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The FRDC plans, invests in and manages fisheries research and development throughout Australia. It is a statutory authority within the portfolio of the Federal Minister for Agriculture, jointly funded by the Australian Government and the fishing industry.

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ISSN: 1833-4784 (Print) **ISSN:** 2202-7122 (Digital)

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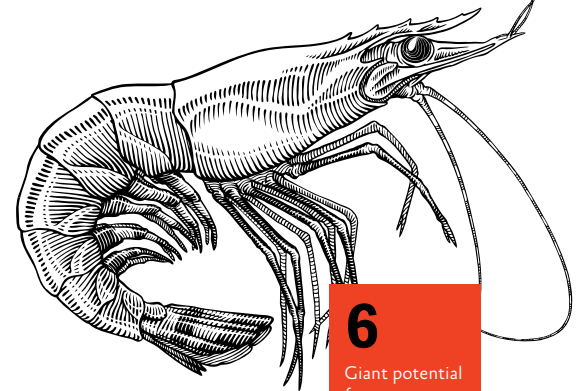
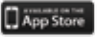
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JUNE 2015



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- Tap to download the app
- Once downloaded, open the app and enjoy reading



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New take on NORTHERN SEAFOOD

CONSUMERS & COMMUNICATIONS

A new publication shares the stories of what it takes to produce seafood along with some tasty takes on how to eat it

By Catherine Norwood

Even in Darwin, with its legacy of tough people working in extreme conditions, the Vietnamese fishers who trap mud crabs at the mouth of the Roper River are the stuff of legend. They fish in one of the

most remote parts of Australia, where the river meets the Gulf of Carpentaria, about 750 kilometres south-east of Darwin.

As many other fishers in the Northern Territory do, the mud crabbers battle sharks, crocodiles and jellyfish to harvest their catch, as well as rough weather and strong currents, and even the mud itself, which sometimes buries their pots.

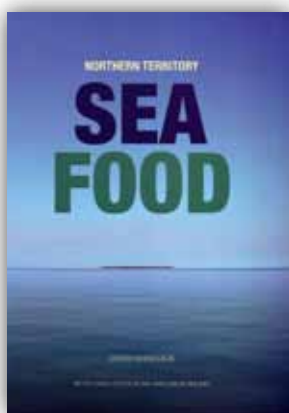
Their story is just one of many that author and photographer David Hancock details in the new book *Northern Territory Seafood*, commissioned by the Northern Territory Seafood Council. Others

include Barramundi fishers and farmers, and those who fish for mackerel, snapper, shark, reef and aquarium species, sea cucumber and prawns.

The book combines the tales of what it takes to bring the best seafood from the Top End to market, along with recipes specially developed for the publication by chefs Steve Sunk and Jason Wilkes.

The concept for the book was initiated almost 10 years ago, and David Hancock has spent two years compiling the stories and photographing commercial fishers and the selected dishes. He says while the book provides recipes to showcase





the distinctive qualities of different seafood, it also shows people where their seafood comes from and provides an insight into the lives of commercial fishers.

“There is a lot of conflict between recreational and commercial fishers, which seems to be exacerbated by local news reporting. A lot of recreational fishers do not understand what commercial fishers go through. There are also a lot of people who like eating seafood who don’t really understand where it comes from, nor catch it themselves.”

David Hancock says from an environmental perspective, it is often the commercial fishers who are leading the way, introducing limited fishing seasons or voluntarily restricting their catch area to ensure the sustainability of the resource. He says these initiatives are in addition to existing rules and regulations that make the NT one of the most regulated fisheries in the world.

Norm Hedditch hauls a Spanish Mackerel onboard as dusk falls.

PHOTOS: DAVID HANCOCK

Spanish Mackerel fisher Norm Hedditch is among the fishers who took David Hancock out to their fishing grounds and shared their stories. Norm Hedditch says with only one day allocated for the photo shoot,

they did not land a mackerel until almost dusk. And then they landed 30 fish in the last hour.

“The book’s been a long time coming, but I had a ball doing the photos,” Norm Hedditch says. His favourite recipe is the entree gravlax of mackerel and salad, in which the fish is cured overnight in a mixture of dill, sugar, salt and lemon.

Barramundi wild-catch fishers also feature in the book along with Barramundi farmers. General manager of Humpty Doo Barramundi Dan Richards says there has been a tremendous response to the book, which has been popular as a gift.

“Visitors who have tried the recipes in the book say they’ve come up a treat. It’s a great initiative and it’s good to see the whole industry working together to promote NT and Australian seafood. The team that has pulled it together have done a great job and the imagery is amazing.”

One of Dan Richards’s favourite Barramundi recipes (a version of which features in the book) is Barramundi sashimi. “Sashimi is our go-to dish when we have special visitors as it highlights the unique culinary features of the saltwater Barramundi.

“When we do in-store demonstrations we fry the fish and children seem to love it. It’s actually good for them, because it’s high in omega-3s, so parents like that too.”

Copies of *Northern Territory Seafood* are available from the NT Seafood Council. -F

CHILLI MANGO MUD CRAB

Ingredients

- 2 live mud crabs
- 6 tbs oil
- 8 garlic cloves, chopped finely
- 4 long red chillies, chopped finely
- 4 tbs ginger, thin strips
- 2 tbs coriander root, chopped finely
- 1.5 cups of water or chicken stock
- 1 cup tomato sauce
- 1/2 cup sweet chilli sauce
- 6 tbs hoisin sauce
- 2 tbs fish sauce
- 1-2 tbs sugar
- 2 tsp sea salt
- 3 firm ripe mangoes, cut into finger slices
- 1 cup spring onions, finely chopped
- 1 cup mixed Vietnamese mint and coriander leaves

Method

Before cooking, place live mud crabs in freezer for approximately 30 minutes.

Clean the crab by removing top shell and gills (also known as dead man’s fingers). Lightly rinse the crab.

Cut body in half lengthways and then cut into three on each side.

Crack the claws to allow the sauce in.

Heat oil in a wok until smoking. Add garlic, chilli, ginger and coriander root. Cook for 30 seconds on high heat until fragrant.

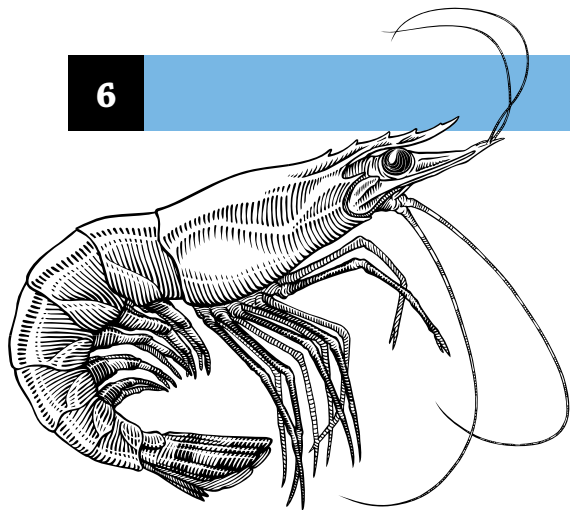
Add crabs and cook for one minute or until shells start to turn orange.

Add water or chicken stock and stir in all sauces, sugar and salt. Bring to the boil. Cover, reduce heat to medium and simmer for 10 minutes.

Add mango, spring onion, mint and coriander leaves before serving.

Recipe by Steve Sunk and Jason Wilkes.





Giant potential for prawn farming

NORTHERN AQUACULTURE

Australia's relatively small profile in global aquaculture production could be overhauled with one giant leap forward for the prawn industry

By Gio Braidotti

Global seafood demand is on a dramatic growth trajectory and it is creating unprecedented opportunities for aquaculture, particularly for companies that can solve issues around quality, environmental sustainability and the increasing cost of feed.

In Australia, the publicly listed company Seafarms Group has anticipated the market dynamics and responded with an ambitious aquaculture plan – Project Sea Dragon – that could catapult Australia into the world's top-10 producers of the planet's second most popular prawn species – the Black Tiger Prawn (*Penaeus monodon*).

Chris Mitchell, who heads Project Sea Dragon, says production is aimed at a specific market 'sweet spot' among Asia's growing middle class, who are the prime drivers of growth in global demand for protein. That sweet spot lies somewhere between small, cheaply produced low-end prawns and 'special-occasion' premium product.

"This will be an export-oriented business based on a global scale, with an integrated production system," Chris Mitchell says. "That means operating our own hatcheries, broodstock facilities, grow-out ponds, feed mills, power stations, and processing, storage and export facilities."

The plan for production starts with 10,000 tonnes of prawns annually from a 1000-hectare operation base in the Northern Territory, with the first prawns projected to enter ponds in 2018.

From that base, the company intends to expand to 10,000 hectares producing 100,000 tonnes a year. This is on par with total prawn production by Brazil or Bangladesh (Figure 1).

The scale of Project Sea Dragon was described to ABC Rural News by the NT Minister for Primary Industry and Fisheries, Willem Westra van Holthe, as "mind-boggling" but achievable, given recent changes to the NT *Pastoral Lands Act*. These seek to encourage diversification of the NT's pastoral leases.

This is precisely what Seafarms will achieve as the company plans to convert part of a cattle station, Legune Station, to an aquaculture operation. The site is located on the Western Australia/NT border, near Kununurra, inland from the intertidal zone but with access to estuarine water.

The company is in the early stages of a 21-month process to obtain approvals for the development. This includes input from Indigenous landholders, an environmental impact study and obtaining a land tenure agreement with the NT Government.

In parallel, Seafarms is undertaking a feasibility study that allows it to rigorously analyse and finalise plans for the development's design, engineering and budget.

"This is not a government development, but we will talk to them about public infrastructure as the project will produce economic activity in the region, including the creation of 1600 ongoing jobs and a lot of flow-on employment," Chris Mitchell says.

The aquaculture operation system has been piloted and improved at Seafarms' existing prawn

ponds in Queensland, which currently produce about a quarter of Australia's total pond production of Banana Prawns and Black Tiger Prawns (about 1000 tonnes in 2014 and increasing to 1500 tonnes once production is in full swing). These are marketed in Australia as Crystal Bay Prawns.

An international management team was recruited to scale up operations for Project Sea Dragon.

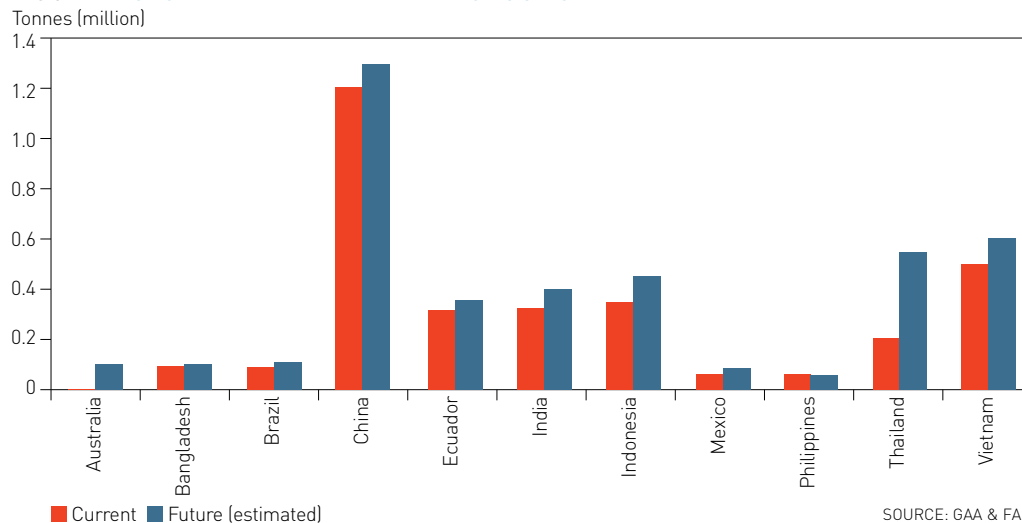
"We have done a lot of preparation and analysis so that when we are ready for the larger project we have systems and processes in place," Chris Mitchell says. "We also have a vested interest in R&D. Our position is that we can improve with science, particularly in the areas of breeding, improved feed and intelligent IT systems."

Seafarms is the commercial partner within the Australian Research Council Hub for Advanced Prawn Breeding along with James Cook University, CSIRO and the University of Sydney.

"Our research partners are using modern genetic technology to map the entire genome of the Black Tiger Prawn," Chris Mitchell says. "We can use that knowledge to refine breeding values and then accelerate breeding cycles with the use of genotypic selection."

The company also has an overarching agreement with CSIRO related to improving aquaculture feed and R&D opportunities more generally. Notably, CSIRO is the key research organisation involved in developing novel aquaculture feed technologies (such as Novacq™, see page 24) that can cheaply and sustainably make feeds that are essential to aquaculture's growth into the future. **F**

FIGURE 1 GLOBAL FARMED PRAWN PRODUCTION.



SOURCE: GAA & FAO

Minister reviews new 2015–20 RD&E Plan

The FRDC's new Research, Development and Extension Plan (RD&E Plan) and its implementation were key components of the FRDC's annual planning workshop with stakeholders, held in Canberra on 31 March and 1 April. At the planning workshop there was widespread support for what the FRDC is trying to achieve with its new plan and stakeholders provided feedback on the plan content before it was finalised.

The FRDC board has reviewed the plan and incorporated stakeholder feedback into the final document. The 2015–20 RD&E Plan has now been submitted to the Australian Minister for Agriculture and his parliamentary secretary for approval before implementation on 1 July 2015.

The FRDC's new RD&E Plan represents

a significant evolution in the way the FRDC plans, prioritises and invests in RD&E.

Under the plan RD&E will be funded in three areas with a national focus on:

- ensuring Australian fishing and aquaculture products are sustainable and acknowledged to be so;
- improving productivity and profitability; and
- the development of emerging aquaculture opportunities.

Industry sectors and regions will have a greater leadership role developing their own strategic RD&E priorities.

The FRDC will use three approaches to implementing the RD&E Plan.

Lead: The FRDC will lead priority setting for RD&E with a national focus and will allocate a significant amount of the

Australian Government Public Good funding to the three national priorities.

Collaborate: The FRDC will provide mechanisms and incentives for those under partnership agreements to leverage funding where there is alignment with priorities at the national level.

Partner: Under agreements made between the FRDC and industry sectors or regions, there will be greater responsibility given to the RD&E end users to set priorities.

Funding for this RD&E comes from industry contributions, the matching dollars from the Australian Government and some Public Good funding for the regions.

Information on the plan, including the draft sent to the minister, is available at the FRDC website (www.frdc.com.au).

PHOTO: PAUL McMILLIAN



The NSW Food Authority sponsors the Champion Sydney Rock Oyster Exhibit, and (from left) their CEO Polly Bennett presents the annual trophy to winners Jo-anne and Gary Rodely from Tathra Oysters.

FINE FOOD CHAMPIONS

Tathra Oysters, located on the New South Wales south coast, took out top honours at the Sydney Royal Fine Food Show Summer Aquaculture competition for a record 12th year running, winning the coveted Champion Sydney Rock Oyster Exhibit from a field of 34 entries.

Exhibitors from Far North Queensland also had a successful show, with Daintree Saltwater Barramundi Fish Farms, from Mossman, taking out Champion Large Whole Fish Barramundi, and Pacific Reef Fisheries, from Ayr, winning Champion Fresh Fish for its Sashimi Grade Pacific Reef North Queensland Cobia.

Canberra's Pialligo Estate celebrated its third consecutive win for Champion Salmon Product, with the accolade this year going to the Pialligo Farm Traditional Smokehouse, Premium Smoked Salmon (500 grams).

The Aquaculture Competition attracted 109 entries, with a total of 60 medals awarded including nine gold, 20 silver and 31 bronze.

This year was the first time the summer and spring aquaculture competitions were amalgamated – judges tasted their way through a seafood smorgasbord of prawns, oysters, salmon, trout and other fresh fish.

Chief judge for aquaculture John Susman commended this year's exhibitors on a bumper competition.

Full results are available at the Royal Agricultural Society of NSW website (www.myras.com.au).

PHOTO: STEVE REOUGH



(From left) FRDC executive director Patrick Hone with Emma Wilkie, 2015 Science and Innovation Award recipient, and FRDC chair Harry Woods.

Innovation award to help oysters shape up

What do you look for when you shop for Sydney Rock Oysters? Plump meat sitting in a beautiful cupped shell? The perfect shell ratio for restaurants and processors is 3:2:1, according to researcher Emma Wilkie, where three is the oyster's length, two is the width and one is the depth. To help with her research to breed oysters with this sought-after shape, she has received a grant of up to \$22,000 as the winner of the FRDC-sponsored 2015 Science and Innovation Award for Young People in Agriculture. "With this shell ratio, they're cuppy rather than flat. This adds value to their marketability in terms of awards and how they look and present on a plate," she says.

Emma Wilkie works for the industry-owned Select Oyster Company and says farmed oysters have been selectively bred for disease resistance and rapid growth but sometimes grow flatter than their wild counterparts. She plans to use her award to develop husbandry guidelines to improve shell shape for the \$35-million-a-year Sydney Rock Oyster industry. Her project will include comprehensive best-practice instructions, a cost-benefit analysis of each husbandry technique, access to seed for farmers, photos and a DVD. The Science and Innovation Awards for Young People in Agriculture is a competitive grants program that supports young scientists, researchers and innovators to undertake a project on an innovative or emerging scientific issue. The awards are announced at the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) Outlook conference in March each year.

\$3 MILLION FUNDING TO GROW WHITE FISH FOR THE FUTURE

The Federal Minister for Agriculture, Barnaby Joyce, has announced \$3 million funding from the Rural Research and Development for Profit Grants Program for research into Australian Yellowtail Kingfish aquaculture production.

The research program consortium members – the FRDC, Cleanseas Tuna, the South Australian Research and Development Institute and the New South Wales Department of Primary Industries – have welcomed the announcement. FRDC executive director Patrick Hone said:

"The funding is a significant boost to the industry investment already planned for Yellowtail Kingfish aquaculture across Australia. It will contribute greatly to the goal of establishing an environmentally sustainable source of locally produced high-quality white-flesh fish."

SURVEY SHOWS GREATER STAKEHOLDER ENGAGEMENT

PERFORMANCE REPORTING

Personal contact and digital communications are part of the mix keeping the FRDC in contact with stakeholders and improving its value to the fisheries and seafood sectors

By Ilaria Catizone

In the past three years the FRDC has made a conscious effort to increase engagement with its end users and the success of these efforts is evident in the results of its latest stakeholder survey.

Intuitive Solutions conducted the survey for the FRDC, with 274 fishers taking part in December 2014 and February 2015. This included 72 participants who were part of large businesses, defined as operations among the top 300 within Australia by value. The other participants are involved in smaller businesses.

A total of 93 per cent of those surveyed reported direct or indirect contact with the FRDC – a major increase in the level of fisher engagement reported in the previous stakeholder survey in 2011, when it was only 52 per cent (Figure 1). This is a positive

result for the FRDC's outreach efforts, both on a face-to-face and digital level.

In 2012, the FRDC launched its new online presence with a major overhaul of its website and its entrance into the social media space, which evolved into the creation of extremely successful accounts on Facebook, YouTube, Twitter and Vimeo. In 2013, the FRDC also launched the Fishfiles website (www.fishfiles.com.au), targeting consumers with the aim of encouraging more seafood consumption.

The value fishers placed on the role of the FRDC also increased. In response to the question 'How important is it for the Australian fishing industry to have an organisation like FRDC?', the FRDC's importance scored 8.5 out of 10. In the 2011 survey this response was 7.8 out of 10.

"The extra effort in consultation and stakeholder engagement helps focus the FRDC's investment in the areas most relevant to fishing and aquaculture," says FRDC executive director Patrick Hone.

"The extra effort in consultation and stakeholder engagement helps focus the FRDC's investment in the areas most relevant to fishing and aquaculture."

– Patrick Hone

FIGURE 1 INCREASE IN STAKEHOLDER ENGAGEMENT WITH THE FRDC, 2011 TO 2015.
TOTAL contact with the FRDC



Direct contact with the FRDC

	2015	2011
Total direct contacts	50%	32%
Person-to-person contact	32%	21%
Events and workshops	42%	28%

Base: All stakeholders, n = 274

Indirect contact with the FRDC

	2015	2011
Total indirect contacts	93%	52%
Digital	35%	23%
Communications	88%	53%

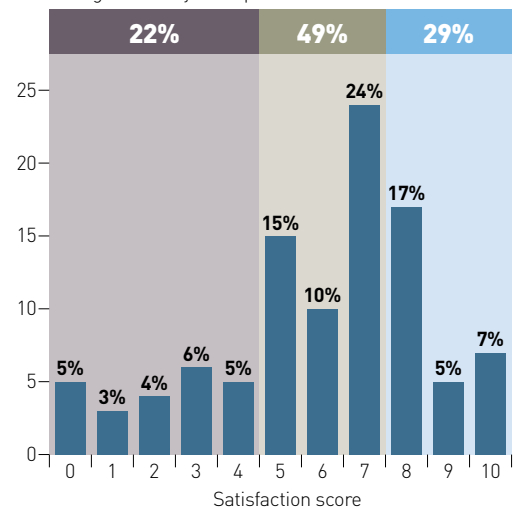
Digital includes Facebook, Twitter and other online services.
Communications includes printed materials such as *FISH* magazine and other.

Overall, the results of the latest survey are positive and show an improved performance on previous years, an upward trend the FRDC intends to continue.

Of those surveyed, 91 per cent were male and the average age was 52.6 years. The majority (89 per cent) were involved in catching or growing seafood and were located all over Australia, with Queensland, Western Australia and New South Wales the most represented states. Satisfaction with how the FRDC funds are allocated was

FIGURE 2 STAKEHOLDER SATISFACTION WITH HOW THE FRDC INVESTS.

Percentage of surveyed respondents



Ratings distribution (2015)

Base: All stakeholders, n = 274

FIGURE 3 2015 LEVEL OF SATISFACTION WITH HOW THE FRDC INVESTS BY COMMERCIAL SECTOR.



*Businesses among the top 300 in Australia.

rated on average 6 out of 10, an improvement from 5.4 in 2011 (Figures 2, 3 and 4).

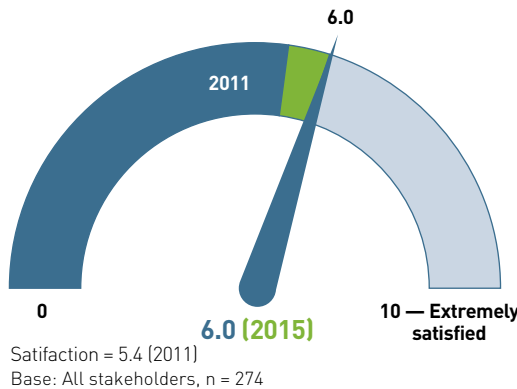
The FRDC rated well as a go-to information hub with its website rated fourth out of all possible sources of information about research and ways to improve business (Figure 5).

FISH magazine

FISH magazine was a clear leader in terms of enhancing the FRDC’s visibility to the industry, with 53 per cent of respondents pointing to it when asked where they had heard of the FRDC.

Overall, FISH magazine was a well-received publication, with 53 per cent of interviewees

FIGURE 4 SATISFACTION WITH INVESTMENT



STAKEHOLDER SUGGESTIONS FOR THE FRDC

“Development of under-utilised fish species. Trying to deliver more to consumers at the right price and investing in methods of processing.”

“Continuation of a high level of industry contact to achieve fair and equitable outcomes for all sectors.”

“Consultation. State bodies already do it for research and it works well so they should continue that model for the marketing.”

STAKEHOLDER SUGGESTIONS FOR FISH MAGAZINE

“It could widen its distribution to the general public so they can use it to understand what’s going on. I think the general public would benefit from knowing and understanding more about the level and depth of research going on.”

“More focus on how we can increase production in the fishery to make sure that we’re catching the right size fish in relation to sustainability.”

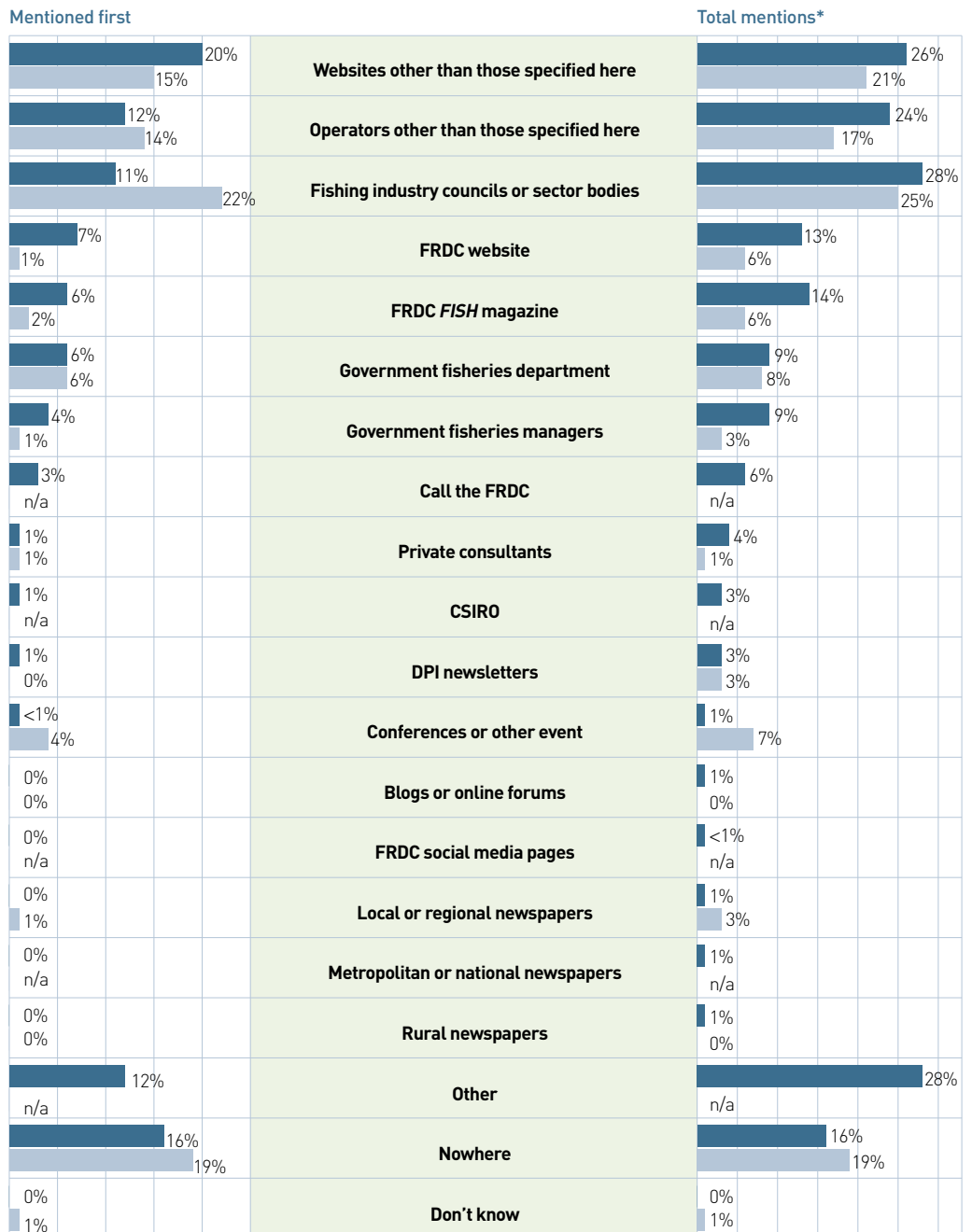
happy with the current mix of content and 24 per cent providing suggestions for additional content, particularly on fisher-related experiences.

Although FISH magazine is available online, on the FRDC website and as an iPad app, only five per cent of readers receive it in its electronic form only. Of the readers

receiving hard copies, 78 per cent pass it on to others or keep it for future reference.

Nearly half – 46 per cent – read it thoroughly, and about the same number follow up on stories they have found in the magazine, while 62 per cent of readers reported learning something useful for their business in it. **F**

FIGURE 5 2015 INDUSTRY INFORMATION SOURCES.
Where do you go to find out information on research or to improve your business?



Base: All stakeholders, n = 274

■ 2014 ■ 2011

*Multiple response. Results do not add to 100%

Industry has its say on SEAFOOD MARKETING

MARKETING

Industry support for marketing initiatives is growing, building on early market research and the positive progress of initial industry campaigns

The FRDC has a clearer understanding of what industry wants at the individual company, sector and national level following the completion of one of the largest industry surveys the FRDC has undertaken.

“In the September issue of *FISH* we indicated that we would spend six months gathering the industry’s views,” the FRDC’s manager for communications, trade and marketing, Peter Horvat, says. “We have been out doing this. We have met face to face with many people, businesses and sectors, listening to what fishers and farmers want.”

In addition to the face-to-face meetings and many emails and discussions on social media, the FRDC commissioned a stakeholder survey, which began in late 2014 and was completed in February 2015.

In total, 274 seafood industry members – comprising 72 of the top 300 companies and a further 202 smaller business – participated.

The survey is part of the FRDC program of research that aims to provide direct feedback from industry. In the latest survey a series of specific questions on marketing were included. The marketing questions aim to provide the FRDC with some quantitative and qualitative data for the development of a national seafood marketing framework.

Is a national plan important?

It is very clear that the majority (80 per cent) of stakeholders are supportive of the need for a national marketing plan. However, just over half (53 per cent) are convinced that it can be achieved. Key to this is the frequent comment and belief that fishers are fiercely independent and protective

of their patch. However, most also agree that this needs to change if the industry is to succeed.

More importantly, almost half (45 per cent) indicate that they are willing to financially contribute to a national marketing plan (Figures 1 and 2). This also reflects the number of industry stakeholders who already invest in marketing (44 per cent).

National priorities

The three key areas industry indicated as priorities for marketing are:

- ensuring the public has a positive perception of the industry;
- developing export markets; and
- promoting and advertising seafood products (Figure 3).

The list of top responses shows that marketing is clearly a major focus; however, the need for market-focused research, development and extension (RD&E) also features strongly. Education of consumers, development of quality standards and ensuring seafood safety all form part of the suite of activities that underpin marketing.

The results provide a clear direction on where the industry at a national level wants to head. At the company or sector level it is a slightly different story. The two key areas industry is keen to invest in are advertising their business or sector and promoting the quality of product to customers (Figure 4).

Another key indicator of where industry wants to invest is evaluation, with increased sales and profitability being the main measure of return on investment (Figure 5). This clearly shows that community perceptions are only seen as a priority at the national level.

Marketing framework

The FRDC will use feedback from industry and stakeholders to begin drafting a national seafood marketing framework. This will encompass the broad range of activities that link to and form part of an integrated approach to marketing including: consumer research, quality systems, food

safety, and campaign planning and evaluation. In addition, national and sectoral marketing plans will be added as they are developed.

The FRDC has engaged Lachlan Bowtell (formerly with Meat and Livestock Australia) to help develop the marketing framework. [Once a draft is completed it will be available for public comment on the Seafood Marketing website: http://seafoodmarketing.frdc.com.au](http://seafoodmarketing.frdc.com.au)

Marketing levies development

As part of developing the appropriate systems and knowledge, the FRDC has met with the Levies Revenue Service within the Australian Department of Agriculture. The meeting was to establish a clear picture of the processes, steps and time frames required to put in place a statutory levy, in case industry decides to go down this path.

The Australian Government is reviewing levies, with several inquiries underway (or just completed) including the industry structures and systems governing the imposition of and disbursement of marketing and RD&E levies in the agricultural sector.

[For more on the inquiries, visit the Parliament of Australia website: www.aph.gov.au/Parliamentary_Business/Committees](http://www.aph.gov.au/Parliamentary_Business/Committees)

Australian Wild Abalone™

Keeping a close watching brief on the levy review is the Abalone Council Australia (ACA). The ACA has started discussing an abalone marketing levy with a view to funding the continuation and expansion of the Australian Wild Abalone™ (AWA) program.

While the ACA is aware the Senate’s Levy Review may have an impact on how levies are handled in the future, it also understands the need to advance the discussion on marketing.

Over the past five years, a small team has been conducting RD&E activities in China (including Hong Kong), and more recently Singapore and Japan, regarding AWA™. This important and timely research project was initiated by the ACA in 2010 and has been supported with RD&E funding provided by the FRDC and the Australian Seafood

Cooperative Research Centre (Seafood CRC).

The market research has underpinned the development of the AWA™ program. The program includes the AWA™ certification trademark, supply-chain education, brand-protection technology through NanoTag Technology® and other tamper-evident packaging, preparation of submissions to government negotiating free trade agreements (in collaboration with Southern Rock Lobster) and funding risk assessments by SafeFish. Taking this holistic approach has put in place a solid foundation for future activities.

About 80 per cent of Australia's abalone exporters (measured by value and volume of sales) have signed up to the AWA™ program since it was launched in Shanghai in 2010. Likewise, a significant number of abalone importers (more than 50) in China (including Hong Kong), Singapore and Japan have endorsed and are actively supporting the AWA™ program.

In China and Hong Kong importers are waiting for (and encouraging Australia) to begin AWA™ 'in-market' activities and to launch the AWA™ promotional presence. With voluntary funding from the Tasmanian Abalone Council, the AWA™ program will soon have an online presence in China and several promotional activities are planned, including a chef ambassador competition with the China Cuisine Association.

From research to marketing

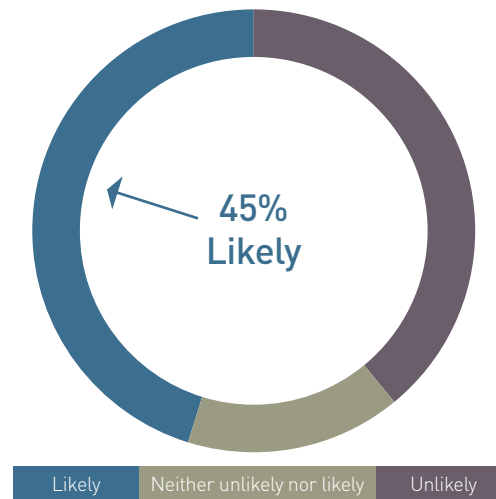
As the AWA™ program transitions from an RD&E project to full commercialisation, the time has come for it to stand independently, with funding sources transitioning from RD&E (the FRDC and the Seafood CRC) to marketing and promotion.

If the Australian abalone industry wants the AWA™ program to go forward and promote Australian wild-caught abalone products on a global stage into the future, industry needs to establish a dedicated funding mechanism.

The AWA™ project is a generic promotion of Australian wild abalone based on the values of the product and why people in these markets should purchase it in preference to abalone from other supply sources. The AWA™ program is not involved in buying or selling abalone, just the promotion of the brand.

Executive officer of the ACA Dean Lisson says managing the next steps is critical for the long-term success of the program. It is important that all abalone industry stakeholders are properly informed about what has been happening to date with the AWA™ program

FIGURE 1 SEAFOOD INDUSTRY MEMBERS LIKELY TO CONTRIBUTE TO A NATIONAL SEAFOOD MARKETING PLAN.



Base: All stakeholders, n = 274

and the activities planned for the future.

More regular updates about the program will be provided to all Australian abalone stakeholders, who are encouraged to contribute to the design of this important industry-wide initiative.

The AWA™ project team has been travelling to each of the abalone-producing states and hosting briefing sessions with stakeholders – abalone divers, licence and quota owners, processors and exporters.

Briefing sessions have taken place across the country, including in Hobart, Port Lincoln (South Australia), Fremantle (Western Australia), Merimbula (New South Wales) and Mallacoota (Victoria).

Copies of the presentation and answers to frequently asked questions from stakeholders are available on the FRDC's marketing website: <http://seafoodmarketing.frdc.com.au/abalone>

For more information on the AWA™ program contact Dean Lisson: deanlisson@tassie.net.au

Jayne Gallagher: jayne.gallagher@seafoodcrc.com

Prawn farmers pave path to market

The Australian Prawn Farmers Association (APFA) board met in November 2014 and voted unanimously to work towards a more formalised way to collect marketing contributions from members.

In October 2001, the APFA became the first (and only) organisation to put in place a statutory R&D levy. The APFA board, R&D committee

FIGURE 2 SEAFOOD INDUSTRY MEMBERS LIKELY TO CONTRIBUTE TO A NATIONAL SEAFOOD MARKETING PLAN.

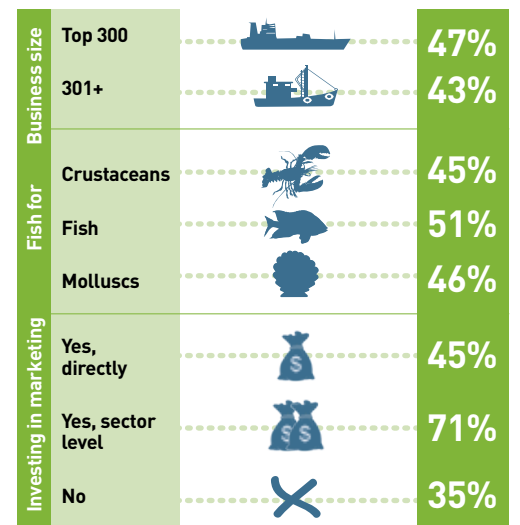
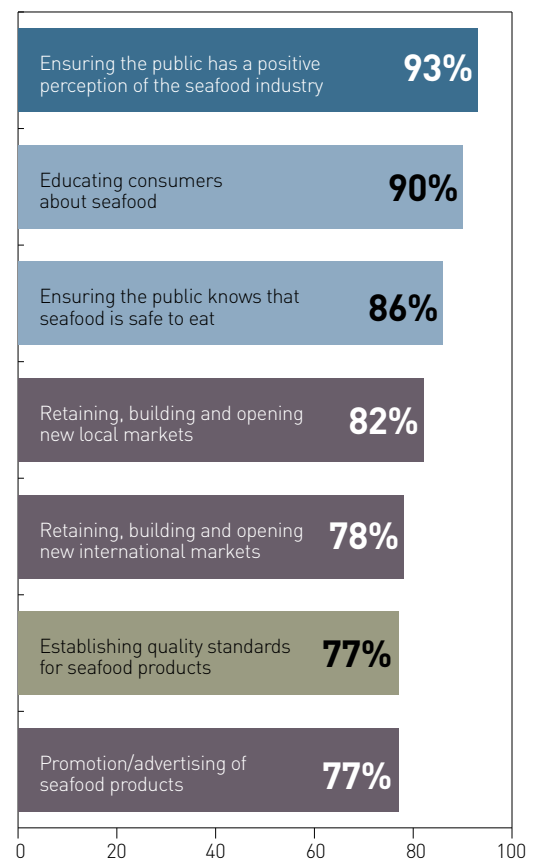


FIGURE 3 AREAS THAT SHOULD BE INVESTED IN UNDER A NATIONAL SEAFOOD MARKETING PLAN.



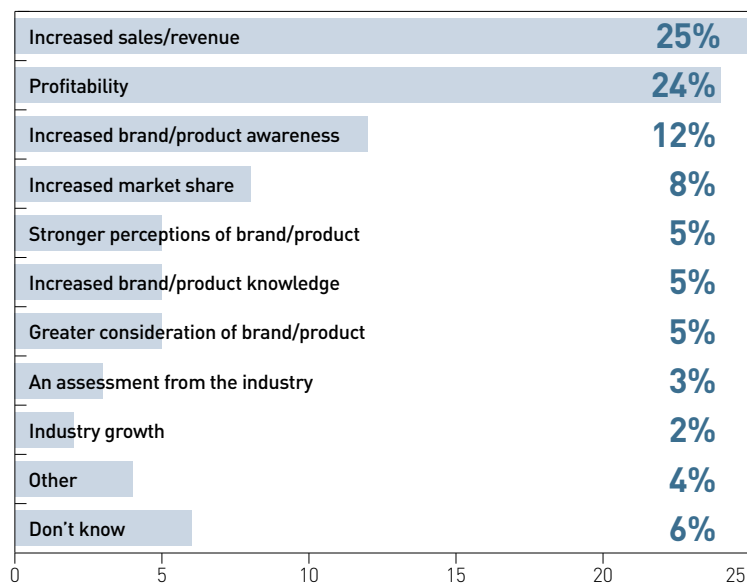
Base: All stakeholders, n = 274

FIGURE 4 WHAT ARE COMPANIES' MARKETING PRIORITY AREAS FOR THEIR BUSINESS/SECTOR?



Base: All stakeholders who invest in marketing, n = 158
Multiple response, results may not add to 100%

FIGURE 5 HOW SUCCESS SHOULD BE MEASURED – MAIN MEASURE.



Base: All stakeholders, n = 274

and members all understand and appreciate the benefits that have come from taking this step.

APFA executive officer Helen Jenkins says the next step for the organisation is to begin work on putting the same process in place for marketing contributions.

“While we are aware that the government is reviewing levies at present, we also know the work to be done before we get to the next stages. We will work with the FRDC to develop a strategy and timetable to speak with all our members to ensure everyone is on the same page,” she says.

“Given the successful implementation of the national ‘Love Australian Prawns’ campaign for the past two years, we would like to see it continue, grow and have all members contribute to its ongoing success or have the ability to direct marketing funds into other activities.”

For more information contact Helen Jenkins:
helen.jenkins@apfa.com.au

Seafood retailers connect

Seafood retailers from across the country met to share and learn from producers but also each other as part of two-day education and networking events held in Sydney and Hobart recently.

The Australian Seafood CRC’s program manager, Emily Mantilla, says the response

from seafood retailers was overwhelming: “Spaces fill up very quickly, which means we have a long waiting list of keen retailers. It is great that they are keen, and bad that we are not able to engage fully with them.”

She says this highlights the need for a friendly, interactive education platform for seafood retailers to help them with their everyday business challenges by providing professional support – not only from the Seafood CRC and the FRDC, but also from each other.

“At the initial network meeting, held in Sydney in May 2014, retailers were clear they wanted to get out and visit industry to learn more about the production that would provide them with stories and knowledge to share with and engage with their customers,” Emily Mantilla says.

In addition to visiting producers, several guest speakers presented at the workshops. These included:

- Russell Zimmerman, from the Australian Retailers Association (ARA), who spoke on staff penalty rates;
- Megan Rusk, from communications company FULLER, who spoke on social media and online presence;
- Sue Anderson, from ARA Retail Institute, who spoke on the power of visual merchandising

and helping businesses articulate stories; and

- Kerry Lambert, from MTC Australia, who spoke on the potential for thinking outside the square when it comes to seeking and finding staff.

The Seafood CRC sees the network as a good vehicle to engage and communicate with retailers on relevant research being undertaken, for example, the oyster visual merchandising project, the ‘Love Australian Prawns’ campaign and the recently launched Seafood Quality Index app.

Another key part of the network meeting is the retailer roundtable discussions where members can talk about their challenges, seek help and gather solutions. Often they discover they are all facing similar issues and can learn from each other.

At the most recent meeting, retailers had the opportunity to work with some of Australia’s leading chefs at the Sydney Seafood School to discuss what seafood they use and how they would develop simple ‘meal solutions’. This is a trend customers are driving, as they seek ready-to-go meals that are quick, convenient and tasty.

With the closure of the Seafood CRC on 30 June, the FRDC is exploring opportunities to keep this educational network alive and to build it into its marketing framework. F

To join the database for invitations to retailer events contact Emily Mantilla: lemadoenterprises@gmail.com

Tropical approach to water quality

ENVIRONMENTAL MONITORING

From giant clams to clown fish, five 'indicator' species are helping researchers revise water-quality guidelines to better reflect the sensitivities of tropical marine life

By Clare Straten-Joyce

Most of Australia's environmental water-quality standards and testing protocols have been developed with the effects on temperate marine wildlife in mind, but new research is focusing on the risks and responses of tropical species as coastal development expands across the nation's north.

The Australian Institute of Marine Sciences (AIMS) is leading new research into the potential impact of water pollution and heavy metals in northern waterways and oceans.

Research scientist Melanie Trenfield says, in general, there is a lack of information on the long-term effects of metals and other toxicants on tropical marine biota in Australia. "This means that current water-quality guidelines may be inadequate for the protection of tropical seas."

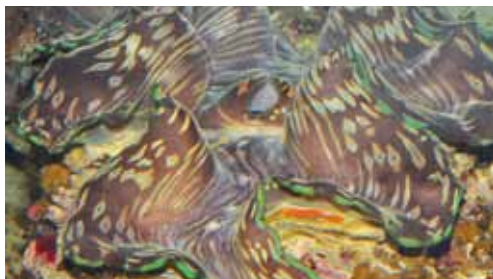
She and her colleague Joost van Dam are working on research designed to address information gaps in tropical waters. They are investigating the effects of metals on the larvae of selected marine species and will use their findings to develop water-quality guidelines for industry, government and the public.

Collaborators in the research with AIMS include the Australian Department of Environment's Environmental Research Institute of the Supervising Scientist and Charles Darwin University. Funding has come from Rio Tinto Alcan, North Australian Marine Research Alliance and the Northern Territory Research and Innovation Board, with in-kind support from the Australian Department of the Environment.

Indicator species

With a huge range of tropical species to select from as indicators for toxicity testing, the researchers looked for organisms that represented different levels of life forms within the ecosystem.

The indicator species selected for water quality research include (clockwise from right) Purple Acorn Barnacle (*Amphibalanus amphitrite*), hermit crab (*Coenobita variabilis*) and giant clam (*Tridacna squamosa*).



PHOTOS: JOOST VAN DAM



The indicator species were also selected for their ease of rearing in the research facility. "Although the species selected for toxicity testing in this project are not necessarily food sources themselves, they are somewhat representative of what effect toxicants will have on other iconic species, such as the mud crab (*Scylla* species) and Golden Snapper (*Lutjanus johnii*)," Joost van Dam explains.

Using the food species directly for the tests was not viable in the research facility as mud crabs are highly cannibalistic and Golden Snapper need large volumes of water to thrive.

The candidates were narrowed down to five species. Giant clam (*Tridacna squamosa*) was chosen as it is a lower trophic level species and benthic filter feeder; while hermit crabs (*Coenobita variabilis*), also a lower-level benthic species, are more mobile and scavenge what they can find from the ocean floor. Western Clown Anemonefish (*Amphiprion ocellaris*) (widely known as clown fish) represent a higher-level species, as an omnivorous and occasionally predatory finfish. The Purple Acorn Barnacle (*Amphibalanus amphitrite*) is an opportunistic filter feeder with the ability to be selective about its diet (unlike clams). Finally, the marine snail (*Nassarius dorsatus*), a burrowing, benthic scavenger, is the project's representative of the marine gastropod community.

"We are interested primarily in protecting marine species that are native to marine waters in tropical Australia," Joost van Dam says. "This will have the added benefit of protecting people who depend on these animals for food."

It can take three to 12 months to develop the toxicity test protocols for each species. Protocols for the hermit crab, barnacle and marine snail have already been completed, while test development for the clown fish is well underway.

Their findings will help revise water-quality guidelines for several priority metals related to the alumina-refining industry: aluminium, gallium and molybdenum.

Once developed, the toxicity tests can be applied to discharges and contaminants associated with industrial activities, such as oil and gas drilling, and port and dredging activities in or near the marine environment.

This research is part of the AIMS national program investigating the toxicity of environmental contaminants. "We are very passionate about the health and sustainability of marine and freshwater ecosystems," Melanie Trenfield says. "Working in a job such as this enables us to do our bit to protect our environment. Plus we get to work with some really awesome critters including clown fish, giant clams, marine snails and hermit crabs," she says. F

TROPICAL SANCTUARY FOR ELUSIVE RIVERINE SPECIES

THREATENED SPECIES

Researchers have braved the dangers of remote northern locations – and fish with sharp teeth – to learn more about the health of Australia’s rare sawfish and river shark populations

By Briena Barrett
Communications coordinator, NERP
Northern Australia Hub

Australia’s tropical rivers, estuaries and coastal waters represent one of the world’s last remaining strongholds for sawfish and river sharks. While ocean sharks are often in the spotlight, threatened river sharks (*Glyphis* species) and sawfish (*Pristis* species) are elusive and poorly understood inhabitants of Australia’s tropical waterways.

For the past three years, scientists have spent thousands of hours trying to catch and better understand these riverine and estuarine shark species and sawfish (which are technically rays, close relatives of sharks). This research has been carried out through the National Environmental Research Program’s (NERP) Marine Biodiversity Hub and Northern Australian Hub.

Surveys and tagging have focused on the Alligator Rivers region of Kakadu National Park, in the Northern Territory, and the Adelaide River, east of Darwin. Remoteness, wild monsoonal weather and high densities of

estuarine crocodiles have challenged researchers who have been recording relevant information, taking DNA samples and tagging animals.

Peter Kyne from Charles Darwin University, who is leading the NERP project, says close to 600 river sharks and 70 sawfish have been caught, tagged and released back into the Van Diemen Gulf’s major river systems.

“Until now, very little has been known about the population size and status of sawfish, Speartooth and Northern River Sharks. This has made effective management difficult,” Peter Kyne says.

DNA samples are being used to build a better picture of population structure, sizes and trends, while acoustic tags are used to monitor species’ movements and habitat use in and between rivers and estuaries.

Mark Bravington, from project partner CSIRO, is leading the application of novel genetic techniques – close-kin mark-recapture – to determine population sizes and trends.

“If we find a lot of closely related individuals, such as half-siblings, it tells us that there are not many breeding adults and the population must be fairly small,” Mark Bravington says.

“Another thing we look for is whether sharks from one river system move to adjacent rivers to breed, or whether each river contains a separate population of sharks with little movement in-between.

“This has important management implications – for example, if each river carries

its own unique population, then conservation plans also need to be individualised.”

The research has already delivered promising results. For example, until recently, the Northern River Shark was considered one of the rarest sharks in the world. But to date, the team has caught more than 350 individuals and now knows the Alligator Rivers region supports the most significant known population of this endangered species in the world.

In August 2014, the researchers also recorded a Speartooth Shark for the first time in the Wildman River and have documented new locations of Northern River Sharks.

A preliminary population estimate for the Speartooth Shark in northern Australia, based on the close-kin mark-recapture approach, will be available later in 2015.

“We first developed close-kin mark-recapture for a commercial species (Southern Bluefin Tuna, FRDC Project 2007/034). This is the first application to rare and threatened species,” Mark Bravington says.

“Thanks to improvements in genetics, we can now find half-siblings as well as parent-offspring pairs, which means we can work with a much wider range of species in the future.”

Peter Kyne says monitoring will help to determine whether existing management strategies are effective and what plans might be required to ensure the survival of these species. “As the desire to develop northern Australia grows, we must keep biodiversity values at the forefront of these discussions,” he says.

TABLE 1 SAWFISH AND RIVER SHARK SPECIES LISTED IN THE COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999 AND STATE/TERRITORY LEGISLATION.

COMMON NAME	SCIENTIFIC NAME	EPBC ACT LISTING ¹	QUEENSLAND LISTING ²	NT LISTING ³	WA LISTING ⁴
Dwarf Sawfish	<i>Pristis clavata</i>	Vulnerable	Protected	Vulnerable	Totally Protected
Green Sawfish	<i>Pristis zijsron</i>	Vulnerable	Protected	Vulnerable	Totally Protected
Largetooth Sawfish	<i>Pristis pristis</i>	Vulnerable	Protected	Vulnerable	Totally Protected
Narrow Sawfish	<i>Anoxypristis cuspidata</i>	Not listed	Protected	Not listed	Totally Protected
Northern River Shark	<i>Glyphis garricki</i>	Endangered	NA	Endangered	Totally Protected
Speartooth Shark	<i>Glyphis glyphis</i>	Critically Endangered	Protected	Vulnerable	NA

1 Environment Protection and Biodiversity Conservation Act 1999; 2 Queensland: Fisheries Act 1994; 3 Northern Territory: Territory Parks and Wildlife Conservation Act 2000; 4 Western Australia: Fish Resources Management Act 1994. NA (not applicable): species does not occur in that state or territory.

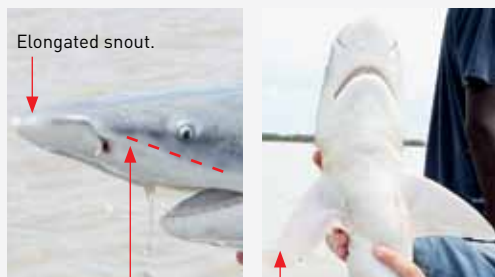
Know the difference

Commercial fishers who incidentally interact with river sharks and sawfishes as bycatch are required to record these interactions in a logbook. Researchers are also keen to receive reports of any encounters, including information about the location of the sighting or capture, the date, size and photographs to better understand the population dynamics of these species.

These species do look similar in many ways – but they have several distinctive identifying features.

RIVER SHARKS

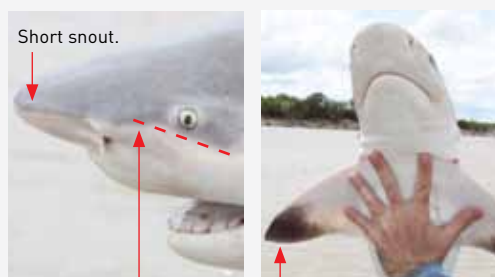
▼ Northern River Shark (*Glyphis garricki*)



The waterline runs well below the eyes.

The undersides of its pectoral fins are often pale.

▼ Speartooth Shark (*Glyphis glyphis*)



The waterline runs just below the eyes.

The undersides of its pectoral fins have prominent black blotches.

■ A larger second dorsal fin (height is about three-quarters the height of the first dorsal fin) separates both the Northern River and Speartooth Sharks from the commonly found Bull Shark.



SAWFISH

To differentiate between the four species of sawfish in Australia, pay close attention to the spacing of teeth on the rostrum and the position of the first dorsal fin relative to the pelvic fin.

▼ Narrow Sawfish (*Anoxypristis cuspidata*)

No rostral teeth on the base of the rostrum.



Relatively enlarged lower lobe of the tail fin.

▼ Green Sawfish (*Pristis zijsron*)

Rostral teeth start at the base and are unevenly spaced.



First dorsal fin origin is behind the pelvic fin origin.

▼ Dwarf Sawfish (*Pristis clavata*)

Rostral teeth start at the base and are evenly spaced.



First dorsal fin origin is over or slightly behind the pelvic fin origin.

▼ Largetooth Sawfish (*Pristis pristis*)

Rostral teeth start at the base and are evenly spaced.



First dorsal fin origin is well forward of the pelvic fin origin.

SAFE ENCOUNTERS

Fishers or community members who experience a close encounter with one of Australia's sawfish or river shark species are meeting with some of the rarest inhabitants of our northern waterways.

Such an encounter is not without its dangers, as the species are all well-equipped with features designed to inflict injury, as the researchers involved in efforts to tag and monitor these species can attest. However, *Pristis* sawfish and river sharks are protected species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, as well as state/territory fisheries or conservation legislation (see Table 1), and are required to be released when accidentally caught.

Simple measures can help the survival of animals accidentally caught, while reducing the risk of injury to fishers. These measures are outlined in the publication *Protocols for surveying and tagging sawfishes and river sharks*, produced as part of the National Environmental Research Program (NERP) project, available on the NERP website (www.nerpmarine.edu.au/sawfish).

"These are potentially dangerous species," researcher Peter Kyne says. "No one wants to come into contact with the sharp rostrum of a sawfish or the mouth of a shark, so a firm grip should be kept on the animals at all times."

Measures to improve the survival of released animals include limiting the time they are handled and exposed to the sun, removing fishing line and hooks wherever possible and placing them into the water for release rather than throwing them.

Report a sighting to: peter.kyne@cdu.edu.au

River sharks and sawfish continue to come under threat from habitat degradation and are at risk of becoming bycatch in commercial and recreational fishing. The long-toothed rostrum of sawfish makes them particularly vulnerable to entanglement in fishing nets.

"This isn't intentional," Peter Kyne says. "But they do become caught in nets in commercial

fisheries that are targeting fish such as Barramundi, which occupy the same habitat."

While this research will help form the building blocks of future conservation strategies, providing information to local communities, commercial fishers and recreational fishers is also seen as crucial to protect these vulnerable species.

The project 'Supporting Management of Listed and Rare Species' runs until mid-2015. It has been a joint initiative between the Marine Biodiversity Hub and the Northern Australia Hub of NERP, and is a partnership between CSIRO, the NT Department of Primary Industry and Fisheries and Charles Darwin University. Additional support is provided by Kakadu National Park. **F**



Jungle Perch GO WILD

ENVIRONMENTAL MANAGEMENT
The recovery of Jungle Perch populations in central and south-east Queensland is one step closer following the first ever release of captive bred fingerlings into local streams



By Jodana Anglesey

Once a popular fish for anglers, Jungle Perch (*Kuhlia rupestris*) has been in decline for more than 30 years, and wild populations are largely limited to a few areas in northern Queensland.

New research has helped breed the species in captivity and is evaluating the potential to rebuild populations in Queensland through a restocking program.

Jungle Perch can grow to more than 50 centimetres in length and weigh more than three kilograms. They readily take flies and lures and are usually targeted for catch-and-release fishing, which has made them an easy and popular target for anglers.

The species was once found from Cape York down to northern New South Wales. However, in the 1950s and 1960s they began to decline, eventually disappearing altogether from most rivers and streams in the southern part of their range and from the Mackay–Whitsunday Island region. While they can still be found in northern Queensland, only a few small remnant populations occur anywhere south of Proserpine.

Responding to this decline, three recreational fishing groups – the Freshwater Fishing and Stocking Association of Queensland, the Australian National Sportfishing Association and Sunfish – recognised the need for research to assess the feasibility of a captive breeding and release program to help restore local populations.

Breeding at Bribie Island

This led Queensland Department of Agriculture and Fisheries (DAF) researchers at the Bribie Island Research Centre to begin work on captive breeding of Jungle Perch. Preliminary research focused on verifying past distributions of the species, studying their breeding biology and running preliminary captive rearing trials.

In 2012 the FRDC co-funded a project with Queensland DAF to develop Jungle Perch fingerling production, with the aim of running stocking trials and developing a hatchery production manual. This manual could then be used to scale-up production to commercial quantities if a large-scale restocking program was subsequently recommended and approved.



From the laboratory to the waterways: Jungle Perch have been successfully bred in captivity and more than 1000 fingerlings were released into Queensland streams in 2014, with further releases planned for this year.



PHOTOS: QUEENSLAND DEPARTMENT OF AGRICULTURE AND FISHERIES

In 2014 more than 1000 fingerlings were successfully produced. Most of these were released into a Gold Coast hinterland stream, with a smaller batch released into a stream near Mackay. These were the first successful stockings of captive-reared Jungle Perch.

At this stage, Jungle Perch are not an approved species for restocking in Queensland. Last year's fingerling release trials are an important step in assessing the costs and benefits of restocking as a management measure for the species.

Research leader Michael Hutchison says this was a world first. "The Jungle Perch was once endemic in the Gold Coast region where the fingerlings were released. The stream was selected because it has ideal habitat and no major barriers to prevent their spawning migration."

Removing barriers

The lack of barriers is important because researchers believe that barriers to fish migration, such as weirs, barrages and elevated culverts on rivers in the lower catchment, are a likely contributor to the decline of Jungle Perch. While adult fish prefer to live in clear freshwater rivers and streams with bankside shading, they need to migrate to the ocean to spawn.

After spawning, adults return to fresh water. However, juvenile Jungle Perch first migrate into freshwater when they are 40 to 50 days old and about 18 millimetres in length. Barriers to migration are thought to have disrupted this life cycle.

However, since the 1990s, many redundant structures have been removed from rivers and streams, and fishways have been installed on other barriers. Several catchment groups including the Mary River Catchment Coordinating Committee, South East Queensland Catchments and Reef Catchments have been restoring stream-side vegetation, the loss of which has also been identified as a cause of dwindling Jungle Perch numbers. Restoration has involved replanting vegetation and installing riparian fencing to exclude livestock.

Prior to release, the captive-reared Jungle Perch fingerlings were conditioned to recognise

predators likely to occur at the release site. They were also conditioned to take invertebrate (insect and crustacean) foods similar to those they would encounter in the wild. This conditioning is expected to enhance their capacity to survive.

"We believe this is the first step towards Jungle Perch forming self-sustaining populations in the stream system," Michael Hutchison says. "All the stocked fish have been micro-tagged and researchers are now monitoring their progress."

Life-cycle challenges

The breeding program has not been without its challenges. Jungle Perch larvae are difficult to rear in the early stages of development. Standard green-water culture techniques using rotifers, which work well for species such as Australian Bass (*Macquaria novemaculeata*) and Barramundi (*Lates calcarifer*), were not successful. Green-water culture is where a microscopic algae is introduced into the larval rearing tank. The algae provide food for live planktonic organisms on which the larvae feed.

The researchers determined that early-stage Jungle Perch larvae need to be reared on larvae (nauplii) of a type of small planktonic crustacean (copepods) under bright light. Researchers also discovered that Jungle Perch larvae must be reared in full seawater salinities and aeration of the water needs to be gentle during the early stages of rearing.

Several species that spawn at sea and migrate back into fresh water are known to follow the odours of fish from their own species back into suitable streams. If Jungle Perch also use odours as migratory cues, restocking could speed the recovery of Jungle Perch streams by attracting wild fingerlings into restocked sites.

To test the theory that Jungle Perch fingerlings home in on odours, laboratory trials will offer fingerlings a choice of two artificial streams to follow – one with Jungle Perch odour, the other stream without. The experiment will be replicated at least 10 times and odour sources will be rotated to eliminate bias. Ongoing monitoring could also help validate this in the wild.

In 2015 further fingerlings will be produced with the next batch soon to be released into a Sunshine Coast stream. Post-stocking monitoring of the fingerlings stocked in the Gold Coast hinterland has shown encouraging results. The fish have dispersed over several kilometres of stream and are growing well. Researchers will continue to monitor the progress of the stocked fingerlings to properly document the costs and benefits of the trial stocking program.

Michael Hutchison says if the stocking trials are successful and cost-effective, Jungle Perch could ultimately become an approved species for large-scale stocking in Queensland. Over time, restocking and improved habitat management could help re-establish self-sustaining Jungle Perch populations in the streams where they previously occurred. This would benefit anglers and regional economies.

"All going well, we would expect that many anglers from southern states would travel to Queensland to fish for Jungle Perch," he says.

Beyond Australia, Jungle Perch occur in rivers and streams in some of the wetter parts of the Indo-Pacific region. This includes parts of eastern Africa, Madagascar, Mauritius, Reunion, India, Sri Lanka, western Malaysia, Taiwan, the Philippines, southern Japan, New Guinea, New Caledonia, Vanuatu, Fiji and Samoa.

"Jungle Perch have declined in some of these regions also, including in Taiwan and Reunion, and there is interest in restoring populations in those countries."

Looking to the future, researchers at Queensland DAF's Bribie Island Research Centre are developing a hatchery production manual, which is expected to be completed by July 2015. Staff are keen to host visits by hatchery operators at the research site to share their knowledge.

The project is supported by the FRDC, with James Cook University and the Freshwater Fishing and Stocking Association of Queensland as project partners. **F**

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BACK FROM THE BRINK

Matthew McLellan, Narrandera Fisheries Centre hatchery manager, holds a mature Trout Cod ready for egg collection.

PHOTO: STEPHEN THURSTAN

CONSERVATION AND BREEDING

It takes a rare combination of factors for a restocking program to work and be successful including long-term commitment and breeding know-how; popular appeal also helps

By Natasha Prokop

The tale of the Trout Cod (*Maccullochella macquariensis*), a native of the southern Murray–Darling Basin, is one that highlights the potential of fish culture and restocking to conserve and rebuild populations of threatened species.

Once a popular recreational fish, by the 1970s it had been in severe decline for decades; there was only a single naturally occurring population remaining – between Yarrowonga and Echuca, on the Murray River.

These days the endangered and protected Trout Cod can be found in numerous rivers in New South Wales, the Australian Capital Territory and Victoria. This recovery is largely due to an extensive and ongoing conservation restocking program. Since the mid-1980s more than 1.5 million cultured Trout Cod have been released in NSW, ACT and Victoria combined.

Despite the small, remnant population that broodstock were captured from, the releases of hatchery-reared fingerlings have not negatively affected the genetics of the wild population and Trout Cod is widely considered one of Australia's greatest successes in conservation restocking.

Conservation motives

As principal research scientist with NSW Fisheries for more than 30 years, Stuart Rowland (now retired) saw firsthand just how dire the situation had become for Trout Cod and other large-bodied native species in Australia.

“I don’t think a lot of people realise just how serious the situation was by the late 1970s,” he says. “Species such as Eastern Freshwater Cod (*Maccullochella ikei*), Trout Cod and Mary River Cod (*Maccullochella mariensis*) were virtually gone. Some populations were wiped out and remnant populations were very small and in isolated locations.”

In response to the general decline of native fish, the NSW Department of Fisheries began research in the 1970s to develop hatchery techniques for these few key species, to re-

establish their stocks, increase their abundance and distribution and provide for recreational fisheries. Stuart Rowland led the initial research at the Narrandera Fisheries Centre and then later at the Grafton Primary Industries Institute.

After 30 years of conservation restocking, many of these large-bodied native species have returned to their former distribution and established self-sustaining populations.

“We found that most stockings were really successful and have basically brought those key threatened species back from the brink of extinction,” Stuart Rowland says.

Best practice

While these programs have been successful, other programs have not had the same results. Every failure and success has helped to improve future programs, with more rigorous breeding protocols and new technologies to help address critical issues such as genetic and domestication effects of hatchery programs.

In 2004, NSW Fisheries introduced a Hatchery Quality Assurance Program (HQAP) to set the standard for responsible conservation restocking practices and address such issues.

Best practices for broodstock management, artificial breeding, larval rearing, fingerling production and management of infectious diseases were established for hatcheries.

Guidelines for breeding programs seek to maintain the genetic identity of stocked populations, maximise genetic diversity and minimise inbreeding in cultured fish. A failure



PHOTO: STUART ROWLAND

Restocking of Eastern Freshwater Cod fingerlings into the Orara River, NSW, in 1988.

to do so can reduce survival and fitness, and the ability of the cultured (and ultimately wild) populations to adapt to changing environments.

‘Domestication effects’, such as failure to recognise the need to seek refuge from predators or preference for artificial foods, are now prevented by introducing simulated predators in the hatchery and using live prey diets.

Stuart Rowland says Australia has a great track record in conserving threatened species and our practices are world-class.

“The HQAP set a standard for both government and commercial hatcheries that was based on years of research and practical experience.”

Principal research scientist at the Western Australian Department of Fisheries Craig Lawrence says, despite the advances, closing the life cycles of threatened species still takes time. On average, his team requires three to five years to close a species life cycle, from wild broodstock collection to hatchery production of juveniles. He argues we need to start this process for our vulnerable species sooner rather than later.

“It would be far better to do the hatchery groundwork now and either save them from being listed, or if they do get listed we’ve already got a really good production system in place before they disappear from the wild.”

Craig Lawrence offers a perspective from work on the endangered Margaret River Hairy Marron (*Cherax tenuimanus*). He says that the population continued to decline during the five or so years it took to investigate the biology, genetics and threats to the species (key elements critics say need to be established prior to stocking). By the time his team was allowed to collect broodstock to commence a breeding program in 2006 it was very difficult to find any.

“That project highlighted the detriment of doing nothing aside from monitoring the decline of a species,” Craig Lawrence says. “So if you have a declining population and you do nothing but monitor it, because you are too cautious to take any action such as commencing a conservation restocking program, you will probably lose it anyway.”

Stuart Rowland makes the distinction between ‘conservation stockings’ and ‘stock enhancement’.

“Conservation stockings in NSW are ideally undertaken for three to five consecutive years in a particular river or location with the aim of establishing breeding, self-maintaining populations; stocking then ceases and the recovery

is monitored,” Stuart Rowland says. “Whereas stock enhancement involves regular stocking into environments where the species does not breed and/or recruit successfully, like in impoundments.”

Conservation restocking is only one tool in a larger toolkit of management options; it is not a cure-all for threatened fish stocks. While returning fish to an area is an important early step, addressing the causes of decline is still necessary for recovery.

However, in emphasising the importance of the initial conservation stockings Stuart Rowland makes the point that undertaking initiatives such as fishing management including severe restrictions, habitat restoration and general environmental improvements are of limited value if the target species is absent or no longer present in sufficient numbers to breed.

The way forward

Best hatchery practices for conservation restocking help to optimise success, but there are still hurdles outside the hatchery process to be overcome. Unlike Trout Cod, not all threatened fishes have the benefit of being high-profile, former recreational species with enough community and political momentum to support 30-year-long restocking programs.

Another factor contributing to the lack of success of some programs is the small scale of releases and the short-term nature of programs designed, for example, to overcome immediate threats such as drought.

Mark Lintermans, from the University of Canberra, is widely published on the subject of native fish conservation and says the lack of resources for restocking in Australia is a major impediment to success with some species.

“Governments or agencies generally work on political or funding time frames rather than ecological ones,” he says. “That lack of ability to sustain long-term programs is a real problem. The scale of the reintroductions is often too small, and by that I mean both the number of fish we release and the number of years we release them for.”

There are few facilities with even fewer resources capable of undertaking captive breeding for conservation, Mark Lintermans says. This limits the ability to produce the numbers necessary for successful restocking.

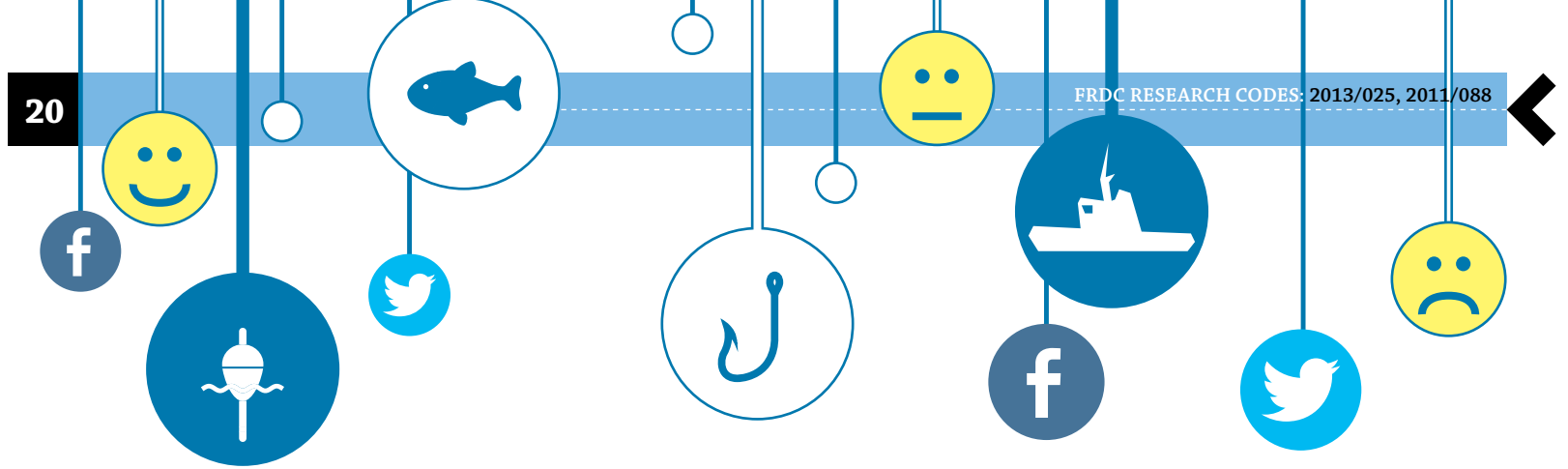
“You need to ensure that at least some of your stockings encounter favourable environmental conditions. There are good years and bad years in a river and if you only stock for a couple of years then the chances are you might have stocked in two bad years.”

Situations where projects have been successful, such as Trout Cod stocking in the Ovens River in Victoria, have been long term. The 10-year project found released populations were dominated by only a few strong year classes that had encountered favourable conditions and survived to breed.

“When it comes to species recovery, it is a very long road we’re on here and there are no quick fixes,” Mark Lintermans says. **F**

TABLE 1 EXAMPLES OF THREATENED SPECIES HATCHERY PRODUCTION AND RESTOCKING PROGRAMS FOR CONSERVATION IN THE VARIOUS STATES AND TERRITORIES.

STATES	LARGE-BODIED SPECIES (PURELY CONSERVATION)	LARGE-BODIED SPECIES (FISHING AND CONSERVATION)	SMALL-BODIED SPECIES (<12cm)
ACT	Trout Cod	Murray Cod, Silver Perch	-
QLD	-	Mary River Cod, Murray Cod, Silver Perch	-
NSW	Eastern Freshwater Cod, Macquarie Perch, Trout Cod	Murray Cod, Silver Perch	Southern Pygmy Perch, Olive Perchlet, Purple Spotted Gudgeon
SA	-	-	Southern Purple-Spotted Gudgeon, Yarra Pygmy Perch, Southern Pygmy Perch, Murray Hardyhead
VIC	Trout Cod	Murray Cod, Macquarie Perch, Silver Perch, Tandanus Freshwater catfish	-
WA	-	Black Bream	Western Trout Minnow, Balston’s Pygmy Perch, Margaret River Hairy Marron



THE GOOD, BAD AND UGLY OF SOCIAL MEDIA

RECREATIONAL FISHING

Social media is providing opportunities to create stronger connections for fishers and scientists, but is not without its dangers

By Catherine Norwood

There are more active mobile phones in Australia than there are people – 1.33 per man, woman and child, according to the Australian Communications and Media Authority. And almost 90 per cent of those are smartphones, with photo-taking, internet-posting capabilities.

It is just part of Australia's love affair with digital technologies, including social media; there are almost 14 million Facebook users in Australia.

But it is a double-edged sword. While digital communication allows the instant sharing of information, it also provides almost constant surveillance of both real and imagined wrongs and unlimited, unmonitored forums for the exchange of comment – however positive or destructive that comment may be.

THE GOOD New connections

Social media can reach thousands, if not millions, of followers very quickly. One tweet from US singer Katy Perry reaches her 69 million Twitter followers. Real Madrid footballer Cristiano Ronaldo has 107 million 'likes' on his Facebook page.

On a somewhat smaller, but more relevant, scale, the use of social media by the Queensland Police Service (QPS) during the 2010-11 floods in Queensland highlights how effective social media is in sharing information. During the flooding of Toowoomba, Ipswich and Brisbane in January 2011 the QPS Facebook and Twitter accounts became the leading source of flood

information and reporting. The number of 'likes' on the Facebook page jumped from about 17,000 to 100,000 in 24 hours, and there were about 39 million flood-related posts to the Facebook page, equating to 450 post views per second over the peak 24-hour period.

The case for social media and fisheries science and engagement may not be quite as urgent as that during the Queensland floods, nor would it have the same reach as Katy Perry or Cristiano Ronaldo. However, social media remains a powerful tool the sector can make use of.

When the FRDC posted information about the Asian paddle crab biosecurity threat in Western Australia in 2014 it generated 350,000 views within a few days.

For Australian fishing journalist Al McGlashan the potential of social media first really clicked after an epic battle with a Southern Bluefin Tuna off the coast of Warrnambool, Victoria, a few years ago. His team tweeted the progress of their seven-hour saga, and by the time they finally landed their catch and returned to port there were – unexpectedly – hundreds of people gathered to witness the weigh-in of the catch (155 kilograms, just for the record). It was at that point social media became a much more serious and integral part of his business.

Today, Al McGlashan has 60,000 followers on Facebook and his YouTube videos have received more than 8.1 million views. This is in addition to his mainstream-media television programs, such as *Big Fish Small Boats*, and numerous articles in Australian and international newspapers and magazines.

He says social media has brought recreational fishers together in ways that would not have been possible even 10 years ago. Recreational fishers are now working with other fishers and other groups, such as researchers, to make things happen as a community.

He points to the recent FRDC-funded research tagging program for Southern Bluefin Tuna as an example of recreational and commercial fishers working cooperatively with scientists to gather information about the species and improve fishing practices.

Sean Tracey at the Institute of Marine and Antarctic Studies (IMAS) in Tasmania has been leading a FRDC-funded project into the survival rate of Southern Bluefin Tuna released by recreational fishers. This has involved working with fishers to tag the fish before they are released, and social media has helped to track where the fish are biting and to connect with fishers willing to help.

Sean Tracey says the good news from the research is that more than 80 per cent of fish caught and released survive.

Because of the strong fisher involvement and continuous feedback from researchers during the project (also provided through social media), people are following the research and its findings with interest, which should increase the adoption of recommendations to improve fish handling and survival.

He says the fisher involvement has also led recreational fishers to suggest a second, similar project to assess the catch-and-release survival of Swordfish, which is an emerging recreational fishery off Tasmania's east coast. This project has now been funded.

Online engagement

The FRDC's recfishing research officer, Matt Barwick, says the use of social media by the recreational fishing community has exploded in the past few years.

"It has become a very busy space. More fishers use it to post images of their catches and to share information on Facebook, Instagram and Pinterest. Commercial businesses are getting more sophisticated with their use of social media,

incorporating brand messages with images or footage of amazing fish from idyllic locations – content that fishers really engage with.”

One practical research application of this willingness of fishers to share pictures of their catch is Redmap (Range Extension Database and Mapping project). Initiated by Gretta Pecl, also at IMAS, it allows community members to register unusual marine catches or sightings, which is helping to document changes in the range of different species and the arrival of new species. Launched with a web-based portal in 2009 in Tasmania, Redmap went national in 2012, with support from the GRDC, and now has Facebook and Twitter accounts, as well as Android and iTunes apps, which allow community members to instantly log any unusual sightings.

Matt Barwick says social media is also being used by fishing management authorities, which have traditionally communicated with the recreational fishing community through formal organisations.

“Peak bodies and clubs play an important role, but members make up about five per cent of the recreational fishing community. Social media provides an opportunity to engage with a much larger proportion, including the mums and dads who may only fish once in a while.”

THE BAD Destructive influences

When it comes to community feedback, Al McGlashan says his personal experience is that it needs to be taken with a grain of salt.

“You always get the extremes – the lovers and the haters – and the odd troll who has no idea what they’re talking about but thought they’d throw an opinion in there anyway.”

His social media support staff have, on occasion, tracked down some of his ‘haters’, to find that they range from a nine-year-old kid, who doesn’t quite realise that everything posted on sites such as Facebook is public, to environmental activists running campaigns from ‘empty’ (or fake) Facebook accounts.

Matt Barwick says social media does lend itself to community policing of rules and regulations, based on the photos and information that fishers post online to share with their friends. “But what you see online is not always the whole story,” he says.

The Northern Daily Leader in Tamworth, New South Wales, recently reported on a fisher targeted by a ‘name and shame’ campaign after posting a photo of himself on his own Facebook page with a Murray Cod, which was legal size at the time he caught it.

Subsequent to his fishing expedition, maximum size restrictions for Murray Cod were changed, which would have made his catch illegal – and this was the basis for targeting the fisher. The catch was reviewed by NSW Department of Primary Industries officers, who said no law had been breached. The fisher was, however, subjected to an ongoing hate campaign in his home town.

Matt Barwick says pictures of washed-up catch or nets can go viral on social media, because they generate an emotional response. But accusations

of wrongdoing are often unverified, he says, and can intensify mistrust, particularly between commercial and recreational fishing communities.

“It highlights the power of social media in surveillance and in generating an emotional impact. But the content can be constructed to do that, and too much of the content is assumed to be factual, when it may not be,” he says.

The FRDC has only had a few negative and factually incorrect posts on its Facebook page in response to posted news articles.

FRDC manager of communications, trade and marketing Peter Horvat says this is because the FRDC has a very strong social media policy, which outlines acceptable online behaviour.

“Despite being great for engagement, at the end of the day if people want to be malicious there is little you can do. It can be a very destructive medium when it is hijacked by a small number of people with a cause to push who don’t necessarily know what they’re talking about.

“Comments made on social media can be potentially defamatory and affect a person’s standing in the community and their livelihood. Although commenters may feel that they are immune to legal action, they’re not and it will not be long before there are more people taken to task and prosecuted for their actions.

“People have a responsibility, even in this space, to act responsibly. Organisations that have not yet stepped into social media should consider it carefully and do some planning beforehand to ensure they have clear policies for engagement and commenting,” Peter Horvat says. **F**

THE UGLY A matter of perspective

It is common knowledge that recreational fishers are prone to exaggerating the size of their catch. With a few camera tricks, fishers can even make the photographic ‘evidence’ of the catch match their stories. When a fisher holds their catch as close to the camera as possible – and as far from their own body – it makes the fish look as big as possible. The Flathead caught (far right) was a few centimetres over legal size, but thanks to the camera’s perspective, it looks like a more impressive catch than it actually was.

Now there is even a Danish proposal for a crowd-funded Kickstarter project, ‘Fish Fingers’, to help fishers “exploit the power of perspective” (www.moef.dk/fishfingers).



PHOTO: MICHAEL EDMONDS

THE WORLD IS THEIR OYSTER

EDUCATION AND AQUACULTURE

An innovative school program allows Eyre Peninsula students to 'dip their toes' into the waters of the aquaculture industry

By Rebecca Jennings

It is a Monday morning in Cowell, a small rural town on the east coast of South Australia's Eyre Peninsula, and Year 11 student Brad Armstrong jumps aboard the waiting oyster punt to start his day's classes. While his fellow students are settling in with their books in the classroom, he heads out into Franklin Harbour with local oyster farmer Simon Turner.



Geoff Turner – one of Cowell's original oyster farmers – checks a basket of oysters in the school's lease.

PHOTOS: REBECCA JENNINGS

And he would not have it any other way. Brad Armstrong is one of about 120 students who have taken part in the oyster industry in the past 25 years, thanks to the Cowell Area School's aquaculture program. The 170-student school (Reception to Year 12) takes pride in running the only aquaculture program of its kind in Australia.

The program was initiated in 1991 when local oyster growers came to the school with the request for a course that could suitably equip students for entry into the aquaculture industry. The first course was offered in 1992. The linchpin is the school's own oyster farm – a 2.5-hectare lease in Franklin Harbour allocated to the Cowell Area School through the SA Department of Fisheries in 1991.

Cowell has also developed a trade-training centre to deliver vocational education and training (VET) for students across the Eyre Peninsula, offering a Certificate I and Certificate II in Aquaculture. In these courses students in Years 10 to 12 can learn to harvest and shuck oysters, set up an oyster farm and follow seaboard safety, as well as more transferable skills such as food-handling practices and work health and safety requirements.

As well as the oyster lease, students can turn their hand to 'aquaponics' with the school's recirculating tanks for finfish such as Barramundi.

However, aquaculture is not just for senior students at Cowell – it is woven through every year level. In Reception, literacy and numeracy is based on sea creatures. By Years 3 and 4, students are learning about fishing and sand-dune erosion. By Years 5 and 6, they are working with oysters. From Years 7 to 10, Cowell students study marine sustainability, fisheries regulations, water sampling and the microbiology of aquaculture. Aquaculture is even part of the school's hospitality and business subjects, with students learning to cook oysters and sell them at school fundraising events.

Cowell Area School aquaculture education manager Bob Combes says the program would not be possible without the support of local oyster farmers. "The program has always been to instil in students the skills required to advance the local industry and create an opportunity for those

wanting to work in the region," he says. "Our local community has been invaluable, offering us its business expertise and ensuring that our lease is kept up to date with developing technologies."

The SA Department of Education and Child Development assists in funding the school's oyster lease manager, infrastructure and equipment for the program. But it has not all been smooth sailing. Early on, some local oyster farmers were concerned this government support would give the school an unfair advantage in the market, but today there is widespread support and recognition that the school's program is good for the industry's future.

Five local growers sit on the school's aquaculture advisory board to provide advice and guidance, and other growers contribute their knowledge and host work experience students. These work experience placements often lead to jobs.

For example, Brad Armstrong's work experience placement at Turners Oysters when he was in Year 10 eventually led to a casual position during busy periods. He began his Certificate II in Aquaculture this year and spends one day a week with Simon Turner learning about the business, which sells about 160,000 dozen oysters a year to restaurants across Australia.

The school sources oyster spat from Tasmanian companies Geordy River Aquaculture, Cameron of Tasmania Pty Ltd and Shellfish Culture Ltd, which have also provided work experience opportunities for Cowell Area School students.

Industry support

Retired oyster farmers Geoff and Janet Turner have backed the school program since it began. They made the transition from agriculture to aquaculture in 1987 and are among the pioneers of Cowell's oyster industry. Oyster leases now dot the southern end of Franklin Harbour, where tidal currents and food sources are optimal for oysters.

The Turners co-founded BST Oyster Supplies, and developed the adjustable longline system used by oyster farmers around the world. The adjustable height feature has been critical to weather the 'dodge tides' characteristic of the Spencer Gulf. In this tidal pattern, one tide a fortnight is missed.



Pacific oysters from the Cowell Area School's oyster farm in Franklin Harbour.



Oysters are an integral part of the Cowell community, even gracing a street sign in the Spencer Gulf town.



The Cowell Area School's oyster lease in Franklin Harbour, Cowell.

It is a scenario which, if it coincides with a scorching 40°C-plus day, can devastate the farms.

The Turners are only too happy to impart their knowledge of the oyster industry – from farm set-up to disease management to marketing – to Cowell students. An important lesson is the value of environmental sustainability.

“There are 5000 hectares of water in the Cowell harbour, but the oyster industry decided only 112.5 hectares should be used for aquaculture,” Geoff Turner explains. “It’s one of the local industry’s environmental commitments.”

Career opportunities

Geoff Turner believes positioning oyster farming as a rewarding, sustainable career choice will encourage the young people of Cowell to stay. Cowell is nearly 500 kilometres from Adelaide by road; the ferry across the Spencer Gulf closed in 2014. Many young people head to the city for jobs and further study. With iron ore mines right on the doorstep, the lure of the mining industry is also strong.

“It is absolutely critical to have the next generation coming into the industry. Oyster farming offers stability and a lifestyle that the mines can’t provide,” Geoff Turner says. He takes pride in seeing Cowell students developing skills in managing the oyster farms, embracing new technology in the grading sheds, and gaining business sense and an appreciation for the industry’s environmental commitment.

“I see it as absolutely important to keep this course going, and that the education system recognises the value it is providing for industry,” he says. “It is developing skills for aquaculture that will drive the state into the future.”

Although Cowell Area School boasts a 100 per cent success rate at placing students into local aquaculture jobs, the program has also underpinned careers in other aspects of the industry, such as science. It was the catalyst for former student Laura Inglis, 18, to study a Bachelor of Science, majoring in marine biology, at Flinders University in Adelaide.

“The school’s aquaculture program is unique. I don’t know of many school students who would get such an opportunity to learn about the oyster industry,” Laura Inglis says.

She combined her interest in science and access to the school’s oyster lease for her Year 12 research project, which studied diploid and triploid oysters, and work experience at Shellfish Culture Ltd in Tasmania, where Cowell sources oyster spat. Today, she is in her second year of her three-year degree, with her sights firmly set on a career involving the Great Barrier Reef or deep ocean.

Bright future

Self-sufficiency is on the horizon for the Cowell Area School’s oyster program, with plans to sell ‘on grows’ – oysters aged five months – to make a profit earlier than the current practice of growing oysters out to 15 months.

“In the next two years, we will move to selling 70 per cent of our oysters as on grow

and the remainder as bistro or standard size,” Bob Combes says. “We hope that this will provide us with a steady income to pay for the enterprise as it continues to develop, so we can contribute to the industry that forms the backbone of our community.”

Cowell Area School’s innovative aquaculture program and its oyster lease are garnering international interest. The school has hosted school leaders and business executives from Japan who are interested in setting up a similar curriculum and business. Principal Jan Potter took to the global stage to share Cowell’s story at the 2014 World Aquaculture Conference in Adelaide, and Cowell Area School staff have also visited the US to see how schools there incorporate aquaculture into their curriculum. **F**

Cowell Area School student Brad Armstrong is completing his Certificate II in Aquaculture, which involves learning the ropes from local oyster farmer Simon Turner.



Year 11 students Angus Dewson (left) and Dante Zanet in the Cowell Area School’s aquaculture facility.



PHOTO: CSIRO

Australian development of a new bioactive feed supplement will allow wild-caught fishmeal and fish oil to be removed from the diets of farmed prawns without compromising animal growth.

World lead on prawn feed

AQUACULTURE NUTRITION

Australian innovation is producing world-leading advances in the sustainability of prawn aquaculture

By Catherine Norwood

While many farmed fish and crustacean species are reliant on wild-caught fish as a component of their diets, the limits of wild resources have also limited the potential to increase production of these species.

However, for prawns at least, the potential for a fish-free diet is on the horizon, with the development of the bioactive supplement Novacq™.

It has taken a decade of research at CSIRO and a further two years of refinement by feed manufacturer Ridley AgriProducts Pty Ltd (Ridley) on the way to commercialisation, but

Novacq™ marks a significant step forward in the sustainability of aquaculture feed.

Nigel Preston, research director for CSIRO's Integrated Sustainable Aquaculture Production program, says aquaculture is the fastest-growing animal-protein production sector in the world. "Anything we can do to support this production in a more sustainable manner will help."

He says the solution lies in developing ways to cultivate the necessary ingredients, rather than harvesting limited wild sources.

"There has been a push for quite some time to substitute land-based proteins such as grains for fish protein. It's a cultivated solution, as opposed to stripping the wild," Nigel Preston says. "Novacq™ has its genesis in that background."

However, Novacq™ is not a complete prawn feed. "You still need the basic building blocks of life, the proteins, the carbohydrates and the oils. Novacq™ is a supplement that

allows prawns to use those building blocks in the other feed ingredients more efficiently."

Novacq™ is a microbial biomass that is produced using a complex mixture of ingredients including waste organic matter from plant industries such as sugarcane, wheat and rice production and processing. It is harvested as slurry, which is about 90 per cent moisture, and the bioactive ingredients are filtered, creating an additive that resembles green-tinted talcum powder.

Fishmeal is normally a significant contributor to the protein portion of fish feeds. Novacq™ improves the ability of prawns to convert a range of feed ingredients into growth by so much that fishmeal and fish oil could be removed without any loss of growth compared with current feeding regimes that include fish-based components. This means the prawn industry is no longer beholden to fishmeal for its future, Nigel Preston says.

“This is a game changer for the industry. It is a major achievement for the sustainability of Australia’s aquaculture industry as prawns fed this diet are not only a top-quality product and reach market size faster, but they also no longer need to be fed with any products from wild fishery resources.”

Internationally, he says it solidifies aquaculture as a sustainable source of protein to help meet the ever-growing demand for food.

Retaining fishmeal at current levels while adding Novacq™ can increase growth rates by 50 to 60 per cent, based on Ridley’s latest trials, which include commercial-scale trials in Queensland at Australian Prawn Farms at Ilbilbie and Gold Coast Marine Aquaculture. Novacq™ also significantly improves the feed-conversion ratio, requiring less feed per kilogram of prawns produced.

Nick Moore from Gold Coast Marine Aquaculture has been involved in trials with Ridley for more than two years, providing ponds for the trial-scale production of Novacq™ in 2014 as well as conducting commercial-scale feed trials this year.

“So far it has done everything we wanted it to do,” Nick Moore says. “We wanted to make sure that the prawns would eat it – that it was palatable. We also wanted to be sure there was no degradation in the taste or the texture of the prawns themselves.

“As for increased growth, the trials haven’t finished, but it looks good. However, we see the potential to eliminate the wild-fish component of feed as the greatest advantage, not just for Gold Coast Marine, but for the industry in general. The demand for fishmeal is going to increase as aquaculture continues to grow, but Novacq™ means we won’t be restricted by that, we will be self-sufficient and sustainable.”

Ridley group technical and research and development manager Richard Smullen says while Australian trials have been conducted with Tiger Prawns, trials with other species have been held in New Caledonia, French Polynesia, Oman, Thailand and Vietnam. The international trials have been laboratory-based, tank-based trials comparing Novacq™ supplemented feeds and standard local feeds, with promising results.

“So with commercial prawns, or shrimp as they’re called overseas, we’ve covered most commercial species, both marine and freshwater,” Richard Smullen says. “We also plan to look at other species such as yabbies and crabs.”

FIGURE 1 RESULTS OF A LABORATORY-BASED TRIAL OF NOVACQ™ FED TO BLACK TIGER PRAWNS (*PENAEUS MONODON*), AFTER 28 DAYS.

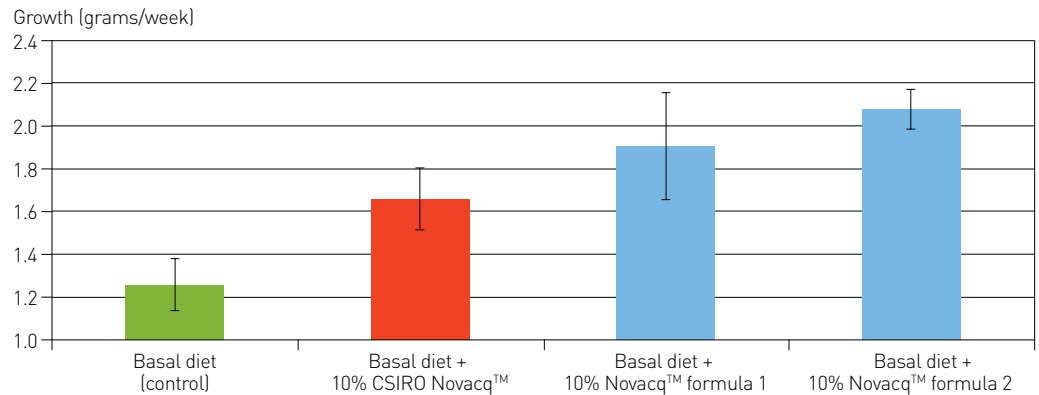


PHOTO: RIDLEY AGRIPRODUCTS PTY LTD

Novacq™ under production in a pond.



PHOTO: DARREN JEW

Novacq™ (foreground) and other raw materials.

Matthew Briggs is Ridley’s technical project manager, responsible for refining the production process and the formula to ensure large volumes of a consistent product occurs as production is scaled-up from laboratory to commercial-scale production.

CSIRO data had already demonstrated improved growth of 30 per cent. With some finessing, trials have shown consistent improvements, with up to 60 per cent (Figure 1) improvement in some Australian trials.

From a producer perspective, it will allow prawns to be grown to a larger size, or to be harvested at the current sizes but produced in a shorter time. In some locations the faster growth rates may even allow an additional crop to be harvested each year, although probably not in Australia, where temperatures are relatively cool compared with other major prawn-producing regions.

Given that more than three million tonnes of prawns are farmed globally, the potential reduction in fishmeal and fish-oil consumption and the increase in production is significant; three million tonnes of global production could theoretically become five million tonnes with no additional feed.

Australia’s current production is comparatively small at only 5000 tonnes: China, Vietnam, Thailand and Indonesia are responsible for 2.05 million tonnes (65 per cent of current world production of about 3.18 million tonnes).

Following the success of Novacq™, CSIRO is now using the same approach to develop more-sustainable diets for fish such as Atlantic Salmon and Barramundi.

“It will be more challenging because fish are more highly evolved than prawns, higher up the trophic levels,” Nigel Preston says. **F**

OYSTER GROWERS INVEST IN GENETIC POMS RESISTANCE



PHOTO: LILLY DUTHIE

DISEASE CONTROL

As a devastating disease spreads from French Pacific Oyster farms to the rest of the world, an Australian industry-based R&D company is preparing to defend against inevitable incursions

By Gio Braidotti

When infectious disease devastates human health, the world has sophisticated healthcare strategies on stand-by. But what happens when crops and animals in our food-producing farms are struck down by disease outbreaks that threaten entire sectors?

The Pacific Oyster (*Crassostrea gigas*) industry has faced that question since the arrival in New South Wales in late 2010 of Pacific Oyster Mortality Syndrome (POMS). The same disease has previously devastated oyster industries as it spread from France in 2008 to the UK, the Netherlands and New Zealand.

In NSW, the Georges River, Botany Bay, Port Jackson, Parramatta River and the Hawkesbury River were badly affected. Local research found that POMS reduced oyster survival to just one per cent when water temperature and environmental stresses conspired to assist the disease. At best, survival peaked at 40 per cent.

Some NSW operators have now left the oyster industry, unable to survive the dramatic economic impact of disease – first they were hit by QX disease, which affected Sydney Rock Oyster (*Saccostrea glomerata*) production, and then

by POMS, which decimated the triploid Pacific Oysters used to rebuild some of those farms.

Research to find a solution to this devastating issue is happening all around the country and across the Tasman, with the University of Sydney, CSIRO, the NSW Department of Primary Industries, Hornsby Council (NSW), Tasmanian hatchery Shellfish Culture, Aglign Consulting and two groups in New Zealand working on POMS.

Tasmanian and South Australian growers – while currently unaffected by POMS – are facing a ticking bomb. It is generally accepted that the arrival of POMS in these areas is a matter of ‘when’ not ‘if’.

Rather than present a sitting target, growers are acting pre-emptively to safeguard their farms. This includes agreeing to a specific research levy to support a program to breed POMS-resistant oysters. The program will be conducted by the industry-owned company Australian Seafood Industries Pty Ltd (ASI).

Research levy

Created in 2000, ASI has developed an applied breeding program for Pacific Oysters that has focused on breeding oysters with a balanced range of traits to improve productivity and marketability. These include gain in growth rate, shell width index, time to reach market condition, survivability and uniformity.

In the past, a premium has applied to spat produced from ASI’s advanced broodstock, for those growers who chose to buy it. However, the significance of POMS to the industry as a

whole – and the importance of breeding POMS-resistant stock – has resulted in a new approach.

With support from growers and the Australian Seafood Cooperative Research Centre (Seafood CRC), a compulsory levy of \$2.80 per 1000 spat has been introduced on all hatchery-produced Pacific Oyster spat sold in Australia, whether it is produced from ASI broodstock or not.

The levy will be collected by ASI from growers and invested in an accelerated POMS-resistance breeding program. The levy was approved by the Australian Competition and Consumer Commission in late 2014 and will apply for the next decade, with industry to review progress after three and seven years, providing opportunity for “go/no-go” continuation of the levy.

Breeding program

ASI director Ian Duthie says the POMS resistance program is based on testing genetically diverse oyster families in which all pedigrees are known. The families are exposed to POMS in NSW (or in laboratory tests that correlate with field findings and better ensure exposure to POMS). Back in Tasmania, relatives of the best-performing families are bred.

“None of the ASI families possessed complete resistance to POMS,” Ian Duthie says. “Some had none but others possessed various levels of partial immunity. With CSIRO assistance, we were able to devise crosses that will allow us to gradually increase resistance to commercially viable levels.”

The program’s goal is to achieve 70 per cent resistance to POMS in five years and



Making use of ASI breeding improvements: (from left) Ian, Anna and Thomas Duthie on the water at Pittwater, Tasmania.

the most recent trials in 2014 show the program is on track to achieve this.

This approach to POMS was adopted following a review of POMS' impact internationally and the efficacy of various disease-control strategies.

ASI general manager Matt Cunningham says two broad strategies exist. In France and New Zealand growers buy three to four times more spat than needed and harvest whatever POMS spares. This approach is not economically viable in Australia where spat prices are considerably higher.

Globally, the consensus is that breeding for resistance to POMS is the only practical solution. In response, ASI adapted its longstanding breeding program to include selection for disease resistance.

Ian Duthie explains that selection for one trait can inadvertently force unwanted changes in other desirable traits the ASI program has been focusing on, such as meat to shell ratio. This is true in all agricultural breeding programs, be it in crops, livestock, timber or fisheries.

He says this proved the case with the QX-resistance work in Sydney Rock Oyster and in ASI's earliest attempts to accelerate growth rates in Pacific Oyster. Today, ASI uses economically weighted values that balance productivity and marketability traits.

"The beauty of this strategy is that it achieves resistance without sacrificing gains made over many years in traits that improve farm-gate profitability," Ian Duthie says.

The other advantage for growers is the

cost. "If each hatchery was to pursue applied breeding independently it would cost industry more overall and disadvantage the customers of smaller hatcheries," Matt Cunningham says.

Individual hatcheries have estimated that POMS-related breeding would result in costs of \$5 per 1000 spat, compared with the \$2.80 per 1000 spat for the industry-wide levy.

"That's a clear case of costs to growers being minimised," Matt Cunningham says. For a farm achieving 80 per cent recovery to sale, the levy represents less than one per cent of the oysters' farm-gate sales price (4.2 cents per dozen oyster sold).

Peter Kosmeyer, general manager of Southern Cross Marine Culture, manages the purchase of more than 15 million Pacific Oyster spat a year for farming in Tasmania, South Australia and NSW. He says that achieving POMS resistance is vitally important to industry and hatcheries.

"The consequences of not having something in place are too horrible to think about," he says. "Ditto SAMS [South Australian Mortality Syndrome] and whatever is next."

ASI's breeding model is being adopted by other nations, including New Zealand. But since Australia started accruing resistance earlier, ASI's program is leading the world.

"This approach is measurable, reproducible and, most importantly, can achieve genetic gains for POMS resistance," Matt Cunningham says.

Families most recently underwent a juvenile field challenge in late 2014 in the POMS-affected Georges River region, in NSW.

As with previous trials, high levels of genetic variation in POMS resistance were observed.

"The results suggest that resistance is accumulating with successive generations of selection and we can remain confident that we will achieve our expected levels of resistance in the time frames predicted," Matt Cunningham says.

"The fundamentals and science we are using is held up as the model for other oyster breeding programs around the world, in the US, New Zealand and France."

Business changes

The levy provides greater stability for ASI's research program, but other changes to the business are also being made to further improve the sustainability of its operations. While the levy funds the POMS resistance program, other ASI projects are funded independently of this.

Since its inception as an industry-owned company, ASI has relied on dedicated volunteers as directors and a small, tightly focused budget. As the technical and business environment became more challenging, ASI recognised that this governance model needed to change.

Following a strategic review, ASI's new business plan incorporates an expansion of the board, with remuneration for directors. It will include an independent chair, two independent directors and two shareholder-nominated directors. Managing director of the Seafood CRC Len Stephens has been appointed as the new independent chair of the ASI board, and the process of appointing the other directors is being finalised. **F**

Native species serves as industry safety net

AQUACULTURE

A new oyster aquaculture industry is on the verge of large-scale commercialisation in South Australia

By Gio Braidotti

The sensitivity of cultured oysters to new and exotic disease outbreaks has revealed a critical weakness in the way this lucrative industry is structured in Australia. Lack of diversification means the livelihoods of too many growers are based on a single, disease-prone species.

South Australia relies exclusively on Pacific Oysters (*Crassostrea gigas*) to sustain a \$40 million oyster industry. Aware of the risks, some growers have begun exploring the feasibility of cultivating the Native Oyster (*Ostrea angasi*).

Research at the University of Sydney has confirmed the Native Oyster is resistant to Pacific Oyster Mortality Syndrome (POMS), a disease that has been decimating production internationally and in Australia (see page 26).

In Coffin Bay, on the Eyre Peninsula, Pristine Oyster Farm's Brendan Guidera considers the Native Oyster a premium seafood. "What interests me is their flavour and fat," he says. "They are on par with the famous Belon oysters from France – the world's most expensive oyster."

Keen to run grow-out trials he and other farmers, particularly on Kangaroo Island and the Eyre Peninsula, sought the assistance of the South Australian Research and Development Institute (SARDI) to continue to develop hatchery and broodstock technology for Native Oyster to supply industry with spat and to form the basis of a program of genetic and further technical improvements.

SARDI shellfish aquaculture geneticist Xiaoxu Li says the main difficulty is that unlike Pacific Oysters, Native Oysters do not release millions of seed from which hatcheries can produce spat. Rather, they rear a much smaller number of young – about five times less than Pacific Oyster – in their mantle cavity. From there, the fertilised eggs develop into shelled larvae before finally being released into the surrounding water.

SARDI production capacity over the past four years has totalled four million Native Oyster spat – one million per year. This is made available to growers by open tender after disease clearance assessment, usually some time between February and May each year.

"Diversification is critical to manage potential business risks from disease," Xiaoxu Li says. "The development of Native Oyster aquaculture would be an ideal strategy to mitigate impacts from POMS when it occurs in SA."

Recent advances include the ability to store sperm (for year-round spat production) through the development of a cryopreservation technique and optimisation of the early (or 'white') larvae rearing system.

"Preliminary results from trials with our prototype rearing system were promising, with fully shelled (or 'D-larvae') produced," Xiaoxu Li says. "This is essential to the long-term development of the industry. In addition, the optimisation of a chemical metamorphosis-induction method has now achieved more than 80 per cent metamorphosis and survival."

Farmers such as Brendan Guidera have been using the spat to test grow-out methods while also providing SARDI with fertile broodstock. He says farming methods optimised for intertidal oysters, such as Pacific Oysters, are not ideal for the Native Oyster, which grows slowly and is prone to dying, especially in high heat. However, if left too low in the water the baskets and oysters foul up with weed and parasites.

"I think the most likely way to viably farm Native Oyster is to grow them to market size sub-tidally in baskets and finish them off inter-tidally using the adjustable longline method," Brendan Guidera says. "The shape and flesh composition is improved, and the abductor muscle is also strengthened, giving them a much better shelf life."

While the threat from POMS is the major reason cited for trialling Native Oysters, Brendan Guidera says they also present new market opportunities. During tastings at recent 'oyster and wine' events in SA, about three-quarters of people preferred the Native Oyster to the Pacific Oyster despite never before tasting a Native Oyster.

Consumers reported preferring the firmness and chewiness of the Native Oyster flesh and the long-lasting range of changing aftertaste.



PHOTO: SARDI

Xiaoxu Li of SARDI Aquatic Sciences.



PHOTO: XIAOXU LI

Larvae of Native Oyster (*Ostrea angasi*) 14 days after strip spawning (black larvae) produced in culture in South Australia, thanks to research led by Xiaoxu Li.

Another option Brendan Guidera is considering is to sell Native Oysters to Europe, where they are very highly regarded.

"We will be sending a trial shipment in 2015. We also sell some direct to some Australian restaurants."

Pristine Oyster Farm has been operating for more than 20 years, with leases at Cowell and Coffin Bay. It produces about six million Pacific Oysters a year, about 65 per cent of which are exported, mainly to Hong Kong. **F**

Indigenous perspectives step up

INDIGENOUS FISHERIES

Indigenous knowledge can provide new ways of understanding the value of Australian fisheries

By Catherine Norwood

For Matt Osborne, a member of the Kaurna and the Narungga people of South Australia, the ocean is very much a part of his cultural heritage. This includes learning and practising customary fishing techniques that target many different species. Some of the species highly prized for cultural significance are also well-recognised commercial species – for instance, abalone and Southern Rock Lobster. Others, such as the Dusky Morwong, have little value to either commercial or recreational fishers.

Matt Osborne also knows, as do many other Indigenous Australians, what it is like to be restricted or legally prevented from carrying out the traditional practices of his people.

He says this is beginning to change slowly, with many jurisdictions around Australia now providing for and protecting Indigenous access to fisheries. However, there remains a gap in many cases between legislation and initiatives on the ground.

It is a gap Matt Osborne hopes he can help to address by supporting efforts to encourage greater Aboriginal and Torres Strait Islander participation in fisheries – not only in preserving traditional fishing practices and cultural knowledge but also in commercial and recreational fishing and fisheries management.

Working with Rural Solutions SA, the service-delivery arm of Primary Industries and Regions South Australia, he has been involved in several projects aimed at expanding Indigenous participation. This includes a feasibility study for abalone aquaculture as an Aboriginal business initiative.

In the past two years, Matt Osborne has built his skills and expanded his networks through the National Seafood Industry

Leadership Program (NSILP). He also received an FRDC-sponsored Indigenous Development Scholarship, which has allowed him to learn more about Indigenous initiatives in fisheries management, commercial operations and traditional practices in other parts of the country.

Matt Osborne says NSILP provided him with a broader understanding of the fishing industry as a whole, and where Aboriginal fishing could be more supported. “The program brought together participants from a lot of different industry sectors. We didn’t necessarily know a lot about the aspirations of the different sectors when we started. To be able to provide an Aboriginal perspective in that forum was good, and it would be good to see more of that – to be recognised as important stakeholders in the fishing industry.”

The Indigenous Development Scholarship allowed him to travel to the Northern Territory, Queensland, Western Australia and the Torres Strait Islands, speaking with both fisheries managers and Indigenous community representatives.

During a NT visit, Matt Osborne was particularly impressed with the involvement of Yirralka rangers in both fisheries management and compliance. The rangers help manage the Laynhapuy Indigenous Protected Area, which covers 4500 square kilometres of coastal vegetation, heathlands, mangroves, flood plains and wetlands.

“It was good to see how traditional owners were respected and supported to take charge and provide advice about what is happening in the area, and where the commercial fishers are,” he says.

As well as being authorised to conduct compliance activities, such as checking for commercial crabbing equipment, he says Indigenous people had a substantial influence in defining compliance operations to manage and protect their Sea Country.

It provides a good example of a mutual benefits approach to Indigenous fisheries, he says. Indigenous knowledge and participation assist government agencies to manage the long-term sustainability of the fisheries for the benefit of the entire community.

Matt Osborne is now a member of the FRDC’s Indigenous Reference Group, which works to define fisheries-related aspirations of Indigenous

Australians and relevant research, development and extension activities needed to support these. With a Bachelor of Science in marine biology, he also brings experience in the practical delivery of government policy and projects.

In addressing the gaps between legislated rights and policy, he has already been involved in testing fisheries’ social objectives and indicators with the Narungga community of SA and the SA Sea Ranger forum.

Representing the Indigenous Reference Group, he also presented at a national ecosystem-based fisheries management (EBFM) workshop in 2014. He says while EBFM is seen as a best-practice management framework, it often fails to incorporate the objectives of Indigenous communities.

For example, maximum economic yield and allocation are often used as proxies for social objectives. But customary fishing is not recognised



Matt Osborne at the Banyiala campground with a Golden Snapper during his Northern Territory regional visit.

for economic gain, and economic objectives do not recognise the social value of cultural practices.

Matt Osborne says the FRDC’s investment in Indigenous research provides strong recognition of the significance of the sector.

“I believe it will lead to further changes to fisheries management and Indigenous participation across Australia,” he says. “Other sectors of the fishing community will also benefit from recognition of Indigenous fisheries through improved decisions and a true triple-bottom-line approach that meaningfully incorporates all users.” **F**

BIO-ECONOMICS INTELLIGENCE

key to effective fisheries management



FISHERIES ECONOMICS

Fisheries managers are making greater use of fisheries number crunching to ensure public resources provide the best possible returns for the country

By Melissa Branagh

Maximising the returns from Australia's fisheries for the nation is far more than a matter of maintaining the biological sustainability of fish stocks. But for fisheries managers with a background in biological sciences, it can be difficult to know how to go about the new management paradigm of "fisheries bio-economics".

Bio-economics is essentially the process of combining biological information about fisheries with economic information in order to make management decisions. For example: how will changing the legal size limit of a fish affect the sustainability of the species, and how will it affect the productivity and profitability of fishers?

Providing new economic perspectives and skills was the aim of a workshop for fisheries managers held in Queenscliff, Victoria, in February. The workshop was coordinated by the University of Tasmania (UTAS), which has several researchers working on economics-related projects.

The workshop drew together managers and researchers from all Australian states and New Zealand to discuss common economic management strategies, such as quotas, and the use of economic indicators, which range from employment figures to the cost of going fishing and the beach price for fish.

Among the presenters was Caleb Gardner, from the Institute for Marine and

Antarctic Studies (IMAS) at UTAS, who has undertaken several economic assessments including an analysis of potential benefits from the relocation of Southern Rock Lobsters in the Tasmanian fishery.

He said while fisheries management in Australia was initially based on the rationale of providing food for domestic markets, exports now provide the greatest value for Australian fisheries.

"As managers of a commonly owned resource, we need to make sure that commercial industries can operate as productively as possible, while also protecting the sustainability of the resource and benefits to other users.

"Fisheries managers need to step up to maximise community benefits and create economic opportunities for local communities, for the states and for the nation. Creating economic benefits is already enshrined in fisheries legislation in all jurisdictions and we need to get smarter about how we do this."

"The focus in Australia is largely on preventing fishery collapse, which is necessary, but is only one aspect of management of a fishery. Economic methods are useful in situations where choices need to be made and this is broader than just commercial profitability."

– CALEB GARDNER, IMAS

Knowledge gap

UTAS research scientist Tim Emery conducted a national survey of fisheries managers prior to the Queenscliff workshop. He found that more than 60 per cent of managers had a background in biological sciences and limited working knowledge of fisheries economics methods and concepts.

However, more than 80 per cent of respondents said they were expected to be familiar with economic theory; more than 70 per cent agreed that education and training in bio-economics was necessary to improve their management capabilities.

The UTAS survey also found that fisheries managers believed government and industry were equally responsible for maximising economic yield in fisheries. However, about 75 per cent reported opposition from the commercial fisheries sector to measures designed to improve economic yield and cited resistance to revolutionary change, scepticism and suspicion about future financial wellbeing.

Workshop report

At the workshop Tim Emery reported on the survey findings, which included that only half of Australian fisheries organisations actually collected and used economic data.

He said market price data was most common; about 50 per cent had economic performance indicators for their fisheries, such as the gross value of the fishery, and only 30 per cent had targets for their performance indicators, such as a specific

dollar value they wanted to achieve for the gross value of the fishery.

Caleb Gardner also outlined some of the responsibilities of fisheries managers at the workshop, saying that while many decisions in Australian fisheries were driven by biological information, managers were also required to generate and sustain triple-bottom-line benefits. This means they must consider ecological, economic and social sustainability from fish-capture stage to market.

"The focus in Australia is largely on preventing fishery collapse, which is necessary, but is only

ILLUSTRATION: PAUL DICKENSON



one aspect of management of a fishery. Economic methods are useful in situations where choices need to be made and this is broader than just commercial profitability," he said.

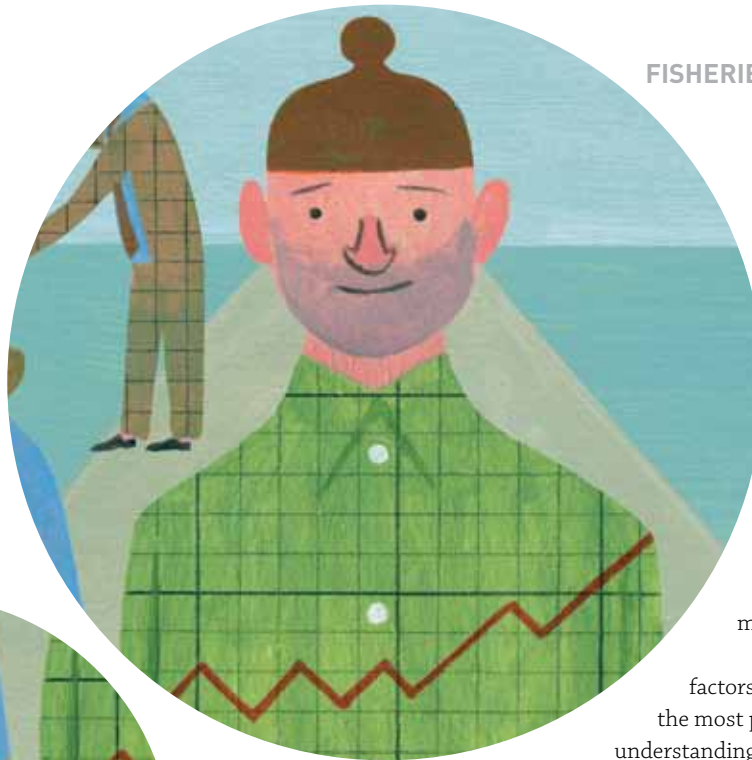
"The economic benefits are not solely related to commercial fisheries, and managers need to keep other stakeholders in mind.

"Some fisheries managers are lukewarm about using economics. But economic performance is one of the objectives in most fisheries legislation. If you don't measure or analyse economic performance, it's difficult to say if the management is achieving what it's supposed to be doing."

He said some economic information, such as the number of jobs involved in commercial fishing or the price of fish, was available from existing sources. Other information, such as the cost of going fishing – fuel, bait, equipment, wages – could be obtained with relatively simple and inexpensive surveys of fishers.

The case for quota

The workshop discussed quota-managed fisheries as one potential economic management strategy – one which is designed to maximise the economic yield or value of the fishery. The economic theory behind quota fisheries holds that by giving fishers quota units, it encourages them to make decisions that improve the economic



performance of fisheries.

IMAS PhD candidate Rafael León reported on his analysis of decision-making in quota-managed fisheries, finding that the operational reality often contradicted the economic theory. The theory suggests, in part, that in quota systems the aims of industry and government – sustainable stocks and maximum returns – will align.

One expected result of this is that setting the total allowable catch becomes a more harmonious process because the economic incentives of maintaining long-term economic yield and a sustainable fishery encourage quota owners to voluntarily reduce their take in response to declines in abundance or catch rate.

However, Rafael León said his study of Australian and New Zealand fisheries quota owners showed that they did not necessarily demonstrate stewardship in this way, and failed to reduce their take in response to periods of declining stock abundance. There was often continued pressure from industry to maintain the highest possible quota, so that setting a "profit-maximising and conservative total allowable catch" did not always occur in quota-managed fisheries.

"Many people believe that providing quota owners with an economic incentive to set conservative catches means economic targets will be easy to achieve. But in practice, many of the fisheries [studied] failed to target higher economic yield despite being managed under quota," he said. Rafael León said several factors explained this behaviour, the most pervasive being a poor understanding of the rationale of individual transferable quota systems.

"More needs to be done to increase economic yield beyond just providing quota ownership, for example using bio-economic analyses and economic targets." This could mean setting a catch rate that correlates with maximum economic yield as the target catch rate for the fishery.

Adding to Rafael León's presentation, Caleb Gardner said, legally, quota owners hold usage rights, not property rights. "Unlike farming, the oceans are a community resource and the legislation is clear, across jurisdictions, that the government's role is more than just sustainability. In some cases this is explicit," he told the workshop.

He said it had often been difficult for fisheries managers to argue with industry to increase long-term profitability – as opposed to maintaining biological sustainability. There were often conflicting views between fisheries managers and industry on issues such as setting total catch or size limits. In the past, this has meant that managers might not challenge industry in this arena, which had resulted in missed opportunities for the wider community.

Trade-offs

Caleb Gardner said it was difficult for fisheries managers to move from the traditional 'government manages sustainability' perspective to 'government manages benefit' approach.





“We have to ask what economic benefits we want from the fishery and whether this is about maximising economic benefit across all [sectors] or whether that conflicts with sustainability benefits. We have to confront the issue of winners, losers and trade-offs. Being clear about who we want to benefit is important for selecting performance indicators and targets for the fishery.”

He said that to manage stocks for the benefit of consumers suggested targeting maximum sustainable yield and food production (more fish and cheaper prices).

Managing for recreational fishers suggested a target to maximise recreational use and access. Managing for community benefit suggested a target of high gross state product and royalties or regional employment. Managing for the benefit of quota owners suggested targeting maximum economic yield (more profit from highly efficient fishing).

Emily Ogier, a fisheries social sciences researcher at IMAS, also reported at the workshop on her research into public policy drivers and how public values influence management objectives for marine resources.

She said economic approaches and theory could help to allocate access between commercial, recreational and conservational uses. They could make the trade-offs between sectors clear, as well as measuring the success (or otherwise) of the management objectives and the trade-offs.

Optimising economic benefits to the broader Australian community was a widely held objective for most Australian fisheries, and this required management for a broad set of economic interests including, but not limited to, the viability of the commercial seafood industry.

“Other economic objectives include maximising the use and benefits from the fishery, encompassing recreational and Indigenous fisheries,” Emily Ogier said. The links between legislation, policy and management decisions needed to be clearer and more explicit, and bio-economic analysis and targets could help with this, she said.

Harvest strategies

The workshop also discussed the development of harvest strategies, which most Australian fisheries are now using. In its simplest form, a harvest strategy provides a framework to ensure that fishery managers, fishers and key stakeholders agree on how they will respond to various fishery conditions, both good and bad, before those conditions occur.

New *National Guidelines to Develop Fishery Harvest Strategies*, released in 2014 and backed by the FRDC, have set a clear direction and a consistent, more harmonised approach to harvest strategy development that can be applied across all fisheries management jurisdictions.

Caleb Gardner helped to develop the guidelines and told the workshop that harvest strategies would substantially increase the number of specific targets managers set for their fisheries management, including economic targets, which typically include objectives such as increasing maximum economic yield.

The new guidelines are voluntary, but are supported by the Australian Fisheries Management Forum as a best-practice approach to fisheries management decision-making. The guidelines provide increased certainty and transparency in harvest strategies. This, in turn, is expected to foster trust between stakeholders, allowing fishery managers and fishers to operate with greater confidence, and support more objective, efficient and proactive decision-making. **F**

National Guidelines to Develop Fishery Harvest Strategies is available at: www.frdc.com.au

RECREATIONAL TRADE-OFFS

The former chief economist for the New Zealand Ministry of Fisheries, Ralph Townsend, was among the presenters at the recent bio-economics workshop held in Queenscliff, Victoria. He spoke about New Zealand's experiences with recreational and commercial fishing resources sharing.

Bio-economics is not only useful for management of commercial fisheries but can also help decision-making involving trade-offs between recreational and commercial fisheries, and cultural, ecological and environmental interests.

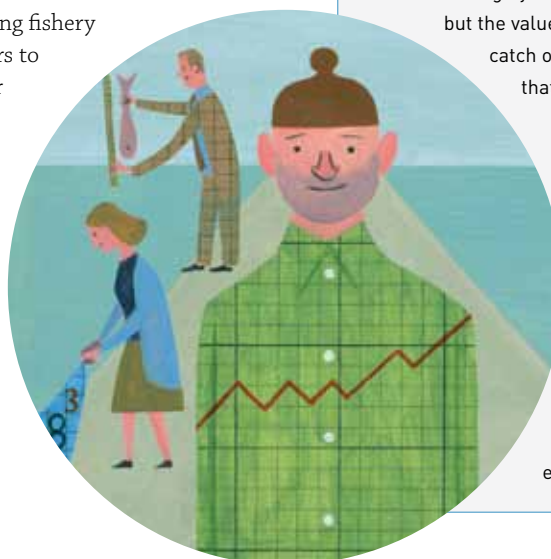
Now Dean of the College of Liberal Arts of Winona State University in the US, Ralph Townsend said economics had successfully established trade-offs in New Zealand's fisheries, such as between different species in a multi-species commercial fishery and also with recreational fisheries.

Caleb Gardner, from the Institute for Marine and Antarctic Studies at the University of Tasmania, said the same approach could be applied in Australia. “By using economic data to measure the value of fish caught for the commercial sector and using tools to put a dollar value on enjoyment, fisheries managers can compare recreational with commercial values,” he said.

He said contingent valuation methods had been easily incorporated into existing recreational surveys, asking recreational fishers how much they were prepared to pay for an extra day fishing then equating that with other recreational activities.

“Recreational fishers typically rate their first catch more highly than commercial fishers do, but the value they attach to the last catch of the day is much lower than that of commercial fishers.

“We can use that information to set bag limits that maximise the enjoyment rather than the profit of the recreational fishery,” he said. “Objectives for the recreational and commercial fisheries are different but both can be examined economically.”



Fish breathe easy en route

TECHNOLOGY & INNOVATION

By transforming plastic bags and polystyrene into continuously oxygenated bulk-transport containers Australian engineering is revolutionising the transport of live fish

By Louis White

Transporting live fish across Australia and the world has never been an easy task, but Australian innovation is now transforming the live fish trade. Traditionally, fingerlings and fish have been kept alive by packing them in water-filled plastic bags, placed into polystyrene boxes for transport.

The longer the journey, the more water is required to provide enough dissolved oxygen gas for the fish for the duration of the trip. For longer trips, including international flights, this can involve transporting more water than fish.

In the late 1990s, Melbourne-based engineer John Curtain re-imagined this process: What if you could continuously add oxygen gas to the water throughout the journey?

Today he is managing director of FishPac, which provides the world's only approved live seafood system that uses added oxygen gas to sustain the seafood being transported by both land and air. The system will keep up to 500 kilograms of fish alive for 25 hours or more.

The FishPac StacPac system uses cylinders of up to 4100 litres of pressurised oxygen gas. Given the sensitivities of aircraft operators and pressurised gas, gaining air freight approval from the Civil Aviation Safety Authority (CASA) and the International Air Transport Authority has been a major achievement and has taken many years of close consultation, testing and review.

In the FishPac system, the oxygen gas flows through a purpose-designed, patented and approved regulator at approximately three litres per minute into a StacPac bin, which looks like a large blue plastic spa.

FishPac general manager Gavin Hodgins says the system was adopted very quickly for Coral Trout and grouper from Cairns



PHOTOS: FISHPAC

(Above) large numbers of fish can be moved in a single container, which uses a constant flow of pressurised oxygen to the keep them alive and healthy during the trip. (Left) juvenile Greenlip Abalone from Western Australia packed for transport.

and Brisbane, with the first commercial shipments starting in mid-2000.

"Since that time, FishPac has had an exceptional success rate without a single mechanical failure and constant delivery of grouper to Hong Kong and Los Angeles with a zero to one per cent mortality," Gavin Hodgins says.

The FishPac containers are continuously re-used, unlike the polystyrene boxes commonly used for live fish transport, which are easily damaged and often leak. Polystyrene can be difficult to dispose of and if the foam is burnt releases toxic fumes.

Max Cullen of Queensland-based fish and seafood exporter Omni Export says that the FishPac StacPac system is a boon for aquaculture. "Not only does it deliver better quality and healthier fish but using the new system also reduces manpower.

"I think the fish mortality rate was as high as 10 per cent before the StacPac system was introduced."

The FishPac oxygen system is approved for carriage by civil aviation authorities in Australia, the US, Canada, Singapore, China (including Hong Kong), Belgium, New Zealand, France, Malaysia, Taiwan, the Philippines, Iceland and Japan, with further approvals pending.

CASA assisted with the product development to facilitate Australia's aquaculture trade. CASA approval is required for the carriage and consignment of operational oxygenation systems for transporting live aquatic animals and this involves a series of tests including a stack test, tilt test, drop test, temperature test, and oxygen quantity and flow tests.

CASA was successful in having the International Civil Aviation Organization Technical Instructions for the Safe Transport of Dangerous Goods by Air amended in 1999 for a rule change to allow the air transportation of live aquatic animals using compressed oxygen gas. This has allowed the legal transport of oxygenation systems such as the FishPac system.

Gavin Hodgins says FishPac offers substantial benefits for live fish freight. "Not only are we providing a better-quality product at the port of destination, which results in happier customers, we have increased payloads versus old systems by more than 35 per cent on average, while reducing mortality and wastage." **F**



Health study assesses stress factors

HEALTH AND SAFETY

Fishers identify stress as the greatest workplace issue facing their industry

By Tanya King, Sue Kilpatrick and Karen Willis

Researcher: “*What are the biggest issues facing the fishing industry at the moment?*”

Fishers: “*Stress.*”

There are some stress factors that fishers can address and some they cannot. Recognising the difference allows them and their supporting organisations to focus on preventing and treating the associated physical and mental-health issues.

A recent project funded by the FRDC found that one of the key health and wellbeing challenges facing fishers relates to poor mental health. This includes feelings of stress, anxiety and hopelessness, sleeplessness, domestic unrest, substance overuse and abuse, anger, shaking,

hair loss and discolouration and, in the worst cases reported, suicide or attempted suicide.

In addition to mental health concerns, the project, *Staying Healthy: Industry organisations’ influence on behaviours and services used by fishers*, also identified a range of health issues of particular concern to the commercial fishing sector including skin disease, wear and tear on joints, and diet.

The project investigated the role of industry organisations in combating these problems. Given the gravity of mental health issues reported by fishers and their families, researchers involved in this project are now developing partnerships and exploring strategies to address the symptoms, causes and treatment of poor mental health in the fishing industry.

Researchers from Deakin University, the University of Tasmania and the University of Sydney collaborated on the project. Three case-study sites were selected on the basis of local interest and the capacity of on-the-ground liaison assistants to organise fishers for interviews and group discussions.

Thirty-four fishers participated from across the three locations. These included commercial fishing owners, skippers, deckhands and family members.

Other participants included two fishing industry association representatives, two healthcare providers, one industry office bearer and one local government representative.

An invisible workforce

Fishing industry organisations have limited influence on the health and wellbeing behaviours and health service use of fishers. While some organisations are proactive, the majority of efforts identified in this study were ‘ad hoc’ and initiated by individual, influential women in the local fishing community.

Some skippers reported being proactive in addressing the causes and treatment of physical injury to themselves and their crew. This health behaviour was the result of health messages such as the ‘Slip! Slop! Slap!’ skin-cancer-prevention campaign, or the general awareness of correct lifting to prevent back injuries. Fishers as a collective tend to be ‘invisible’ to local healthcare

TRADITIONAL RISKS:
the dangerous nature of fishing, fluctuating market prices, peaks and troughs in catches, and machinery break-downs.

MODERN UNCERTAINTIES:
ongoing occupational and livelihood uncertainty resulting from insecure licensing and management arrangements.

PHOTO: 123RF.COM

include the dangers associated with fishing, fluctuating market prices, peaks and troughs in catches, and machinery break-downs.

Fishers are able to exert a degree of control over this first set of stressors. Industry organisations can also suggest, model or facilitate best-practice strategies based on evidence and industrial experience.

Modern uncertainties

A very different set of stressors is labelled 'modern uncertainties'. These emerge from the tenuous nature of the licences fishers hold to harvest a common-property resource and the ongoing occupational and livelihood uncertainty resulting from insecure licensing and management arrangements.

Research into other industries tells us that uncertainty in relation to future capacity to work and make a living contributes to poor health outcomes, both physical and, particularly, mental. It is important to distinguish between the stress of actual job loss and the constant perceived threat of redundancy, such as that experienced by the fishers in this study.

There are no support strategies to help those who are still employed; the potential for individuals to take positive self-help steps is limited because there is no concrete problem to remedy, just the perpetual stress of impending livelihood collapse.

According to the 2003 World Health Organization report *Social dimension of health: the solid facts*:

The health effects start when people first feel their jobs are threatened, even before they actually become unemployed. This shows that anxiety about insecurity is also detrimental to health. Job insecurity has been shown to increase effects on mental health (particularly anxiety and depression), self-reported ill health, heart disease and risk factors for heart disease. Because very unsatisfactory or insecure jobs can be as harmful as unemployment, merely having a job will not always protect physical and mental health: job quality is also important.

An earlier report, *Chronic job insecurity among automobile workers*, showed that chronic job insecurity had a more detrimental effect on the health and wellbeing of workers than isolated cases of high stress, both in terms of the intensity and persistence of physical and mental problems.

"Job insecurity acts as a potent chronic stressor and should be included in studies of

occupational stress, particularly in industries where employment opportunities are declining."

The extensive literature on the poor mental-health outcomes for those experiencing chronic job insecurity is relevant to the study of health and wellbeing in the Australian fishing industry as fishers are subject to chronic insecurity in their access rights due to the public nature of the resource they harvest.

Drivers versus symptoms

Research also identified the importance of distinguishing between the drivers and the symptoms of poor mental health. Fishers and their organisations can potentially treat the symptoms of poor mental health derived from both traditional and modern uncertainties, although there is greater capacity to address the actual causes of traditional stresses. Fishers have only a limited capacity to address the actual causes of 'modern' stresses.

The distinction between drivers of stress and symptoms is important. Acknowledging that some things are controllable (response to symptoms) while others are not (perpetual access insecurity), gives fishers a realistic focus for their efforts to combat poor mental health.

Discussion of the associated health issues focuses almost exclusively on the cause – the insecure management and licensing arrangements themselves – rather than on efforts to address the acute symptoms and signs of poor mental health.

What can fishers do?

Fishers and their families can take steps to look after themselves and each other by collectively acknowledging the impact of stress and anxiety on their lives.

Continuing to focus on 'modern uncertainties' – stressors that lie beyond their control – may add to feelings of hopelessness and lack of self-determination.

Likewise, there is a role for fisher organisations to expand their responses beyond the causes of occupational uncertainty (such as combating insecure licence and harvest arrangements) and develop strategies and programs that recognise and address the ongoing stress faced by industry members. **F**

If you, or anyone you know, is experiencing signs of stress, or if you just need to talk, please contact Lifeline on 13 11 14.

providers and tend to present to health services only when their work schedules allow. Where service providers are aware of access issues and the need for targeted programs they are, in the main, not resourced to provide these.

It is for this reason that the provision of 'soft entry points' for fisher health services is vital to improving the health and wellbeing of fishers. Soft entry points occur when services enter existing gathering places or everyday environments where people live and work to provide health information or services, for example, providing health information in fishing publications and at industry events. This study found that there is a lack of soft entry points available for fishers to access health services.

The most significant challenge to achieving good health in the fishing industry is related to mental-health issues, including work-related stress.

Traditional fishing risks

The first kind of stressors fishers face as part of their job are the 'traditional risks'. These

A common future for food security



PHOTO: WAYNE DREDGE

Dalian seafood market, northern China.

PEOPLE DEVELOPMENT

The role of fishing in global food security – often overlooked in Australia – was one of the ‘big picture’ issues to emerge from Wayne Dredge’s 2014 Nuffield Scholarship international study program

By Wayne Dredge

When I applied for a Nuffield Scholarship in 2013 it was an opportunity to study different fishing practices being used

overseas in the hope of identifying some that could provide benefits for my business and the Australian industry. However, the experience has far exceeded my expectations.

Throughout the course of the scholarship I have been able to meet some of the world’s most respected marine and fisheries scientists, leaders in fishery management practices, fishers from more than 20 different countries, policymakers from Brussels to Washington, DC, and several of the world’s most successful seafood-based businesses.

I have travelled to more than 100 different fishing ports talking with hundreds of fishers from

varying scales of production, cultures, backgrounds and fishery sectors. I have been fortunate enough to go to sea on vessels that ranged from a simple Arab Dhow still using a single lateen sail off the Kenyan coast, to ships using some of the most advanced technology available globally.

Most recently, through an additional Nuffield program, I was able to join an agribusiness tour through China to gain a true understanding of exactly what 1.4 billion people looks like and what it takes to feed them.

Chinese capacity

In China’s far-northern port city of Dalian I stood in a freezer cold store that housed 3000 tonnes of capture-fishery products in one room. The facility had 11 other similar cold stores – a total capacity of 36,000 tonnes. There were another five facilities in Dalian, each of which could hold the same volume. This one Chinese city could store 216,000 tonnes of fish at any given time.

By comparison, the entire combined production of Australian seafood nationally (capture and farmed) is about 233,119 tonnes – only marginally more than the storage capacity at Dalian.

In Australia, it can be easy to overlook just how important fish and fishers are to global food production and global food security, given our relatively low seafood production volumes.

Globally, food production industries from dairy and livestock production, to rice farming, cropping and tea plantations are facing significant problems due to the ageing demographic of food producers. In China we visited valleys with thousands of years of rice farming history that were now being tended to mostly by people in their 50s and 60s. One could not help but wonder whether we were witnessing one of the last generations of family food production in those regions.

In Australia’s capture fisheries the average age of fishing vessels is now well past 30 years and the average age of those operating them is nearing 60 years. In this context, the steady reduction of fishing capacity and skills in Australian capture fisheries, not from an environmental sustainability point of view but from an industry perspective, will be very difficult to remedy.

Food demand

According to the United Nations Food and Agriculture Organization (FAO), seafood accounts for about 31 per cent of all animal meat protein supply. Given that supply is split roughly 50/50 between capture and farmed products

our global capture fisheries provide about 15 per cent of the world's animal protein needs.

Considering there are already 800 million people who lack sufficient protein to maintain basic human health and that the FAO estimates our global human population will continue to rise to 9.5 billion people over the next 30 to 40 years, countries with fisheries as sustainable as Australia's should be looked to as part of the solution to this problem.

Through all the research I have done during the course of my scholarship, I believe that Australian fishers are among the most technologically advanced, innovative and environmentally conscious of any in the world.

We can only continue to hold this position and make a significant contribution to global food solutions through greater collaboration among fishers, greater willingness to adopt new and innovative technologies and greater accountability to our consumers. We need more engagement with management, more transparency of our industry and a vision to look towards the future rather than the past.

As an Australian capture fisher, it is highly unlikely that I will ever personally solve any of the numerous problems that the world faces. However, the exposure that a Nuffield Scholarship gives to selected people means that they get to meet and discuss the big-picture issues, concepts and ideas with the very people who are solving the problems of the world.

As a result of the program I have dramatically changed the management approach towards my own business. I have invested in new technologies to further improve economic efficiency and have recognised the need for professional and personal development training to build the capacity within my staff.

In meeting with vessel and equipment manufacturers, I witnessed what I believe to be the infancy of next-generation trawl technologies that use electricity to decrease benthic disturbance and increase fuel efficiency. This technology has doubled catch-per-unit effort in Belgium.

While in Norway, I discussed automated and semi-automated longline fishing technologies that can increase selectivity, decrease environmental impact and provide alternative harvest options for Australian producers. In every country I visited, I witnessed how Australian fisheries could benefit from a significantly expanded trap-fishing sector.

At present there are many hurdles to overcome in implementing industry innovation

PHOTO: WAYNE DREDGE



PHOTO: WAYNE DREDGE



A 3000-tonne cold store in Dalian, northern China.

on both an operational and management level. I hope the experience I have gained through the scholarship may help provide some positive input for Australian commercial fishing when working through these problems.

Nuffield commitment

Undertaking a Nuffield Scholarship program is a serious commitment. It involves an extensive period of time away from work, businesses, family and friends. However, the knowledge imparted, the truly global perspective gained and the international contacts made make it a

NUFFIELD APPLICATIONS OPEN

Applications for 2016 Nuffield Scholarships are now open and close on 30 June 2015. The scholarship provides \$30,000 towards a 16-week international study program, to be completed over two years. This includes a six to seven-week international group tour, with the remaining time for an individual study. The program enables scholars to travel to countries of their choice.

great personal and professional investment. The diversity of perspectives that a Nuffield Scholarship offers is one of the most valuable aspects of the program. I never imagined I could have learnt so much that was relevant to commercial capture fisheries through conversations with livestock producers, sugarcane growers, dairy consultants, agronomists or dry-land croppers, to name a few.

Each industry has its own grounding principles in economics: environmental sustainability, social awareness, consumer engagement and possibilities for the future. Once shared, the principles become beneficial to all sectors. It has been a life-changing experience for me, and I am indebted to the many people who have been part of this remarkable opportunity. **F**



Sharing different net-making practices on the northern Kenyan coast.

WAYNE DREDGE

Wayne Dredge is the owner and operator of a commercial fishing business active in the Tasmanian and Victorian Southern Rocklobster sectors and the Southern and Eastern Scalefish and Shark Fishery (SESSF). His scholarship was sponsored by the FRDC and Woolworths.

Before entering the rocklobster industry he had 10 years of experience in the south-east trawl sector. In 2014 he was awarded an Australian Nuffield Scholarship to study different fishing methods of potential benefit to the SESSF.

Human factors top fisheries' risk list

PROFILE

Rapidly changing cultural values have emerged as a high risk for the future of the fishing industry, not so much for the fish, says Western Australia's Rick Fletcher

By Catherine Norwood

Fisheries management is not as much about fish as it is about people, says Rick Fletcher, research leader for the Western Australian Department of Fisheries. And while good data supports better decisions, it is the governance systems – managing the way people behave – that make or break the sustainability of a fishery.

Governance has been an ongoing theme in Rick Fletcher's career, from his first project assessing coconut crab stocks in Vanuatu, to recent risk-management workshops in developing countries as part of his work with the United Nations Food and Agriculture Organization (FAO).

Risk management is an approach he helped to pioneer in fisheries management in the early 2000s, following the introduction of Australia's landmark *Environment Protection and Biodiversity Conservation Act 1999*.

"The government signed off on the Act, and we had to come up with a practical way to implement it. That's when we first started working with risk-assessment techniques, as a way to implement 'ecologically sustainable development'," he says.

"It represented a significantly different approach to fisheries management – looking at all the things that might be directly or indirectly affected by a fishery, not just the target species. And then assessing whether those impacts were likely to be acceptable or unacceptable."

As leader of the FRDC's ecologically sustainable development research subprogram for more than a decade, Rick Fletcher has helped to embed these principles into fisheries research.

What risk is that?

Initially most of the risks are related to

environmental and biological factors, such as the effect of different fishing methods on habitats or the impact on bycatch species from specific fisheries. Rick Fletcher says when a risk has an ecological basis it is possible to come up with reasonably consistent views or standards of acceptable impact that are based on the inherent vulnerability of the stock or habitat and the management controls being applied.

"Prawns, for instance, are highly fecund, broadcast spawners whose population rebuilds annually. From a biological risk perspective, you can harvest a relatively high percentage of the spawning stock each year and this could still be considered acceptable," he says. "But to harvest the same high percentage of a long-lived species that produces only a few offspring each year would generate an unacceptably high risk to the species."

However, risk-management decisions now take greater account of social and cultural values, and these sometimes change more rapidly than the fishing industry can respond.

"In Western Australia, whales occasionally get entangled in lobster pot ropes," Rick Fletcher says. "From an ecological perspective, this has a negligible impact on whale stocks. But, from a public perception standpoint, it is a major issue. For some people, even the capture of a single whale is unacceptable."

"Therefore, what we are often dealing with now are moral or social objectives, not just environmental or biological objectives. And this is harder, because there are no absolutes; values can change."

"What was acceptable 20 years ago from a social perspective is not acceptable any more, and that is hard for industry to effectively deal with, because there is often no biological-science-based solution."

Make a start

He says this is also why an ecosystem-based approach to fisheries management that explicitly takes human considerations into account when assessing risks is so crucial.

Working with the FAO, he has helped to develop a web-based toolkit that any fisheries manager can use to assist in the implementation of an ecosystem-based approach in any situation – from a two-person fishery on a remote island, to the largest fishery in the world.

He says when it comes to assessing risks and setting priorities, it does not matter whether that just involves shuffling sticky notes around on a wall or using complex modelling. The important thing is to start, and not to wait for 'more data' before beginning the process.

"In most cases you know when there's a problem in a fishery," he says. "More data may tell you more precisely how much of a problem you have, but this alone won't help you fix it."

"The ecosystem-based approach tries to identify the real risks. In most cases when I've done workshops in developing countries, the highest risks they identify are in the governance area. Not the lack of information or risks to the environment; it mostly comes from their lack of systems and capacity to manage effectively."

This latest work with developing nations brings his career almost full circle. His first position after completing his PhD was with the Australian Centre for International Agricultural Research (ACIAR) on the remote islands of northern Vanuatu.

Counting coconut crabs

The initial focus of the ACIAR project was to assess stocks of coconut crabs, with the aim of designing a management strategy to ensure their sustainable harvest. In the Pacific, Vanuatu was one of the few places where there were significant populations of reasonable-sized crabs. In most other places they had already been fished to low levels.

In the 1980s, coconut crabs were one of the few cash crops available in the more remote regions of Vanuatu. These large nocturnal land crabs can grow up to five kilograms and crack open coconuts with their claws and were considered a unique culinary delicacy at restaurants in Port Vila.



Rick Fletcher: helping new research staff to develop their own scientific skills, and especially their ability to translate research results into sound advice for management, is very satisfying.

Ecologically Sustainable Development (ESD) includes ecological, economic, social and governance components, and expands fisheries reporting beyond the traditional focus on specific species fished. ESD is now accepted as the foundation for natural resource management in Australia.

More information: www.fisheries-esd.com

Originally from Melbourne, Rick Fletcher completed his Bachelor of Science at the University of Melbourne. As a keen diver he was initially drawn to underwater research. But after diving three days a week in Port Phillip Bay during winter as part of his honours research project, in water of 10°C, diving lost its appeal.

Research legacy

At the University of Sydney he studied the impact of sea urchins on sub-tidal algal and limpet communities in New South Wales for his PhD thesis supervised by Tony Underwood, who has had a lasting influence. “He was a pioneering marine ecologist who introduced proper experimental design to Australian marine science, which is a major legacy,” Rick Fletcher says.

It is from this perspective that he sees ensuring scientific objectivity as one of the greatest challenges for the future of fisheries, and for science generally. “We need to reverse the apparent trend for science to be more focused on proving hypotheses rather than testing them. Science only advances by being sceptical, not by being an advocate.”

After the ACIAR project he joined the Western Australian Department of Fisheries for the first time. Using innovative egg-based methods, he established the levels of biomass for pelagic fish stocks such as sardines and whitebait across the south-west regions of WA. In 1996 he moved to the NSW Department of Primary Industries as director of fisheries research.

“This gave me an opportunity to work on a larger number of issues and to assist in developing department-wide initiatives rather than just focusing on one particular science area,” he says. “I like to work with others to establish practical systems that can then be ‘handed over’ for implementation. Helping new research staff to

develop their own scientific skills, and especially their ability to translate research results into sound advice for management, is very satisfying.”

After five years in NSW he returned to WA, first in a policy role and, in 2005, as director of fisheries research. He also continues to lead the refinement of risk assessment and ecosystem-based management strategies.

“In WA we not only undertake assessments of individual fisheries but we now look collectively at the overall impact of all fishing within each of our ‘bioregions’. We use the regional-level ecological, social and economic risks associated with the 80 ‘ecological assets’ identified across WA’s 13,000-kilometre coastline as the basis for determining departmental priorities.”

Public perceptions

Rick Fletcher says managing public perceptions will be a major ongoing challenge for the fishing industry and the government in general.

“There is a rising, but ultimately unrealistic, expectation in the community that all activities, and especially those like fishing, should generate no impacts. I think this is coming from the increasing disconnect for most of the population with how activities such as fishing and food production in general actually work.

“This is combined with the media’s prevalence to sensationalise and generalise specific extreme events and infer they are widespread. So with only reports of the fisheries that have collapsed around the world, the public assumes this is happening, or will happen, in Australia.

“The scare tactics often used in access allocation debates between fishing and other non-fishing sectors, but also between different fishing sectors, are also part of the problem. It is much easier to sell a fear to the public than to sell an assurance.”

It is these issues Rick Fletcher highlights as high priorities to deal with for the future – they have nothing directly to do with the fish or the biological sustainability of fisheries. They’re all about the way people behave. **F**

Rick Fletcher says the challenges included learning to speak *Bislama* (pidgin English) to communicate, hard physical work (often at night) and irregular transport to the remote field locations, which sometimes led to limited access to food and water. He had to learn how different cultures affected decision-making, and how to work with the local people to come up with practical management systems.

“Every village has a chief, and you have to get permission from the chief, and also from the people on whose land you were going to sample the crabs.

“The advantage was that because there are multiple small islands, and each island has its own governance structure you could deal with each one independently. But, if the chief didn’t agree, it didn’t happen.”

By determining the growth rate of the crabs and developing simple techniques to evaluate local crab populations, he was able to come up with effective management regimes that still operate in some of the northern islands.

DERMERSAL IMPACT ON HABITAT**2006/042**

Australia uses bottom-fishing methods, including demersal trawls and longlines, to target Patagonian Toothfish and mackerel icefish at Heard Island and the McDonald Islands (HIMI). These methods have the potential to impact upon benthic habitats, but a lack of information has hampered understanding about the scale of disturbance in the deep Southern Ocean.

The project developed tools to allow such an assessment of effects, with a focus on the fishery that has operated since 1997 targeting Patagonian Toothfish and mackerel icefish in the exclusive economic zone (EEZ) around HIMI.

This project used novel methodology including the development of cameras attached to demersal longlines and trawls. The assessment indicates that the majority of vulnerable organisms live on the sea floor at depths of less than 1200 metres. This range overlaps with the depths targeted by the trawl fishery and, to a lesser extent, by the longline fishery. However, the majority of trawling has focused on a few relatively small fishing grounds. It is estimated that less than 1.5 per cent of all the biomass in waters less than 1200 metres has been damaged or destroyed.

The HIMI Marine Reserve, established in 2003, is estimated to contain more than 40 per cent of the biomass of the groups of benthic organisms considered most vulnerable to bottom fishing at HIMI. Overall, an estimated 0.7 per cent of the sea floor area within the EEZ at HIMI has had some level of interaction with bottom fishing gear between 1997 and 2013.

MORE INFORMATION: Andrew Constable, Australian Antarctic Division, 03 6232 3209

OPTIONS TO PREVENT SEA URCHIN BARRENS**2007/045**

This project attempted to identify cost-effective options to minimise the impact of the long-spined sea urchin (*Centrostephanus rodgersii*) in Tasmania, either through the prevention of formation of further barrens or the rehabilitation of areas of existing *C. rodgersii* barrens.

As a result of this study, stakeholders have recognised that a multifaceted approach to managing the threat of establishment of *C. rodgersii* in Tasmania is warranted. This includes rebuilding biomass of legal-sized rock lobsters, facilitating the *C. rodgersii* harvesting industry, permitting and encouraging abalone divers to cull urchins while fishing (particularly in high-yield areas), and examining other means of reducing *C. rodgersii* densities.

Loss of productive reef from overgrazing by *C. rodgersii* has direct implications for Tasmanian fisheries, including the two most valuable – abalone and rock lobster.

Largely (but not wholly) as a result of the findings of this study, the Tasmanian Minister for Primary Industries and Water announced in August 2013 support for a 10-year strategy to rebuild rock lobster stocks in eastern Tasmania by introducing spatial management of the rock lobster fishery, and limiting the total allowable catch of the commercial sector in eastern Tasmania. Recovery of rock lobster biomass is likely to both improve the economic efficiency of the fishery and reduce the likelihood of significant ongoing *C. rodgersii* barren formation.

MORE INFORMATION: Craig Johnson, University of Tasmania, 03 6226 2582

CLEAN GREEN FOR QUEENSLAND PRAWNS**2008/205**

Fishers in the Queensland East Coast Otter Trawl Fishery will adapt the Tasmanian Clean Green Southern Rocklobster™ program to differentiate their wild prawns from cheaper farmed imports to offer a guarantee of a sustainable, high-quality wild product.

An eight-year program for the development and implementation of Clean Green Queensland wild prawns is expected to allow fishers, processors and distributors to align their quality and branding efforts to increase prices for their product.

With comparatively low volumes of potentially high-quality Eastern King Prawns and Tiger Prawns, Queensland wild-caught prawns present an opportunity for premium niche marketing. The Clean Green program incorporates auditable attributes of sustainability, environmental management, product quality, food safety, workplace safety and animal welfare.

A gap analysis comparing the Tasmania program with current Queensland operations revealed that product attributes of sustainability, environmental management, product quality, food safety and workplace safety could all be supported by workplace standards capturing existing best practice in the fishery. A business plan and implementation strategy, based on a premium of between \$3 and \$10 per kilogram, demonstrated positive returns and substantially increased profits to Queensland fishers.

An essential component of the product differentiation, brand development and supply-chain management strategy is an ongoing integrated marketing program to build brand awareness, demand and price. This program would be financially supported by industry.

MORE INFORMATION: Martin Hicks, Queensland Seafood Industry Association, 07 3262 6855

IMPACT OF WESTERN ROCK LOBSTER FISHING**2008/013**

This project, in consultation with an industry working group, has been instrumental in establishing a closed area in the Western Rock Lobster Fishery to assess the potential ecosystem effects of removing lobster biomass from deep water (40 to 100 metres). The major outcome of this research is an improved understanding of the ecosystem that supports the Western Rock Lobster.

This type of information improves the Department of Fisheries' ability to manage the fishery in an ecosystem-based manner and provide scientifically defensible data to more precisely assess the level of risk the fishery poses to deepwater communities.

In early 2013, data from this project was used to reassess the risk of potential ecosystem effects of fishing on deepwater communities at the ecological risk assessment for the fishery. The increased knowledge gained through this project reduced the risk level from moderate to low for deepwater communities and the continued accreditation of the Western Rock Lobster Managed Fishery by the Marine Stewardship Council.

An additional outcome of this project is the development of appropriate techniques to monitor the structure and function of deepwater ecosystems. It has developed a cost-effective, long-term monitoring program to identify changes in risk to the ecosystem due to the ongoing removal of rock lobster biomass, thereby supporting ongoing third-party certification and the maintenance of Department of Environment certification for the export of rock lobster product.

MORE INFORMATION: Lynda Bellchambers, WA Fisheries and Marine Research Laboratories, 08 9203 0175

CLIMATE IMPACTS ON LARVAL DISPERSAL**2008/314.15**

A travel bursary allowed John Keane to attend the 33rd Annual Larval Fish Conference in Portland, USA, which was held in cooperation with the annual meeting of the American Society of Ichthyologists and Herpetologists. He also met with David Checkley from the Scripps Institute of Oceanography and Tony Koslow from the National Oceanic and Atmospheric Administration to discuss the effect of climate change on small pelagic fish.

At the conference John Keane presented the findings of his research, which suggest water temperature changes may be a barrier to the southward dispersal of larvae of some Australian fish species. His overall findings indicate larval

For a copy of an FRDC project final report go to www.frdc.com.au or contact the FRDC on 02 6285 0400, email frdc@frdc.com.au

distributions are determined by the strength and extent of the East Australian Current, and suggest that variable hydrographic conditions play a key role in defining the timing and location of spawning of these small pelagic taxa.

MORE INFORMATION: John Keane, University of Tasmania, 03 6227 7264

TRAVEL TO INVESTIGATE NETWORKING MODEL 2008/314.41

Through an FRDC 2014 International Travel Bursary, Kate Brooks attended the Canadian Fisheries Research Network (CFRN) workshop to present Australia's activities and developments in the areas of social and economic assessment and integration into ecosystem (fisheries-based management) assessments. She also participated in the development of an international community of practice and review of the CFRN for its applicability to the Australian context. The report describes how the CFRN operates, benefits of the CFRN and challenges to success of the network.

MORE INFORMATION: Kate Brooks, KAL Analysis, 03 9917 2665

VISITING OYSTER EXPERT 2008/328.20

Through an FRDC Visiting Expert Award, Dale Leavitt of Roger Williams University (Bristol, USA) spent two weeks with Australia's oyster industry during July to August 2014, hosted by the Select Oyster Company. During his visit, Dale Leavitt addressed several topics to assist the Australian oyster industry with improving production and long-term sustainability. One topic he focused on was Floating Upweller Systems (FLUPSY), which are a proven technology that provide farmers overseas with the infrastructure required to grow delicate nursery-stage oyster seed at a significantly faster rate than sock/tray or land-based nursery methods.

He presented eight farmer workshops and one keynote address and toured 15 oyster farm locations, including regions in New South Wales, South Australia and Tasmania. Dale Leavitt also met with industry members, university groups and government representatives on a one-to-one basis for direct discussion and consultation.

All information provided by Dale Leavitt throughout his workshops has been made available to the industry so that it can be implemented and adopted. Within three months of his visit, several growers have started the planning and/or construction of FLUPSY systems and observed positive results for their oyster stocks.

MORE INFORMATION: Dale Leavitt, Roger Williams University, dleavitt@rwu.edu

ROLE OF SOCIAL SCIENCES 2009/041

From February 2009 to January 2012 the Social Sciences Research Coordination Program (SSRCP) generally succeeded in both establishing itself and in providing what is largely perceived as an enhancement to the services that the FRDC provides to the fishing industry and its management and, by extension, the general public.

This phase of the SSRCP involved setting up, generating awareness in the industry and research communities, and increasing education in the industry of what social science research is and how it can be used. This has been assisted by the production of both the Social Science Research (SSR) Audit (2009/317) and the *Social Science Research for our Natural Resources* brochure and booklet. Further to this, the SSRCP assisted in identifying the research needs of various stakeholders and provided guidance on expressions of interest and tactical research funding proposals.

The key challenges faced by the SSRCP were those of engaging the industry in what social science research is and is not (it is not a marketing activity to promote the industry), and to broaden the scope of industry thinking of research beyond the biophysical or purely economic.

The SSRCP has achieved a relatively high level of awareness of the availability of social science research from its starting position, and has facilitated the development

of tools (the SSR Audit) that, with use, will assist in both leveraging research effort and in maximising the return on research investment. The SSRCP has achieved an overall aim of increasing awareness and appreciation for social science research and the importance of its role in the mix of research required to facilitate the industry's ongoing development.

MORE INFORMATION: Kate Brooks, KAL Analysis, 03 9917 2665

CHARACTERISATION OF ABALONE INFECTIONS 2009/032

This project was a major collaboration to investigate various aspects of the biology, detection and identification of abalone herpesvirus (AbHV), the causative agent of abalone viral ganglioneuritis.

Collaborators included scientists at CSIRO's Australian Animal Health Laboratory, the Victorian Department of Environment and Primary Industries, the South Australian Research and Development Institute, the Tasmanian Department of Primary Industries, Parks, Water and Environment, and the University of Adelaide.

Aspects under investigation included determining the stability of the virus under various physico-chemical conditions, providing new information on the diagnostic tests for the detection and identification of the virus including subclinical infections, and determining the susceptibility of various abalone and other molluscan species to infection and disease.

Much of the work built on research undertaken by previous FRDC-funded projects and involved using diagnostic tests and the in vivo infectivity model developed previously. All in vivo research was undertaken at the CSIRO Australian Animal Health Laboratory, a high-level biosecurity laboratory located in Geelong, Victoria.

It validated an in-situ hybridisation diagnostic test, which was made available to diagnostic laboratories in Australia and overseas.

The sensitivity of the virus to various physico-chemical conditions, including its stability in water/on fomites and its sensitivity to inactivation agents, has been determined. While the virus can be present in mucus secreted by infected abalone, mucus does not appear to play a significant role in prolonging viral infectivity in seawater. Available data indicate that AbHV can exist as a subclinical infection and this is supported by investigations into disease events.

In addition, it was shown that remnant populations of wild abalone (in Victoria) previously exposed to AbHV remain susceptible to infection and disease. Unexposed wild populations in SA were also shown to be susceptible to infection and disease.

MORE INFORMATION: Mark Crane, CSIRO, 03 5227 5118

STRATEGIC FISHERIES RESPONSES 2009/074.40

This report summarises work completed as a subproject of the Climate Change Adaptation – Marine Biodiversity and Fisheries Science Program. This program was a joint investment of the FRDC, the then Australian Department of Climate Change and Energy Efficiency, the then Australian Department of Agriculture, Fisheries and Forestry, state government agencies in South Australia, Tasmania, Victoria and New South Wales, CSIRO and several universities.

This subproject was undertaken to conclude activities arising from the completion of the Climate Change Adaptation – Marine Biodiversity and Fisheries Science Program. In particular there was a need to capitalise on the information and knowledge generated from the suite of projects undertaken within the program and to ensure that key findings were communicated. This subproject consolidated the extension of the knowledge generated by the program through activities such as presentations to key forums, the preparation and distribution of fact sheets, and multiple face-to-face discussions with senior policymakers through to various

marine users. This allowed for the wide sharing of the findings of the program and outlined how the various groups might best apply the findings to their specific issues and needs.

Unfortunately, this project of consolidation and extension was undertaken in a period of rapidly changing and diminishing resources for science and innovative policy formation. Nevertheless, the conclusion of the Climate Change Adaptation Program – Marine Biodiversity and Fisheries allows for a concise reflection on the successes and challenges of instituting, delivering, managing and extending a major body of scientific investigation. This report provides several recommendations based on these learnings.

MORE INFORMATION: Colin Creighton, 0418 225 894

MARINE AUSTRALIA: CLIMATE ADAPTATION 2009/074

Australia's oceans generate considerable economic wealth through fisheries, aquaculture, tourism, oil and natural gas, and transport. Marine ecosystems provide irreplaceable services including defence, oxygen production, nutrient recycling and climate regulation. Australia's oceans, their physical characteristics, marine biodiversity and fisheries, are already experiencing and responding to a changing and more variable climate. This flow-on in climate, ecological and economic change is occurring at a far more rapid rate than that occurring terrestrially. Adapting to our changing climate is essential if Australia is to maintain, build upon and profit from the wealth of goods and services provided by our marine environment.

This report summarises the findings of a series of research and development partnerships and a total research, development and extension investment of more than \$9 million from 2010 to 2014. It was led by the FRDC, with Australian and state governments, CSIRO and universities as the lead co-investors.

It identifies key activities underway towards adoption of the findings of the program and provides a climate adaptation checklist. Much of the climate change adaptation science still required to further our knowledge is best undertaken within a total marine systems context. Evaluating science proposals using this checklist will ensure a greater incorporation of climate-related issues within marine biodiversity and fisheries investments.

High-priority areas for additional investment are identified, with priorities for action best undertaken by incorporating climate and climate-related issues within the bigger and more appropriate context of fostering sustainable in-shore and marine systems-based management. Australia as a marine nation has much to do to achieve smarter marine management, to ensure sustainable marine uses and to apply eco-engineering to repair higher levels of productivity and resilience of our in-shore systems. Adapting to a changing climate is part of this broader all-encompassing goal of a more productive and profitable marine Australia.

MORE INFORMATION: Colin Creighton, 0418 225 894

FISHERS' GUIDE TO QUOTA CONTROL 2010/229

The project has produced a simple but comprehensive guide to understanding individual transferable quota (ITQ) management, with information on how fishers can best adjust and adapt their businesses to operate efficiently and profitably. Much of the information was gathered from interviews with operators from fisheries that have moved to ITQs, as well as from operators who are in fisheries moving to ITQ management. One thousand hard copies and 50 CD-ROMs of the guide have been produced.

The guide has been sent to peak industry associations, management agencies, the FRDC and the Empowering Industry RD&E project. A generic PowerPoint presentation has also been produced (available on the CD version of the guide) for use by industry associations and management agencies at meetings to discuss quota

management with operators. The information contained in the guide should reduce some of the initial resistance of small and medium-sized operators that can occur when moving from input controls to quota management.

MORE INFORMATION: Sevaly Sen, 0414 344 593, sevaly.sen@gmail.com

NORTHERN CLIMATE CHANGE IMPLICATIONS 2010/565

This project has provided scenario-driven recommendations of adaptive management approaches that provide for the sustainability of northern Australian fisheries in a changing climate. The final project workshops with stakeholders identified adaptation options based on likely future fishery scenarios. Scenarios were based on the reviews of species biology and ecology, as well as future localised climate projections, and described the likely response of key species to climate change. Adaptation options across all species were grouped as: alteration of fishing operations, management-based options, research and development, and looking for alternatives.

With these options stakeholders also identified the likely barriers and who is responsible for their implementation. Cost was identified as a key barrier to most options, as well as political opposition. The options presented here represent an initial, but important, step towards northern Australian fisheries preparing for climate change.

A key output from the project was the development and application of vulnerability assessments of key fishery species from three key regions of northern Australia. The assessment framework developed is semi-quantitative and draws on the elements of exposure, sensitivity and adaptive capacity. The framework can readily be adopted for similar assessments in other regions and, with modification, could also be adopted in other disciplines. The vulnerability assessments here focused on 2030, a medium-term outlook and one considered to be more relevant to all stakeholders, although an assessment was also carried out based on the A1FI (high) emissions scenario for 2070.

Collectively, the key outputs of this project provide an informed basis for management and industry to assess current fisheries management against likely future scenarios. Management, as well as commercial and recreational fishing interests, were key participants in the project and had direct input into key outcomes.

MORE INFORMATION: David Welch, James Cook University, 0414 897 490

BENCHMARKING FISHERIES REPORTING 2013/233

The aim of this project was to examine how other countries are dealing with fisheries performance reporting, identify what may constitute 'world's best practices' in this area, compare these to the Australian situation, and so identify if and how the Australian process could be improved.

Despite some similarities, this project found that all jurisdictions around the world differ in the actual details of how they go about reporting the status of their fish stocks. In particular, the terminologies, status categories and tools used all vary. There is not, therefore, any single, detailed 'best practice' manual for how to go about jurisdictional reporting on fisheries and fish stocks. Everyone is doing it differently, but for the same reasons and with the same intended outcomes.

A key issue identified during the preparation and review of the recent *Status of Key Australian Fish Stocks Reports* was the lack of a system in Australia for reporting on bycatch or discards. The FRDC extended this project to provide a brief summary of the *US National Bycatch Report* and other overseas bycatch reports and to investigate current and future Food and Agriculture Organization (FAO) initiatives in this area, then to benchmark current Australian bycatch reporting against the above and recommend a clear pathway towards an appropriate national system.

MORE INFORMATION: Steven J. Kennelly, 0418 290 960, steve.kennelly@icic.net.au

Movers and ...



ROB KERIN is the new independent chair of the South Australian Rock Lobster Advisory Council Inc. He began in the role on 1 May 2015, taking over from **CATHERINE BARNETT**, who had been chair for several years.

RENEE BOWLING is the new executive officer for the Australian Fisheries Management Forum.

The new executive officer of the Amateur Fishermen's Association of the Northern Territory is **TRISTAN SLOAN**.

PAUL GRIMES has left the position of secretary of the Australian Department of Agriculture. **PHIL GLYDE** is acting secretary.

The Professional Fishermen's Association of New South Wales has announced that chair **DON JOHNSON** is standing down from the role and **GREG GOLBY**, director from the Wallis Lake region, has been voted in as the new chair. **GLENN DAWSON**, director from the Clarence region, will be vice-chair.

HEATHER BRAYFORD has been appointed the new director-general of the Department of Fisheries, Western Australia.

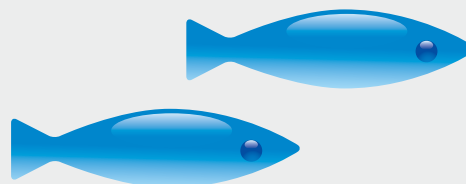
Austral Fisheries' Seafood Trading Division has appointed **MARKUS GERLICH** as general manager.

The new marketing manager for Cleanseas is **MILES TOOMEY**.

LEN STEPHENS is the new chair of industry-owned Pacific Oyster research and breeding company Australian Seafood Industries Pty Ltd (ASI). He has been chair of the Australian Seafood Cooperative Research Centre (Seafood CRC), which closes in June.

GRAHAM MAIR, who has been a program manager at the Seafood CRC, has been appointed to the ASI board. He will also return to his role as a professor at Flinders University when the Seafood CRC closes.

NICK BURROWS, a former chief financial officer of Tassal Ltd and now a corporate governance consultant, is the third new director on the ASI board.



FEEDBACK
FRDC WELCOMES YOUR COMMENTS
frdc@frdc.com.au

MOVERS WE'VE MISSED?
INFO PLEASE TO
Julie Haldane, 02 6285 0415,
julie.haldane@frdc.com.au

Calendar of events

DATE	EVENT	MORE INFORMATION
10 to 11 June	FRDC Board Meeting, Darwin	02 6285 0400
5 to 9 July	Australian Marine Sciences Association 2015 Conference, 'Oceans to Estuaries' Deakin University, Geelong Waterfront Campus, Victoria	amsa@amsa.asn.au www.amsa.asn.au
6 to 11 July	Third Australasian Scientific Conference on Aquatic Animal Health, Pullman Reef Hotel, Cairns	joanne.slater@csiro.au
25 July	2015 Australian Recreational Fishing Conference, Gold Coast Convention and Exhibition Centre, Queensland	www.recreationalfishingconference.com.au
30 to 31 July	Ridley AquaFeed Australian Prawn and Barramundi Farmers Symposium 2015, Sea World Resort, Gold Coast	http://apfa.com.au/events
23 to 26 August	Aquaculture 2015, Le Corum, Montpellier, France	www.aquaculture-conference.com
25 to 26 August	FRDC Board Meeting, Canberra	02 6285 0400
8 to 10 September	Seafood Expo Asia, Hong Kong	www.seafoodexpo.com/asia
11 to 14 October	5th International Symposium on Stock Enhancement and Sea Ranching and 2015 Australian Society for Fish Biology Conference, Aerial Function Centre, University of Technology, Sydney	www.asfb.org.au/events
21 to 23 October	6th International Oyster Symposium, Cape Cod, Massachusetts, USA	www.oystersymposium.org
25 to 27 October	Seafood Directions, Crown Casino, Perth	www.seafooddirections.net.au
17 to 18 November	FRDC Board Meeting, Canberra	02 6285 0400



FRDC

FISHERIES RESEARCH &
DEVELOPMENT CORPORATION



Discover
the latest information
on fish species



Catch of the day

King Prawns

King Prawns are the most popular species of prawn in Australia, due no doubt to their rich flavour and moist flesh. They are extremely versatile and excellent for display purposes. Suggested coatings include batters (regular or tempura) with a touch of saffron.



Recipe of the day

Lime and Lemongrass BBQ Skewered Prawns

The combined flavours of lemongrass, chillies, ginger, sugar and fish sauce will certainly entice you and your guests to more than one of these skewers at your next lunch or dinner event.



Knowing

Trouble deciding on which fish? Look here for some help



Buying

What you need to know about handling and storing seafood



Handling

What you need to know about handling and storing seafood



Cooking

Everything you need to know about seafood

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delicious recipes,
chef tips, events,
fisher profiles
and more!

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