job to make sure I'm not there long term. I'll be really disappointed when that time comes as I love working with the group, but it's for the right reason and is a good thing. What I really love to see at the end of it all is that the people you've worked with are empowered and they take control."

The scope of the IRG is to ensure that fishing and seafood industry-focused research, development and extension helps deliver improved economic, environmental and social benefits to Indigenous people. It does this by providing advice to the FRDC on strategic issues relevant to Indigenous RD&E in the fishing and seafood industry.

"The lessons that I learnt way back about engaging with people were very relevant. So, it is about engaging with the Aboriginal and Torres Strait Islanders, but also about engaging with the commercial sector, the rec sector, the researchers and the agencies to actually have conversations because you can't live in a silo.

Productive negotiations

"It's about getting people to work together, and helping them to understand what they share. Part of it is making sure that the people who feel that they haven't fully got the outcome that they want have been listened to. So it isn't always about getting people to 100 per cent agree, it is about getting to a point where people can say, 'I can live with that'," he says.

He credits the FRDC's National Seafood Industry Leadership Program (NSILP) in 2004 with developing his skills to tackle these problems. He is now a co-facilitator of NSILP and has the opportunity to hear the stories of people who are benefiting from the work he does. His passion for the sector and talent for productive and sincere engagement has had a tangible impact on a new generation.

He says there are some serious challenges ahead for the major groups he works with, such as biosecurity, country of origin labelling, a lack of new blood in the industry and improving Indigenous Australians' role in the industry. However, he is confident that the fisheries sector can continue to grow and build community support.

"I think the industry has got the capacity to gain pre-eminence again," he says, "but everyone needs to work together. If we start arguing and bickering and picking each other off, it's a slippery slope, but if we work together we can all have a really bright future." F

Habitat Risk Assessments 2014-204

This project addresses an Australian Fisheries Management Authority priority requirement for a gap analysis to determine the extent to which individual fishery Ecological Risk Assessments (ERAs) and hence Ecological Risk Management (ERM) need to address habitats, considering other fishery management measures are now in place – including effort reductions and closures – and following the finalisation of a new Commmonwealth Marine Reserve.

In addition to the new management, the project also took into account new data and knowledge, and advances in methods, to implement a consistent national-scale assemblage mapping approach that had not been previously possible. This was applied to Commonwealth demersal trawl fisheries. The scope of the project included Australian continental Commonwealth demersal fisheries that use towed bottom-contact gear in shelf and mid/upper-slope waters.

More information: Roland C. Pitcher, roland.pitcher@csiro.au

Live fish and shellfish welfare 2012-506

A key initiative undertaken by the Federal Government's Aquatic Animal Welfare Working Group (AAWWG), in line with the Australian Animal Welfare Strategy (AAWS), was the development of a generic set of overarching welfare principles to help guide the development of sector-specific guidelines in relation to animal welfare. These principles were applicable to finfish being farmed, transported, captured from the wild by both commercial and recreational fishers, or kept in aquariums in restaurants or private homes. With respect to live fish and shellfish being held in restaurants, community concerns regarding the treatment of these animals prompted the Department of Fisheries in Western Australia in 2008 to develop and distribute a set of welfare guidelines on the holding of fish and shellfish in aquariums to restaurant owners.

This project aimed to develop information that would help promote best-practice handling techniques for restaurants and retailers keeping live fish and shellfish for human consumption. This was to address one of the most common sources of public complaints (both real and perceived concerns) regarding the treatment of live fish and shellfish in these establishments across Australia.

More information: Gaye Looby, gaye.looby@fish.wa.gov.au; frdc.com.au/environment/welfare/Pages/default.aspx

Fish welfare in commercial capture 2012-507

The commercial capture fishing sector in Australia is vast and diverse, both in terms of ocean area that is fished and the number of wild fish captured each year. The Australian Animal Welfare Strategy (AAWS) was an Australian Government initiative which aimed to protect and promote the welfare of all Australian animals, including aquatic animals. It provided a more consistent and coordinated national approach to animal welfare than had been done previously. As a component of the AAWS, a workshop was organised for each of the four key finfish sectors, including the commercial capture fishing sector. The key objective of each workshop was to bring together a representative group of stakeholders to consider and discuss issues of fish welfare through a workshop process. It is well-established that fish quality and welfare can improve with better handling and slaughter techniques.

At the commercial capture workshop, which is the subject of this project, the development of legislated and enforceable minimum regulatory welfare standards through the AAWS process was not supported by workshop participants, but producing specific overarching guidelines to assist in reducing unnecessary suffering of fish during their capture, slaughter and holding was considered a worthwhile aim of any process going forward. The potential improvements in fish quality and fish welfare provided a win-win approach for both commercial fishers and the fish they were capturing. Based on the outcomes from this and the other sector workshops, the AAWWG developed a generic set of overarching welfare principles to help guide the development of sector-specific welfare codes of practice or guidelines.

More information: Paul Hardy-Smith, paul@panaquatic.com; frdc.com.au/environment/welfare/Pages/default.aspx

Atlantic Salmon susceptibility to disease 2011-070

Researchers at the Institute for Marine and Antarctic Studies have completed a two-year experimental project on amoebic gill disease (AGD). Researchers investigated the comparative susceptibility and host responses of endemic and salmonid fishes to AGD. The research, conducted at the University of Tasmania's aquaculture research facility, found that Yellow Eye Mullet were able to spontaneously resolve pathological signs of AGD under experimental conditions. A tempered disease response to experimental infection with the causative agent *Neoparamoeba perurans* was demonstrated in other native species including Australian Salmon, Purple Wrasse and Southern Sand Flathead. The disease has affected Tasmanian salmonid aquaculture since its inception three decades ago. AGD has become an increasingly complex management issue as the industry expands and the condition has emerged worldwide, affecting major northern hemisphere producers. It is anticipated that the identification of fish species resistant to or tolerant of AGD will provide insight and linkage towards alternative treatments or prophylaxis for farmed Atlantic salmon.

More information: Mark Adams, mark.adams@utas.edu.au

Health check for Australian fisheries 2014-008

This project delivers an approach to summarise information to document the sustainability of Australian fisheries – efficiently, consistently, comprehensively and transparently. The health check is designed to support fisheries managers and managing agencies, as well as communities of interest (recreational fisheries, regional coastal communities), eNGOs (as authors of many existing seafood guides) and third-party assessment bodies, and to provide information for interested members of the public. The draft health check covers areas of fisheries including social aspects, economic aspects, overall governance (factors that are not consistently included in fishery assessments), as well as common biological considerations such as stock status. A holistic picture of the sustainability of Australian fisheries is needed to inform both the general public and both public and private organisations about the sustainability of Australian fisheries. If implemented, a fisheries health check portal will support transparent and efficient access to commercial fishery information such as bycatch levels or economic performance, which will then serve in tandem with the Status of Australian Fish Stocks (SAFS) Reports as the 'go-to' source of overview information about Australian fisheries.

More information: Alistair Hobday, alistair.hobday@csiro.au

Marine mammal impact assessment 2015-035

The Commonwealth Small Pelagic Fishery (SPF) has attracted significant public attention as a result of marine mammal bycatch (common dolphins and fur seals) by the FV Geelong Star since it commenced fishing in April 2015. A workshop explored mitigation options to reduce interaction rates with marine mammals. It also recommended that an expert group be established to review available information used to establish trigger limits for key marine mammal species in the area of the SPF. As a result, another

two-day workshop was convened. The first day of the workshop provided stakeholders from Commonwealth and state fisheries, environment agencies, industry and environmental organisations with a summary of available information on the abundance and distribution of key marine mammal species in the area of the SPF.

On the second day, a closed technical workshop (CTW) of invited scientists was held. During the CTW, a process of expert elicitation was used to arrive at estimates of population size for each marine mammal species relative to different spatial zones. Estimates were based on available data on marine mammal abundance and were not provided for those species or zones where there was no data. Estimates obtained through CTW and expert elicitation process were used, where possible, to calculate potential biological removal (PBR) for the species considered.

More information: Alice Mackay, alice.mackay@sa.gov.au

Identifying critical production periods in Macquarie Harbour 2016-229

This project sought to determine the nature and extent of warm and hypoxic conditions in Macquarie Harbour during summer periods to assist in planning future production strategies. The project: 1) summarised the known oxygen requirements of salmon under culture and the known environmental drivers of their swimming depths and densities; 2) analysed existing long-term datasets of environmental dissolved oxygen levels and temperature with depth at Huon Aquaculture leases to determine suitable production depths and how they vary with season; 3) documented the swimming depths and densities of Atlantic salmon in production cages in Macquarie Harbour during a critical summer production period in February 2016 using a cage-based echo-integration system; and 4) combined the environmental and group-based salmon data to determine the temperatures and dissolved oxygen levels salmon are exposed to during critical summer production periods.

More information: Tim Dempster, dempster@unimelb.edu.au

Understanding Dorvilleid ecology 2014-038

The response of the benthic invertebrate communities, and most notably *Dorvilleidae polychaetes*, in Macquarie Harbour to enrichment from salmonid aquaculture has been inconsistent with expectations. In the first part of the study, the international literature was reviewed to establish the current state of understanding regarding Dorvilleid ecology, and in particular, how they respond to organic enrichment. The second part of the study comprised a targeted field survey at selected leases to identify the relationship between Dorvilleids and sediment condition, and to characterise the environmental conditions associated with major changes in Dorvilleid distribution and abundance. The results were compared with previous surveys (including baseline surveys undertaken throughout the harbour) to investigate whether there have been any broadscale changes in the benthic ecology.

More information: Jeff Ross, jeff.ross@utas.edu.au

Seismic survey research on lobsters and scallops 2012-008

Substantial overlap exists between important fishing grounds and areas of interest for oil and gas exploration within south-east Australian waters. The fishing industry is now very concerned about the potential of intense low-frequency acoustic signals produced during these surveys to disturb, harm or even kill fisheries species. Studies conducted to date generally report that fish can demonstrate behavioural responses to seismic activities, including startle and flight responses, displacement, dispersal and disruption of feeding or breeding activity. These behavioural responses could in turn result in changes in commercial catch rates. There have been very few dedicated studies of the effects of marine seismic surveys on invertebrates, and the limited information on invertebrates suggests that they may be relatively resilient to seismic sound. However, further research is required before the impact of seismic activity on commercially important invertebrates can be dismissed. In the light of a general lack of well-designed and scientifically rigorous studies examining the effect of marine seismic surveys on invertebrates and in the absence of any detailed specific studies on commercial scallops and Southern Rock Lobster, fishers in Victoria and Tasmania have lobbied for dedicated research targeting these valuable resources. This study aimed to use a field and laboratory experimental approach to determine the impact of marine seismic surveys on these important fisheries species. The results obtained are broadly applicable to scallop and spiny lobster fisheries throughout the world, and bivalve and crustacean fisheries in general.

More information: Ryan Day, ryan.day@utas.edu.au

Seismic surveys impact on scallops 2014-041

This project was initiated to undertake a before and after assessment to quantify the potential impact of a 2D seismic survey undertaken by Geoscience Australia in the Gippsland Basin off the coast of Victoria. Initially the project was to collect seafloor images and identify scallops via an Autonomous Underwater Vehicle (AUV). Four acoustic recording units were used, with three being used in the vicinity of the seismic survey and one control. A number of dredge samples were also taken in areas outside the seismic survey area to assess numbers of alive and dead scallops as well as the meat and gonad condition of scallops. This study represents the first attempt to quantify the potential impact of noise pollution on scallops in the field using a non-invasive technique (for example, AUV imagery) and will help stakeholders develop, or further refine, management policies according to the best information on species-specific responses to known exposure levels of low-frequency sound.

More information: Rachel Przeslawski, rachel.przeslawski@ga.gov.au

Building cooperation between sectors 2013-209

Sometimes there is overlap of operations of the fishing sector and petroleum industry. The project aimed to improve processes of communication and build relationships between the fishing and petroleum industries to build a shared understanding of potential effects (financial, operational and logistical) and how they could be minimised. During the project, the establishment of the National Offshore Petroleum Safety and Environmental Management Agency improved consultation processes.

More information: Ian Knuckey, ian@fishwell.com.au

Impacts of salmonid farming on rocky reef communities 2014-042

The strategic growth of the Tasmanian salmonid industry is contingent upon ecologically sustainable development. Current Tasmanian production is not meeting domestic demand and the industry is in the process of expanding farming operations. While local-scale impacts are well understood, the extent of broadscale environmental impacts from finfish farming needs to be better understood, especially in relation to nutrient emissions and their potential ecosystem effects on macro-algal community assemblages on rocky reefs. This report describes the results of analyses and surveys designed to examine patterns of change and characterise reef assemblages in south-eastern Tasmania, where there is increasing concern as the salmonid aquaculture sector expands into more exposed waterways that overlap with traditional wild fishing sectors (such as abalone and Rock Lobster). The first part of the study used the existing Marine Protected Area (MPA) monitoring dataset to examine patterns of change in macro-algal communities in

south-eastern Tasmania between 1992 and 2015. The second component of the study included a field survey of rocky reefs, incorporating the MPA sites, along with additional sites chosen to better represent industry expansion into new growth areas.

More information: Sam Ibbott, sam@marinesolutions.net.au

Dynamics of growth in translocated lobsters 2014-725

This research is an extension of two previous projects on Southern Rock Lobster translocation, which showed that translocation of slow-growing lobsters to better habitat can be used as a management tool to increase production in the fishery. It is currently being used on a small scale to increase production in the Tasmanian fishery by 50 tonnes per annum through a fully industry funded program. The growth rate of Southern Rock Lobsters varies spatially with a general trend of growth slowing along a gradient from western Victoria to southern Tasmania. Previous research for defining locations of capture and release of Rock Lobster translocation relied on general models of this spatial trend in growth. The research reported here involved more detailed spatial analyses of growth to try to refine those operations. In particular, the aim was to find locations that would provide for high growth of translocated lobsters with less travel distance (cost) than the sites currently being used.

More information: Caleb Gardner, caleb.gardner@utas.edu.au

Forum for Indigenous fisheries 2014-404.20

This report summarises the outcomes from the third FRDC Indigenous Reference Groups National Indigenous Fisheries Forum held in Cairns in March 2016 (Forum 3). Forum 3, developed and supported by the IRG, continued on from the work achieved at the two previous forums held in Cairns in March 2011 and November 2012. The forums are undertaken as part of a series of discussions in a semi-workshop setting with a national spread of Indigenous fisheries stakeholders in one location.

More information: Jill Briggs, jill@ruraltraininginitiatives.com.au; Stan Lui, stanley.lui@agriculture.gov.au

Aquaculture ventures by Indigenous communities 2010-205

This project has established an Indigenous Australian business development framework that identifies key systems for driving business development in remote Indigenous communities, and the key success factors necessary for viable fisheries-based businesses and enterprises. This in turn has identified the partnerships and processes that are required to ensure key systems are engaged and key success factors are addressed during each of the pre-commercialisation phases of business/enterprise development.

More information: Ann Fleming, ann.fleming@nt.gov.au

Skills and capability building 2016-411

A matrix has been developed that summarises priority people development needs and the availability of programs including existing courses that address the priority areas. A key requirement of the project has been to capture people development priorities as identified through the research and advice from industry stakeholders. The objective is for these to serve as areas for potential co-investment across FRDC partners. Gaps in service delivery have also been noted.

More information: Ross Ord, rossord@hotmail.com

Bycatch reduction gear design 2011-009

This project tested modified gillnets designed by commercial net fishers in the Queensland East Coast Inshore Finfish Fishery (ECIFF) to try to identify gears that would mitigate and/or improve interactions between fishing nets and Species of Conservation Interest (SOCI). The study also documents previously unrecognised initiatives by proactive commercial net fishers that reflect a conservation-minded approach to their fishing practices, which is the opposite of what is perceived publicly.

More information: David Welch, d.welch@c2o.net.au

Internationally managed multi-species fisheries 2013-203

This project addresses one of the most complex fisheries management issues: how to manage a fish stock at the national level when the species is part of a much wider population, migrates across national boundaries and is managed at the population level by an international fisheries management organisation. The project work was undertaken between 2013 to 2016 using the fishery for tuna (*Thunnus albacares, Thunnus obsesus, Thunnus alalunga*) and billfish (*Xiphias gladius, Kajikia audax*) on the east coast of Australia as the example case study.

Australia's Commonwealth Harvest Strategy Policy requires that fisheries within Australia's territory are managed according to that policy, even if the actual spatial population range (and international fisheries harvesting within) includes regions outside Australia's territory and international fisheries management protocols. Using state-of-the-art models and population dynamics modelling, the project explored (i) when and where the national management is effective; (ii) where the current understanding is, and what remains uncertain, with respect to population connectivity and structure between Australia's and international waters; (iii) the cost and benefits of different monitoring strategies to reduce these uncertainties; and (iv) how all this can be brought together with the international management side of the problem, given the clear feedback with the national approach. The feedback between both national fisheries management and research projects and the assessment and wider international management of the South West Pacific stocks suggested that even while having a national management approach, active engagement at the international level is still vital for the national approach to succeed.

More information: Rich Hillary, rich.hillary@csiro.au

Independent observer program 2014-036

This project successfully completed the first observer-based program to assess kept and released catches in the coastal charter boat fishery in NSW, Australia. In doing so it (i) demonstrated the potential value of observer work for obtaining important information for resources assessments and management and (ii) assessed the accuracy of the data collected in the current industry-based logbook program. The project methodologies and results have applicability to other recreational fisheries in Australia and elsewhere.

More information: Charles Gray, charles.gray@dpi.nsw.gov.au

Resource sharing 2013-230

The project used a multi-stakeholder workshop to bring together representatives from each of the designated stakeholder groups to discuss what guiding principles (objectives) should form the basis of, and be incorporated in, a resource allocation option (policy). The implications of this research are significant, particularly in light of the movement in some state jurisdictions in recent years that has made allocation decisions based on competing sector political considerations rather than by knowledge-based, informed and transparent processes (such as a resource allocation policy) accepted and endorsed by all stakeholders.

More information: Andrew Tobin, andrew.tobin@jcu.edu.au

Movers and ...

Dennis Holder has been appointed president of Wildcatch Fisheries SA. He has taken over from **Jonas Woolford**.

The NSW Department of Primary Industries has announced the appointment of **Stuart Richey** to the role of chair of the new CommFish NSW, an advisory council established to provide independent advice to the Minister of Primary Industries on commercial fishing.

Veronica Papacosta has been announced as chair-elect for Seafood Industry Australia, the new peak body for the seafood sector in Australia. **Marshall Betzel, Chauncey Hammond, Dennis Holder, Mark Ryan, Marcus Stehr** and **Belinda Wilson** will join her on the inaugural board of the SIA.

Craig Ellison has been elected as the new chair of Seafood New Zealand, replacing **George Clement**.

The Department of Fisheries Western Australia has been amalgamated into the Department of Primary Industries and Regional Development.

Patrick Seares, CEO of the Western Australian Marine Science Institution (WAMSI), is moving on to a new role as Director of Strategic Policy and Planning at the Environmental Protection Authority. Chair of WAMSI, **Naomi Brown** will be acting CEO until a new arrangement is made.

Tony Worby has taken up the position of Director of Oceans and Atmosphere at CSIRO vacated by **Ken Lee**.

John Duffy, Communications and Programs Officer, leaves WAFIC to take up a position with the WA Government.

Peter Appleford has taken over as head of SARDI from **Pauline Moody**.

Darren Foster has been appointed Director-General of WA's Department of Premier and Cabinet, having moved from the role of Deputy Director in WA's Department of Fisheries. **Gail Owen** is the inaugural Chair of the Victorian Fisheries Association.

FEEDBACK

FRDC WELCOMES YOUR COMMENTS

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MOVERS WE'VE MISSED?

INFO PLEASE TO

Annabel Boyer, 02 6285 0415, annabel.boyer@frdc.com.au

Calendar of events

DATE	EVENT	MORE INFORMATION
2017		
14 to 15 June	**FRDC Board Meeting, Darwin**	02 6285 0400
26 to 30 June	**World Aquaculture 2017, Cape Town, South Africa**	was.org
30 June	**QSMA Marketing Symposium**	contact@queenslandseafoodmarketers.com.au
2 to 6 July	**Australian Marine Sciences Association Conference 2017, Darwin**	www.amsa.asn.au
10 to 14 July	**Australasian Scientific Aquatic Animal Health Conference, Cairns**	mark.crane@csiro.au
16 to 18 July	**Coral Reef Society Conference**	www.australiancoralreefsociety.org/conference
22 to 24 July	**Australian Society for Fish Biology Conference, Albany**	www.asfbconference.org/
25 to 27 July	**Asia Pacific Aquaculture 2017, Kuala Lumpur, Malaysia**	www.was-apc.org/?p22
17 August	**FRDC Board Meeting, Canberra**	02 6285 0400
19 to 21 August	**Shanghai International Fisheries & Seafood Expo, Shanghai, China**	www.sifse.com/en/
23 to 25 August	**Japan International Seafood & Technology Expo, Tokyo**	www.exhibitiontech.com/seafood/e_index.html
10 to 13 September	**World Seafood Congress, Reykjavik, Iceland**	wsc2017.com
23 to 25 September	**10th Trans Tasman Rock Lobster Congress, Hobart**	www.rocklobstercongress2017.com
27 to 29 September	**Seafood Directions Australia, Sydney**	www.seafooddirectionsconference.com

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