

FISHERIES RESEARCH & DEVELOPMENT CORPORATION NEWS

# FISH

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National shark report  
Algal connections



VOLUME 22 NUMBER 1  
MARCH 2014

## PURE DELIGHT



SKRETTING

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Fish, humans seek more omega-3s

## COVER

Coffin Bay oyster farming on South Australia's Eyre Peninsula.  
 Photo by Julie Haldane



# Investigation success no fluke

Mysterious deaths and million-dollar losses brought together a highly focused team of experts and supporters to track down the culprits responsible for jeopardising the Southern Bluefin Tuna industry

**R**ounding up the year's quota of Southern Bluefin Tuna (*Thunnus maccoyii*) and towing them back to South Australia's Port Lincoln coast for ranching is a significant operation requiring an enormous amount of resources. The slow voyage from the Great Australian Bight into the clean waters of Spencer Gulf near Port Lincoln can take up to three weeks, after which the tuna are transferred to pontoons where they are grown out for four to six months to be sold on the international market.

Each fish is worth about \$500, making Southern Bluefin Tuna (SBT) ranching an extremely valuable industry for Port Lincoln and for SA. It employs about 1500 people, directly and indirectly, and underpins the regional economy. Strict catch quotas are reviewed by the Commission for the Conservation of Southern Bluefin Tuna in

October each year, and there is only one opportunity for fishers to catch their share of the migratory tuna before they disappear for another year.

So when, in the mid-2000s, an increasing number of the fish began dying within the first two months of being placed in ranching operations, concerns started to ripple through the industry. All had seemed well when ranching first started in the 1990s. The mortality rate of ranched tuna was as low as two per cent before it started rising, spiking suddenly in 2006. By 2009, mortality rates had climbed to 13 per cent.

### **Urgent investigations**

David Ellis, former research manager of the Australian Southern Bluefin Tuna Industry Association (ASBTIA), says it was clear something was happening and the industry

needed to understand what. The SBT deaths were occurring within six to eight weeks of the fish arriving in the ranching zone – after which mortality rates would drop back to normal. But the cause of the deaths was a mystery, he says. “We’d look at the fish and it was difficult to understand why they had died. They looked the same as healthy fish.”

Given the significance of the industry to the state and regional economy, the SA Government was quick to offer support and resources to help solve the mystery. Mehdi Doroudi, the executive director of Fisheries and Aquaculture at Primary Industries and Regions South Australia (PIRSA), says with the tuna industry losing 10 to 15 per cent of its stock, “you’re talking about millions of dollars a year”.

The spike in mortality rates coincided with a new research partnership between

the FRDC and the SBT industry. Together with the FRDC and PIRSA, ASBTIA swung into action, bringing in experts to combat the problem from several angles. Among them was salmon and tuna health expert Barbara Nowak, a professor at the National Centre for Marine Conservation and Resource Sustainability at the University of Tasmania. In the early 2000s, she had conducted an assessment of potential health risks to the tuna ranching industry.

The usual suspects

Finding the cause of the SBT deaths was a process of elimination, she says. Could it be a lack of vitamins? Was it something to do with the water quality or with an assault on the immune system? “We first thought it might be related to stress, or the way fish were being sourced and handled from the wild.” However, the cortisol levels of the fish did not indicate heightened stress levels. A trial of immunostimulants also had little effect.

Blood fluke of the species *Cardicola forsteri* was another obvious suspect. There was evidence of high levels of the blood fluke species in the hearts of SBT, but this seemed to have little correlation with the condition of the fish. “There could be high numbers of *C. forsteri* adults in the heart and the tuna were still in good condition,” she says.

Although they could not find the ‘smoking gun’ that proved blood fluke was the cause, David Ellis says he was convinced that the blood fluke was somehow the main reason.

In the process of trying to demonstrate the connection, researchers, including parasite experts Thomas Cribb, an associate professor from the University of Queensland, and Rob Adlard, head of Marine Zoology at Queensland Museum, discovered the intermediate host for *C. forsteri* – the polychaete *Longicarpus modestus*, which lives in the sediment of the sea floor. This finding immediately led to a new strategy to reduce blood fluke in the tuna.

Deep-water strategy

Mehdi Doroudi says as soon as researchers knew about the intermediate host it raised the possibility that the farmers could take the tuna into deeper waters where there was greater distance between the fish and the worms and where there is greater movement of water. PIRSA fast-tracked the establishment of new offshore zones and pilot leases to allow farmers to go into these new areas to enable this mitigation strategy.

Several companies took advantage of these provisions, and reported significant drops in mortality as a result.

But ranching further offshore was not a viable option for the whole industry. It can take twice as much time and much more fuel to get to the outer zone. The sea conditions can be worse, with much higher wind speeds and higher wind gusts. Even those who farm offshore bring the fish closer to Port Lincoln for later grow-out and harvesting, because it

1. Craig Hughes removes SBT from the harvesting conveyor as part of research trials for the treatment of blood fluke. 2. University of Tasmania PhD student Mark Polinski collects samples for molecular detection of *Cardicola* spp. 3. Researcher Trent D’Antignana. 4. In the ASBTIA research laboratory: (front) Tom Cribb (University of Queensland) and (from left) Nathan Bott (SARDI), Barbara Nowak (University of Tasmania), Rob Adlard (Queensland Museum) and Craig Hayward (SARDI).



PHOTOS: 1, 2, 4 UTAS; 3 SARDI



A conveyor system is prepared to begin the harvesting of SBT for testing.

is easier to manage them there. With blood fluke on the radar as the probable cause of the deaths – even though the connection still had not been proved – David Ellis and Paul Hardy-Smith decided to test the effectiveness of a common treatment for blood fluke in other farm animals, praziquantel. This was with industry partners Tony's Tuna and Blaslov Fishing.

With the assistance of veterinarians, initial in vivo treatments of tuna with praziquantel showed encouraging success, with almost 100 per cent mortality rates of blood flukes in infected fish.

The results were positive enough to make other SBT ranchers keen to trial the treatment on their fish. But how to administer praziquantel en masse to ranched SBT without having to drench each one individually?

#### Bait test

In 2008, Flinders University adapted meat marination technology to inject feed bait-fish for SBT with vitamins E and C to improve the subsequent SBT shelf life. Tony's Tuna International bought the machine, and it was modified to inject feed fish with praziquantel. Ten to 15 tonnes of sardines were injected with praziquantel in a session, and then fed as bait fish to the SBT.

As a result, industry mortality rates fell to less than one per cent and there was no mortality spike during the first six to eight weeks of ranching, as there had previously been. Initiated by Phil Thomas and implemented by Trent D'Antignana, the bait fish injection method proved a viable way of delivering the prescribed dose of praziquantel and resulted in very little loss to the environment.

Determined to discover exactly what had been causing the deaths, ASBTIA launched a new project to investigate the parasites more deeply, inviting a world expert in fish health, Hugh Ferguson, from St George's University in the Caribbean.

At the instigation of Brian Jeffriess, funding was found for Japanese expert Sho

Shirakashi to examine if there was more than one species of fluke.

Sho Shirakashi identified that the affected SBT were infected not just with the *C. forsteri* species of blood fluke, but also with another *Cardicola* species – *C. orientalis*. It was previously thought this second species only infected Pacific Bluefin Tuna. While adult *C. forsteri* mainly colonise the heart, *C. orientalis* tend to inhabit the gills, where they affect the respiratory system and do far greater damage to the health of fish.

#### Treatment success

Happily, the two species are closely related enough that the praziquantel administered to treat the *C. forsteri* was also effective against the *C. orientalis*.

Trials carried out by PIRSA have established that praziquantel appears to be harmless in the marine environment.

"We were very concerned about monitoring residues," Mehdi Doroudi says, "given that we have a big mussel industry in Port Lincoln and we needed to be sure that the drug would not adversely impact their product."

The next step is to apply for registration from the Australian Pesticides and Veterinary Medicines Authority for a Minor Use Permit to replace the SA ministerial approval for the treatment that has covered its administration since it was shown to be effective.

With the combination of praziquantel and ranching in deeper waters, the project has reduced the mortality of ranched SBT from 13 per cent to less than one per cent, adding approximately \$20 million a year to the value of the industry.

Blood fluke treatment has also reduced has also reduced pressure on the cardiovascular system of the ranched fish, improving feed efficiency, with further savings of \$4 to \$5 million annually.

#### Award-winning collaboration

In 2013, the project was awarded the National Seafood Industry Research, Development and Extension Award, in recognition of its importance to the SBT industry, and the extraordinary level of collaboration between the institutions who lent their expertise and resources to help solve the mystery. Altogether 12 research bodies were involved in the project and dozens of individuals from Australia and overseas.

Just as significant was the unprecedented level of cooperation between industry, researchers and government funding agencies including the FRDC and PIRSA, David Ellis says. "This was a very inclusive research project between industry and researchers, and that cooperation from the industry made all the difference in being able to quickly establish the cause of the deaths and assess the effectiveness of various mitigation strategies and treatments. It took us only two years to come up with a solution because everyone was so focused on achieving the outcome."

Among the examples of invaluable industry cooperation was the offer from one SBT business to provide boats alongside its offshore operations for use as a field laboratory. "That meant we were able to work with samples immediately instead of waiting for them to be shipped back to shore at the end of the day," David Ellis says. Donations of tuna to test praziquantel treatments were also valuable industry contributions.

Another innovation was the annual, rather than three-year, project assessment. "That gave industry a greater input into the direction of the project, and the resources and capabilities needed," he says. "We could look at the best way of progressing the project each year, which led to a fast uptake of research results because industry and research were intertwined." **F**

## Recfishing recruits young leaders

**T**he peak recreational fishing organisations in Victoria and South Australia are actively expanding the pool of potential leaders for the sector, with a recent leadership course targeting younger recreational fishers. VRFish and RecFish SA joined forces to hold a four-day future leaders workshop at Port Fairy, Victoria, in December 2013.

The course was run by Ian Cartwright, former head of the School of Fisheries at the Australian Maritime College and well-known fisheries consultant. Participants responded to a widely advertised call for applications and nine candidates were selected. The course provided a wide range of information on diverse subjects

including fish biology, stock assessments, compliance, conservation, management and advocacy.

VRFish general manager Dallas D'Silva says he would like to see the workshop become an annual event. "The recreational fishing sector is so diverse, and this type of program will help us to ensure that we can incorporate that diversity into our peak representative bodies and advocacy groups.

"These courses are vital if the sector is to grow into the future, effectively represent fishers and keep our fisheries sustainable in the years ahead."

He says the course highlighted the need for recreational fishers to work with fisheries managers and other users, such as commercial fishers and non-extractive users. It also

reinforced the need to have systems in place to monitor changes in fish stock numbers and fishing pressure over time. Participants compiled a list of priority actions that they would like to see implemented to improve recreational fishing.

Participant Anthony McGrath says the course provided a great opportunity for the next generation of recreational fishers to get involved in advocacy. A mentoring program will be put in place to ensure the future leaders become a part of VRFish and RecFish SA.

Funding for the course was provided by the Australian Department of Agriculture, with support from Fisheries Victoria and Primary Industries and Regions SA. **F**

**More information:** Dallas D'Silva, 03 9686 7077, [dallas@vrfish.com.au](mailto:dallas@vrfish.com.au)



## \$10 million pool for 2015 research

**T**he FRDC and the Fisheries Research Advisory Bodies (FRABs) are gearing up for the 2015 annual competitive round of research, development and extension funding. The FRDC expects to invest more than \$10 million through this round. FRABs will meet in March and April 2014 to finalise their priorities, which will form the basis of the call for applications for 2015 projects.

The call will be made in early May 2014. It will outline the priorities each jurisdiction would like applications to address. The priorities of the Aquatic Animal Health, Indigenous RD&E and Recfishing Research subprograms will also be included.

Expressions of interest must be submitted by 15 June 2014. Information on how to apply will be available on the FRDC website as well as through the FRABs' networks.

### People Development opportunities

Applications are also invited for several People Development awards, bursaries and scholarships:

#### APPLICATIONS CLOSE 23 APRIL 2014

- Aquatic Animal Health Training Scheme
- Peter Dundas-Smith Scholarship

- Indigenous Development Scholarship
  - Emerging Leader Governance Scholarship (Australian Institute of Company Directors)
  - Governance Scholarship for Women (Australian Institute of Company Directors)
  - International Travel Bursaries
  - Visiting Expert Bursaries
- APPLICATIONS CLOSE 31 JULY 2014**
- Australian Rural Leadership Program
- APPLICATIONS OPEN 1 APRIL 2014, CLOSING DATE TBA**
- Nuffield Australia Farming Scholarship

To find out more or to apply, visit: [frdc.com.au/research/people\\_dev\\_prog/Pages/dev\\_opportunities.aspx](http://frdc.com.au/research/people_dev_prog/Pages/dev_opportunities.aspx)

# PROMOTIONAL POSSIBILITIES FOR FISHING AND SEAFOOD

**S**eafood and fishing industry stakeholders have welcomed legislative changes that will allow the FRDC to take on the marketing and promotion of Australia's world-class fish and seafood produce, and promote recreational fishing or even the world-leading management practices that underpin its fisheries.

In recent years, the FRDC has supported many market-focused research projects, but has had no capacity to undertake marketing and promotional activities in response to the findings. The legislative changes now allow the FRDC to link research, development and extension to marketing, as part of a natural progression to improved outcomes for the industry.

The changes are expected to improve the industry's productivity and profitability, and allow its many diverse stakeholders to collectively address public perceptions of fishing and aquaculture in the Australian community.

The *Rural Research and Development Legislation Amendment Bill 2013* was passed by Federal Parliament on 12 December 2013. It extends the scope and range of activities the FRDC can undertake by amending its enabling legislation, the *Primary Industries Research and Development Act 1989* (PIRD Act).

The FRDC's executive director, Patrick Hone, says the changes have been a long time coming, with many staff and industry

representatives working hard to establish a marketing and promotion capacity for more than a decade.

"The FRDC is, at its core, a research organisation," Patrick Hone says. "It is what we are, and what we do well. This will not change; it underpins our reputation as an independent, evidence-based organisation. Any marketing or promotion we undertake will adhere to the same rules and standards as our other activities."

In line with this, it is very important for all stakeholders to know that the FRDC will not be able to use the marketing functions to undertake advocacy. There is a clear separation between the FRDC's role and that of the industry, Patrick Hone says.

Patrick Hone says the legislative changes will not affect existing operations. New activities will only be activated in response to a request from the industry or an industry sector. Industry has to want to establish a collective marketing function. Any additional activities must add value to current operations.

## Industry consultation

The FRDC's communications manager, Peter Horvat, is taking on an expanded role as a group manager of communications, trade and marketing activities. He says the focus during the next six months will be firmly on consultation, engagement and communication with industry.

## PLANNING AND CONSULTATION

Two major strategic documents – the *National Fisheries and Aquaculture Research, Development and Extension Strategy* and the FRDC's *Research, Development and Extension Plan* – need to be revised for release in 2015.

Patrick Hone, FRDC executive director, will oversee the planning and consultation for the development of these documents. Over the coming 12 months, the FRDC will use a range of approaches to ensure stakeholders are consulted and heard.

The revision of the FRDC's RD&E plan is well timed, given the changes to the *Primary Industries Research and Development Act 1989*. It is a chance to look at stakeholders' priorities and set in place a solid plan to 2020 and beyond.

An integral part of this process will be linking the work that is also being done to develop a national marketing plan.

A timetable for consultation will be circulated to industry and will also be available from the FRDC website ([www.frdc.com.au](http://www.frdc.com.au)).

The FRDC will not be employing any marketing staff in the near future. However, if industry comes on board, the FRDC would look for the most cost-effective approach to get the result industry is after.

The reality is the FRDC has limited funding, provided via the Australian Seafood Cooperative Research Centre, for any marketing activities. The focus must be to work with industry to identify the key areas and approaches for investment.

"We need to listen to what stakeholders want to do and what they perceive as the key areas of marketing to develop. We have heard over the past few years that a priority for industry, in general, is to address the perceptions held by the community around the industry," Peter Horvat says.

"We have also seen some industry sectors being very proactive in developing voluntary activities: for example, the wild-catch abalone industry targeting China and the prawn sector developing the 'Love Australian Prawns' campaign. But the FRDC will not be taking anything for granted or second-guessing what industry wants."

The initial process the FRDC will work through with stakeholders will have two key components.

- 1 Research – develop a blueprint of the whole industry.
- 2 Communication and consultation – the key area for consultation will be: Purpose – what are the funds being collected for?

"The FRDC must gain an understanding of what the end users (payers) want and what their expectations are. This will be the foundation for developing our marketing implementation plan," Peter Horvat says.

#### Contribute your views

Some areas already suggested for possible promotional investment include improving the industry's image, selling more produce, increasing consumption, improving market development and access, and increasing angler participation. Industry members who have a view on the industry's marketing and promotion, or who would simply like more information should contact Peter Horvat on 02 6285 0400, or email [peter.horvat@frdc.com.au](mailto:peter.horvat@frdc.com.au). **F**

## INDUSTRY RESPONSE

Following the announcement, the FRDC received letters of congratulation and support from all major sectors of the industry and many interested stakeholders. Here are three examples:

"Exactly what our industry needs to develop our markets in the face of increasing global competition."

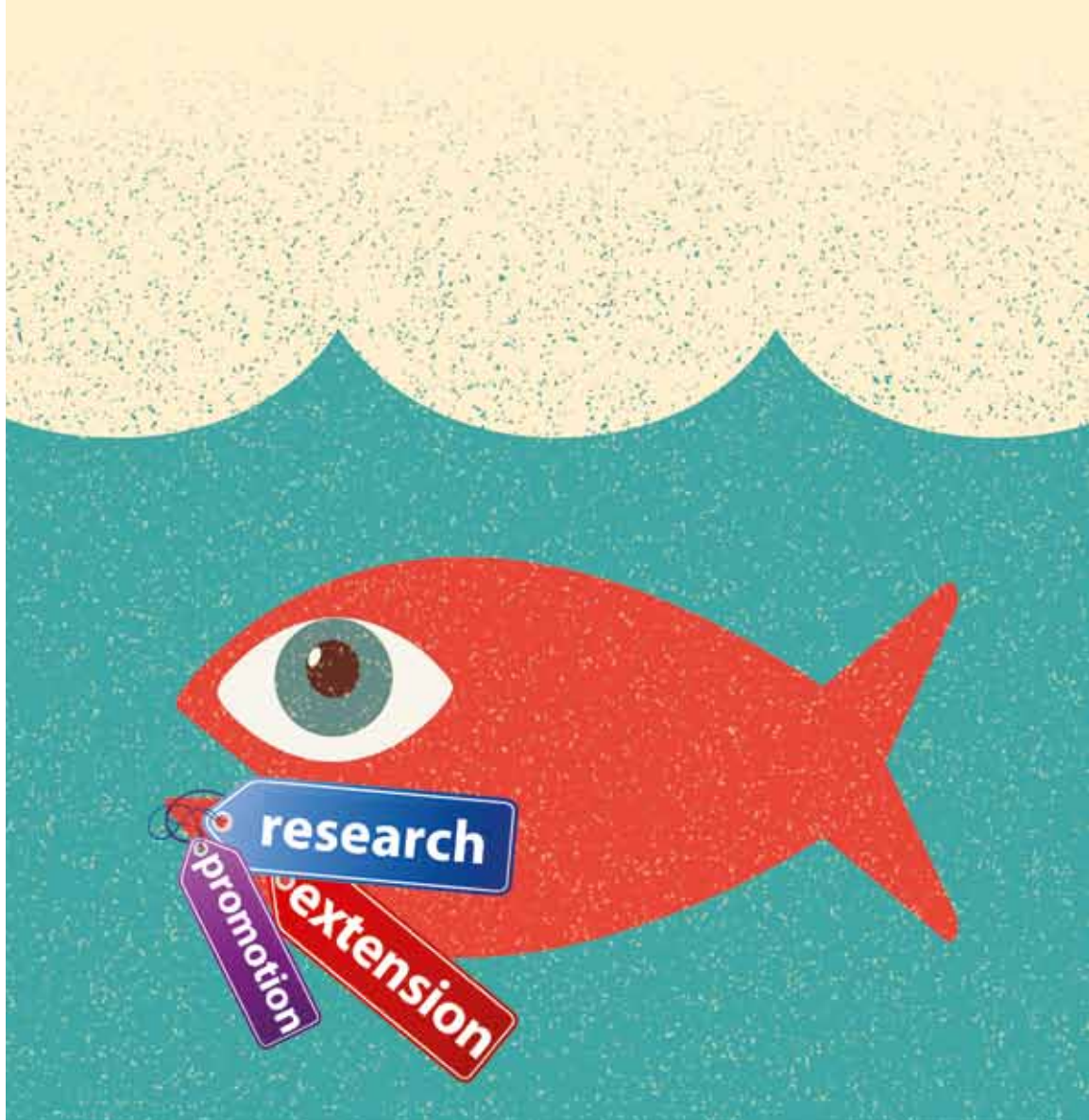
– NATHAN MAXWELL-McGINN, INTERNATIONAL TRADER – CM FOODS DIVISION, CRAIG MOSTYN GROUP

"This truly is a significant milestone for Australian seafood in its journey to developing more significant marketing strategies and objectives in the future. Well done."

– MARSHALL BETZEL, QUEENSLAND SEAFOOD MARKETERS ASSOCIATION

Good news. Looking forward in the new year to be able to prioritise and scope appropriate programs to grow the market and inform the Australian consumer particularly. Here's to a great 2014!"

– FRANCES BENDER, HUON AQUACULTURE



# Click and deliver

Likes, links and tweets are an increasing part of efforts to raise the profile of the best Australian fisheries science and management

A range of new initiatives from the FRDC over the past two years has brought the communication of fisheries science well and truly into the digital age. This includes a revamped FRDC website, Facebook pages, Twitter, a YouTube channel and more.

Social media tools have become an important part of the FRDC's communication strategy, launched in December 2011, to promote the science and best practice that underpins the Australian seafood and angling industry. Central to this strategy is to bring existing science to the broader Australian community as effectively as possible.

The FRDC's communications manager Peter Horvat says social media has provided the opportunity not just to supply information, but to actually engage with the broader community and to become part of a larger network of individuals and organisations telling the story of Australian seafood.

"While traditional media such as radio, newspapers, magazines and television are still important, there are now so many more places to look for information, thanks to the internet. People don't just go to one website when they are looking for information, they follow links from one site to another, and cross-reference information until they find what they are after."

Peter Horvat says the skills of social media specialist Rachelle Etienne-Breidenbach have played an important part in the development and success of the FRDC entering into the social media space. She has helped with both the design and the planning of the social media initiatives, and in developing the necessary policies, procedures and resources.

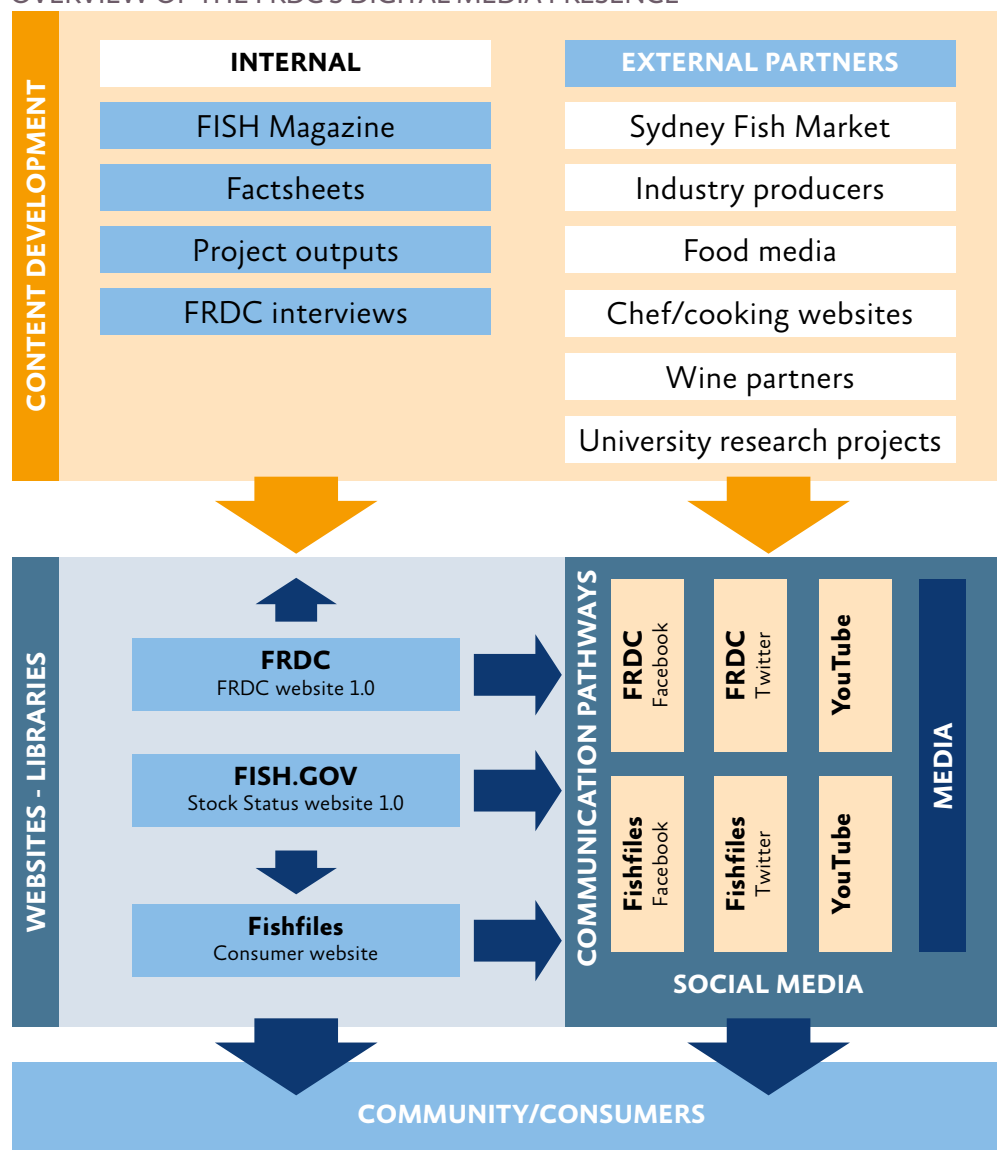
"Social media is about being part of a community – telling and sharing your part

of the broader story. To that end it would be great to have 10, 20 or even more sites telling the story of seafood. There is a role and space for everyone," Peter Horvat says. "We can tap into the knowledge of others, as much as they can tap into our knowledge,

which all helps to bolster the information we can deliver."

The potential for cross-promotion and linking has been important in successfully raising awareness of the FRDC's initiatives. After revamping its website with the new

## OVERVIEW OF THE FRDC'S DIGITAL MEDIA PRESENCE



Facebook page in mind, the FRDC's Facebook page was launched in July 2012. The initial phase involved a small alert sent to a selection of researchers and stakeholders.

The second phase of the Facebook development was to build awareness and coverage. "To do this we embedded a little Facebook reminder into all our publications, even down to staff email signatures," Peter Horvat says. "We used some very targeted adverts to raise the profile of the website. This, combined with cross-promotion between our website and partners, has seen the FRDC Facebook page accumulate more than 20,000 'likes' by January 2014."

In December 2012, the FRDC launched a new website ([www.fish.gov.au](http://www.fish.gov.au)) as the online home of the *Status of Key Australian Fish Stocks Reports*. And in May 2013 it also launched the consumer website Fishfiles ([www.fishfiles.com.au](http://www.fishfiles.com.au)), with a related Facebook page. By January 2014 the Fishfiles Facebook page had accumulated more than 12,500 'likes'.

Information is integrated between the websites and Facebook pages and re-used in different formats to appeal to different audiences using these websites. This cross-promotion has led to an increase in web traffic to all three sites by more than 300 per cent in the past year.

The FRDC's goal is to match content to each of its social media initiatives with its target audiences. For example, the Fishfiles Facebook page aims to achieve a mix of about 20 to 30 per cent recipes and seafood-based cooking, 25 per cent science, 25 per cent better handling and storage, and 20 to 30 per cent partner stories (Sydney Fish Market, the Australian Seafood Cooperative Research Centre, universities, chefs and seafood producers).

"We are also continually tweaking the mix and timing of material used on the FRDC Facebook page. It is clear that Facebook is better suited to certain styles of news. For example, putting research reports up early in the week results in a much better rate of response than later in the week when people are after more light-hearted material. It is also apparent that social media networks such as Facebook continually change how material is viewed and passed on. So we are constantly adjusting the content mixture to get the best results." **F**



## ONLINE INITIATIVES

**The FRDC website – [www.frdc.com.au](http://www.frdc.com.au)**

**UPGRADED FEBRUARY 2012** The FRDC website is primarily designed to provide information to industry, government and researchers, but is an excellent source of fisheries research knowledge for anyone interested in marine and fisheries research.

**FRDC YouTube channel – [www.youtube.com/fisheriesresearchAU](http://www.youtube.com/fisheriesresearchAU)**

**UPGRADED FEBRUARY 2012** This YouTube channel contains stories about or generated by FRDC projects. It provides a good source of information on research results, especially for schools.

**FRDC Facebook page – [www.facebook.com/FRDCAustralia](http://www.facebook.com/FRDCAustralia)**

**JULY 2012** The FRDC Facebook page aims to inform the general public of the latest research and practice. The page has opened up communication channels and allowed the FRDC to promote the latest events, project updates, research facts and fish factoids to a broad audience.

**The Status of Key Australian Fish Stocks Reports – [www.fish.gov.au](http://www.fish.gov.au)**

**DECEMBER 2012** This website is designed for anyone who has an interest in knowing how Australian fish stocks are going. It provides a high level of detail and gives a national perspective. The website also contains an excellent overview and description of fishing methods used in Australia, complete with diagrams for each. **NOTE:** December 2014 will see the revised and expanded reports released.

**Fishfiles – [www.fishfiles.com.au](http://www.fishfiles.com.au)**

**MAY 2013** This website is designed as a consumer education resource for anyone interested in seafood. It brings together existing resources, namely the *Australian Seafood User Manual*, and links to other material such as the *Status of Key Australian Fish Stocks Reports*, *FISH* magazine articles, Eyre Region Species Guide and Seafood Flavour Wheel and seafood safety material from SafeFish.

**Fishfiles Facebook page – [www.facebook.com/Fishfiles](http://www.facebook.com/Fishfiles)**

**MAY 2013** The Fishfiles Facebook page is designed to be the link between the FRDC's three websites ([www.frdc.com.au](http://www.frdc.com.au), [www.fish.gov.au](http://www.fish.gov.au) and [www.fishfiles.com.au](http://www.fishfiles.com.au)), as well linking to our partners and the broader community. The target point for this site is seafood consumers. The Fishfiles page will broaden the current FRDC reach to the community and provide a way to share information (science) that underpins the fishing industry to people who would receive the messages via the FRDC Facebook page.

**Fishfiles YouTube channel – [www.youtube.com/FRDCCFishfiles](http://www.youtube.com/FRDCCFishfiles)**

**MAY 2013** Video is an important component of the Fishfiles website, especially for the younger audience. It is integrated into the website, but is hosted on its own Fishfiles YouTube channel. The format for the video content is aimed at giving a behind-the-scenes insight into what key stakeholders (fishers, retailers, scientists and chefs) think and know about seafood. These stakeholders are experts in their chosen field and will give the viewer confidence in the message being delivered.



# Join forces to manage supply risks

An approach to risk management and diversification that embraces the entire seafood supply chain could help the seafood industry to remain strong in the face of changing conditions

**A** multidisciplinary team of researchers from two universities and CSIRO has identified the steps that the Australian seafood industry could take to seize on and mitigate the pressures of climate change and other major risks to industry health.

These steps, which include diversification and cross-investment, hinge on improved communication between fishers and the rest of the supply chain, and between sectors that have long considered themselves to be in competition.

The outcomes from the FRDC-funded project highlight that fishers and farmers are perceived by the rest of the supply chain as the place where environmental impact should be managed.

“While there has been a focus on what fishers can do, we think there are also a whole range of things that marketers can do, that distributors can do, that retailers can do,” says Alistair Hobday, principal research scientist at CSIRO, who led the project. “To me, a key finding is that fishers need to start having conversations with people further up the supply chain.”

Improved cooperation across the supply chain could not only reduce the overall

carbon footprint, but could also boost the value of a product in varying conditions.

“Imagine if a fish is declining in abundance. If you get no help up the supply chain, all you do is sell less of your product. But what if the supply chain helps you add value to it, or sells it into a market where it receives a higher price?”

“Or, in the case of an increase in catch, where the price usually drops, if processors and distributors and marketers are aware of a glut of product, they can think about strategies to send it to different markets, or storage options that will let them supply that species for longer.”

Unlike many projects related to the effects of climate change that largely focus on the biophysical impacts on species’ location and catch rates, this project considers other key influences such as market perception.

“There are new species arriving and new opportunities for fishers in some parts of Australia. But even for the existing species that might be challenged, there are still opportunities for growth if you consider the whole supply chain,” Alistair Hobday says.

A team of 18 researchers from CSIRO, Queensland University of Technology and

the Institute for Marine and Antarctic Studies at the University of Tasmania conducted the project, with seven different seafood sectors serving as case studies: Southern Rocklobster, Tropical Rocklobster, Western Rocklobster, Sydney Rock Oyster, wild prawn, the Commonwealth Trawl Sector and prawn aquaculture.

## Vulnerabilities and risk

To pinpoint areas demanding particular focus, researchers mapped vulnerabilities in the supply chain using network analysis, a methodology commonly applied to studying food webs or social networks. These weaknesses provide a discussion point for each sector as to how it could mitigate risk, Alistair Hobday says.

“We used network analysis to show where the most critical links in the chain are. And those vulnerable links are places where, if you had a shock or a break to those links, the delivery of product to the consumer could be disrupted,” he says.

“For different fisheries, those things happen at different points in the supply chain and so we don’t have a generic answer.”

In the Tasmanian Southern Rocklobster fishery, for example, 95 per cent of product travels interstate via Burnie and Hobart airports, to both domestic and export markets. An airport strike could completely interrupt the supply chain. Appropriate risk management would centre, therefore, on establishing contingency measures for shipping the product via sea, or ensuring sufficient holding capacity existed close to the airports.

In the tropics, Mother Nature is a major threat. "After Cyclone Yasi, most aquaculture farms survived the actual hit of the cyclone, but then either lost power because they didn't have enough fuel on their farms to run pond aerators, or the roads were closed and they couldn't get the product through to market quickly enough."

ILLUSTRATION: PAUL DICKENSON



For some premium products, the risk lies in heavy reliance on the lucrative Chinese market. All of these vulnerabilities are complex to resolve. For example, to diversify seafood distribution out of Tasmania could introduce additional costs.

"That's a really hard thing to do, though, because economically it's really efficient to put things through one point. If it breaks you're in trouble, but if it works you're doing really well. And people don't really want to make that change until it breaks," Alistair Hobday says.

In terms of spreading risks related to cyclone damage, he suggests that a possible solution might be for prawn farmers from different regions, such as Townsville and Mackay, Queensland, to reciprocally store some of their product at each other's sites. If a cyclone hits, product from each business would therefore still be available for market, maintaining farm income.

For the lobster industry, a decision could be made to collectively target a small portion of product to another market that is less lucrative than China. For example, the US market mainly demands lobster tails, which are lower value than a live animal. But if all lobster fishers decided to place a proportion of

product into this market to develop it, nobody would be left at a comparative financial disadvantage, and the risk would be spread.

### Market perceptions of like products

The researchers also conducted a market analysis of the case-study sectors to identify key points of competition and correlation. They identified points where the market sees different products as like, even though the fishers may believe themselves to be in competition.

For example, Australian wild catch and aquaculture products together compete against imports in the domestic market. Australian prawns in particular, whether farmed or caught, are perceived to be on par

by consumers. “The sectors sometimes think that they need to outcompete each other. But really our analysis shows that those two sectors could work together,” Alistair Hobday explains.

These perceived similarities in the market produce surprising effects in the relationship of supply and demand, as demonstrated by the three species of Australian rocklobster, for which prices correlate.

“If, under climate change, we saw one species of rocklobster become less abundant, you might think, that’s alright because the price is going to go up. But if the market sees two products as equivalent, change in one of them will not necessarily give you the expected price increases,” Alistair Hobday says.



“We looked, for example, at rocklobster exports to Hong Kong. And although Australia exports three different species into Hong Kong, and each one is priced differently, they’re all correlated with each other, and changes in the price of one may lead to a shift in the alternative species.”

Alistair Hobday argues that fishers and fisheries that harvest similar products would benefit from increasing cooperation to capitalise on market opportunities and to spread risk.

“That could be the rocklobster segment, it could be the prawn segment, it could be the white fish segment, because the products are seen as equivalent in the marketplace at the end of the day.”

He also believes that wild-catch fishers and farmers of similar products, such as prawns, could increase cross-investment to spread their risk. In addition to providing a diversified business portfolio, this would ensure that, where one sector was affected, such as prawn farmers were by Cyclone Yasi, prawn product would still be supplied and maintain its foothold in the Australian market.

“Despite the observed and expected impacts of climate change, seafood producers do have growth opportunities if coordination is improved across seafood supply chains, risks are known and managed, and consumers continue to value Australian product.”

The report *Growth opportunities and critical elements in the supply chain for wild fisheries and aquaculture in a changing climate* is available from the FRDC website, along with fact sheets for each sector. **F**

## LIFE-CYCLE ASSESSMENTS OF ENVIRONMENTAL IMPACT

The assessment of the carbon footprint of each of the seven supply chains involved in the climate change–supply chain report was led by Bridget Green, fisheries scientist at the Institute for Marine and Antarctic Studies at the University of Tasmania.

“We looked at the biophysical impacts – so chemical waste, fuel use, air pollution, water use – but not for fishing only, because seafood is not just about fishing. It’s about everything that happens from capture of the fish to delivery to the restaurant,” Bridget Green says.

Overall, the Australian seafood industry emerged as having a lower carbon footprint than land-based food industries such as cattle farming, with water use and nitrous oxide pollution low.

Furthermore, the Commonwealth Trawl Sector and Australian Banana Prawn Trawl Fishery both emerged as highly efficient environmentally compared with their overseas peers. Bridget Green says this is partly attributable to the large boats used in trawl fishing, provided that they record good catch rates.

“It’s also a bit to do with the behaviour of the species. Banana Prawn are a schooling species so you can be quite precise in how you target them, and the Commonwealth Trawl Sector is the same, in that they target schools.”

But there were usage areas that the industry could consider if aiming to reduce its carbon footprint.

Processors had the highest freshwater consumption, largely related to cleaning the factories, with water recycling a possible option.

Meanwhile, fisheries harvesting a live-export product had a significantly larger carbon footprint, with airfreight transport contributing to about half of that overall impact. Bridget Green emphasises that these are high-value products that attract premium prices in Asia, where maximum freshness is desired, and that they constitute only a small component of the industry and emissions. Nevertheless, she says these findings present opportunities for reviewing export transportation, where practical.

“In things such as the Tropical Rocklobster, the product is flown from the Torres Strait down to Cairns and then back up to Asia, so there’s a little bit of doubling up there. At the moment it’s probably not possible to fly directly into Asia because the infrastructure isn’t in the Torres Strait, but we identified that as a potential way to reduce the impact of flying.”

More information: Wayne O'Connor, 02 4982 1232, [wayne.o'connor@dpi.nsw.gov.au](mailto:wayne.o'connor@dpi.nsw.gov.au); World Oyster Society, [www.worldoyster.org](http://www.worldoyster.org)

PHOTO: BRAD COLLIS

## Oyster health on international agenda

The detection and spread of a more virulent strain of Ostreid herpes virus (OsHV 1  $\mu$ var), which causes Pacific Oyster Mortality Syndrome, was a particular concern highlighted at the World Oyster Society's 5th International Oyster Symposium held in December.

The symposium was held in conjunction with Asia Pacific Aquaculture 2013 in Ho Chi Minh City, Vietnam, which had the theme 'Positioning for Profit'.

There were several talks describing impacts and potential management measures, including attempts to breed for OsHV resistance. Researchers from Australia, New Zealand and France involved in breeding efforts devoted a session to progress in reducing the effects of the virus. Work in all the countries has indicated there is potential to breed for OsHV resistance, but researchers acknowledged there was no immediate solution.

Other oyster disease threats discussed included *Perkinsus*, *Rickettsial* and haplosporidian infections.

Environmental change and degradation has been a major theme of previous international oyster symposiums, and climate change impact on oysters remained topical. Studies are now investigating the synergistic effects of multiple stressors on oysters and the likely effects of trophic interactions. Several papers focused on human-related impact, and on ways to minimise environmental effects that may

arise from oyster cultivation, including integrated multi-trophic aquaculture and seagrass-friendly infrastructure.

### Asia expands production

Asia already dominates world oyster production but demand in the region is still growing and widespread efforts are continuing to increase production. Presentations highlighted government initiatives in Malaysia to encourage hatchery production of new species that could help communities dependent on traditional wild-capture fisheries to move into bivalve culture.

In Vietnam, where oyster production has expanded rapidly during the past five years, researchers are gaining a better understanding of the genetics of existing oyster stocks and which of those stocks form the basis of current culture efforts. Internal markets in Vietnam are developing rapidly, and absorb the vast majority of production.

In keeping with the 'Positioning for Profit' theme of the broader conference, presentations also focused on market studies undertaken to better understand local consumer needs and promote consumption. While Vietnamese consumers readily accept oysters and appreciate their nutritional benefits, quality assurance is an issue that Vietnamese producers need to address before export markets can be considered.

Speakers addressed subjects as diverse as clinical studies of the effects of oyster extracts on brain function and 'red' and 'green' tape

constraining oyster industry expansion, through to oyster farming business models and the use of the arts and media to promote an understanding of oysters and oyster issues.

Other conference activities included the World Oyster Society dinner and Young Researcher Awards, and a meeting to ratify substantial changes to the society. Five chapters of the society have now been established – North and South America, Europe and Africa, Oceania, China and Japan – to encourage greater participation and focus on regional needs.

The World Oyster Society was originally formed in 2005, following the 1st International Oyster Symposium in Tokyo. It aims to bring together all those involved with oysters (farmers, researchers, managers, retailers) to protect and better understand oysters and the environments in which they occur. The society has about 600 members from 34 countries.

The 2013 symposium was held in conjunction with Asia Pacific Aquaculture 2013 to introduce the society to a broader audience, and to acknowledge Vietnam's progress in oyster aquaculture.

The 6th International Oyster Symposium will be held in Cape Cod, Massachusetts, US, in 2015. **F**

\* Wayne O'Connor is leader of the New South Wales Department of Primary Industries aquaculture research program and was program manager of the World Oyster Society symposium held in Vietnam in December 2013.

# Pristine waters, pristine oysters

**C**offin Bay is a quiet coastal town on South Australia's Eyre Peninsula. In the summer months the town's resident population of 650 swells to about 4000, with the influx of tourists keen to experience the region's rugged national parks and the tranquil, pure waters of Coffin Bay.

It is a seafood lover's delight: the bay is abundant with fish, cockles, crab and scallops. This is also where the renowned Pacific Oysters (*Crassostrea gigas*) and Native Oysters (*Ostrea angasi*) are grown.

Brendan Guidera has been an oyster farmer at Coffin Bay since 2001. For Brendan and his staff at Pristine Oysters, most days begin with a trip out onto the bay, either returning graded oysters to the water to grow out, or harvesting those ready for market. The powerful 450-horsepower oyster punt they use can zoom across the water at speeds of 80 to 90 kilometres per hour. ■

## NATIVE OYSTER REVIVAL

Native Oysters grow naturally in the Eyre Peninsula region and were harvested in Coffin Bay from the mid-1800s until 1945.

They were not farmed in South Australia until the late-1960s, when a group of five growers established an oyster farm adjacent to the Coffin Bay township. However, the supply of wild-caught spat proved unreliable and growers quickly moved to the Pacific Oyster for farming, sourcing spat from Tasmanian growers.

Brendan Guidera says a number of emerging risks and new market opportunities prompted him to review the potential of Native Oysters in 2008. The species is resistant to the virus that causes Pacific Oyster Mortality Syndrome (POMS).

From a marketing perspective, Native Oysters present well on a plate; the shell looks more like a scallop than an oyster (they are called plates in France due to their shape). They are Australia's Native Oyster and have a very different flavour to the Pacific Oyster. They are also very similar in appearance and flavour to the native European Flat Oyster (*Ostrea edulis*), which can earn up to three times the price of other oysters in European markets.

Worldwide production of Native Oysters has plummeted to just 2000 tonnes a year. Widespread bonamia bacterial infections in France in the 1960s caused most growers there to switch to Pacific Oyster production.

The main challenge in Native Oyster production is to secure the quantities of high-quality seed required, given the small scale of current breeding programs, the South Australian Research and Development Institute is working with growers to overcome this supply issue.

Although production is limited Native Oysters are developing their own economic niche and are considered luxury seafood, commanding premium prices in restaurants.

PHOTOS: JULIE HALDANE





About half of the production from Pristine Oysters is exported – mostly to Hong Kong; fresh oysters arrive within a day of being harvested.



Pristine Oysters has seven hectares of leases in Coffin Bay and another 21 hectares in Franklin Bay, about halfway between Port Lincoln and Port Augusta.



The oysters are grown out in baskets, which hold them suspended in the nutrient-rich water of the Southern Ocean.



The simple yet secure baskets provide the growing environment in the crystal-clear waters of Coffin Bay.



And yes, they taste great!



Pristine Oysters sources its oyster spat from Cameron of Tasmania hatchery and Shellfish Culture Ltd. Pacific Oysters are originally from Japan, coming to Tasmanian waters in the 1930s. They were introduced to Coffin Bay in South Australia in 1969. Today, there are approximately 40 independent growers in the region. Worldwide, Pacific Oysters account for more than 97 per cent of oyster production.

# INDIGENOUS CUSTOMS ADD TO DISCOVERY EXPERIENCE

POSTER ILLUSTRATIONS BY FLUID DESIGN

Recording customary fishing techniques provides new tools for sharing stories and teaching the wider public about traditional practices

**“D**o you want to know who I am? I am a Wiradjuri,” says Angela Jeffery proudly during our first conversation. The Wiradjuri people are a group of skilled hunter-fisher-gatherer Indigenous Australians who lived in clans scattered throughout central New South Wales. Many Wiradjuri people still live within the area today.

Growing up in central NSW and later moving to the Gold Coast, Queensland, Angela Jeffery loved fishing with family and friends, so she is thrilled that her posters about customary fishing methods will help Indigenous communities record their traditions in a new way.

The posters were produced thanks to an FRDC Indigenous Development Scholarship. However, the inspiration came from Angela Jeffery’s fisheries management studies at Southern Cross University, where one of the associate professors, a local Indigenous man, made sure the Indigenous perspective was represented within the syllabus.

After completing her marine science and management degree, Angela Jeffery contacted Fisheries Victoria about its Aboriginal Fishing Strategy. She became the first trainee in its Aboriginal trainee program, based at Fisheries Victoria’s Marine and Freshwater Discovery Centre at Queenscliff.

Driven by a desire to learn and to give a useful teaching tool back to the wider Indigenous community, Angela Jeffery has



The posters are available for download at: [www.frdc.com.au/environment/indigenous\\_fishing](http://www.frdc.com.au/environment/indigenous_fishing)

used her FRDC scholarship to investigate Indigenous fishing practices, compiling her research into two posters detailing these practices, which are now part of the discovery centre’s collection.

“Angela was magnificent,” says Leanne Gunthorpe, manager of the fisheries education group. “We used to only briefly mention Indigenous fishing in our talks, but now we have fantastic props to help us expand our program.”

## Raising awareness

The Freshwater Discovery Centre aims to provide education services that create awareness about the importance of commercial and recreational fishing and the marine and freshwater environments. It promotes responsible fishing and informs non-fishers on the cultural, recreational and economic value of fish.

“Approximately 30,000 schoolchildren visit the centre every year, but our reach is much greater, thanks to activities for adults and our presence at numerous festivals around the region,” Leanne Gunthorpe says. “Angela has now provided us with great resources that will help us inform the Australian public of traditional fishing methods.”

One of Angela Jeffery’s posters reviews traditional Australian fishing methods, past and present, while the other focuses on the fishing methods used by the Wadawurrung people, who are the Traditional Owners of the area where the discovery centre is located.

“We were very happy to contribute information to Angela’s work,” says Sean Fagan, cultural heritage projects officer with the Wathaurung Aboriginal Corporation. “Projects like hers are extremely valuable to our community as they provide a strong sense of place for young Wadawurrung

people as well as raising awareness among other Australians about our culture and the fact that it is still alive today.”

Sean Fagan says the use of the Wadawurrung traditional language in the poster was particularly important, as most Australians do not realise that many commonly used words are in fact Wadawurrung words, such as Ballarat (resting place) or Geelong (tongue). Sean Fagan and the Wadawurrung people are planning to include the poster in their school outreach activities where they discuss cultural traditions of the region.

For Angela Jeffery, one of the highlights of her work was learning about different Indigenous community fishing techniques during the project. “It was important to ensure that the Wadawurrung were comfortable with the release of traditional information, the way it was being represented, and all of the drawings had to be designed specifically for each area.”

She also visited the National Museum of Australia in Canberra to learn about fishing practices in communities too far away for her to visit in person. “After gathering so much information, deciding what to include in the posters was the hardest part of the process,” she says. “But overall it was a very rewarding experience. I am particularly proud of how my work will help the communities involved to record their own traditions in a new way.”

The result is two posters that clearly and simply portray several Indigenous fishing methods, tools, vessels and cooking and feature the different roles of men and women.

### The posters

The national poster is a series of snapshots outlining one unique fishing technique for each Australian state and territory, and the Torres Strait. In NSW, for example, chewed shellfish and shaped shiny shells were used as bait and lures, whereas in Arnhem Land in the Northern Territory people wove barrier nets to trap fish in small creeks and streams.

In Victoria, trapping was also used but mostly to catch eels, with long woven cylinder-shaped tools placed strategically in weirs. Spears and harpoons were used in Queensland and the Torres Strait Islands respectively; some of the spears were made using human hair and some with a stingray barb.

Remarkably, Indigenous Tasmanian people stopped catching fish about 3500 years ago and focused on collecting shellfish instead. In South Australia, men often used simple bark canoes to fish, while women used rafts they made themselves to find and collect freshwater mussels in lakes.

The poster also highlights the many ways in which fishing is important to Indigenous Australians. Not only is it a source of food and something to exchange through trade and barter with neighbouring tribes, but it is also an integral part of many social interactions, such as traditional ceremonies and customs that adults can pass on to children.

Throughout their thousands of years of history, Indigenous people valued and understood the importance of safeguarding water resources, so clan laws and customs ensured fish were harvested sustainably, enabling future availability of food and materials from the water.

The ‘Wadawurrung Traditional Fishing Methods’ poster shows in greater detail the fishing customs and history of this tribe from southern Victoria. Traditional fish names are used throughout and a map which shows some of the traditional names of places in Wadawurrung Country is included.

The poster also provides a list of the names of the 25 clans that originally made up the Wadawurrung language group. Many of the tools and techniques described are still in use now except for the more ancient methods, and the study of middens has been particularly helpful in establishing what different clans ate. Middens are made up of discarded food wastes from many meals in one location and offer a unique insight into the eating habits of each clan throughout time.

Wadawurrung people would cook most of their seafood, with the exception of shellfish such as marine snails, which would mostly be eaten raw. Even in their canoes they would often have a small clay fire pit to



Angela Jeffery with Wadawurrung Elder Bryon Powell conducting a traditional smoking ceremony.

cook the animals they caught and to provide fish-attracting light at night. The canoes were fabricated from a single piece of bark shaped over fire.

Angela Jeffery arranged for the replication of a traditional spear and net to accompany the posters. This will give visitors to the Freshwater Discovery Centre a more complete experience thanks to the opportunity to handle the artefacts and really understand how they worked.

With a view to expanding the program to be better integrated into the school curriculum, these posters are the first of their kind and an important step towards maintaining Indigenous traditions in Australia.

### Scholarships

The FRDC will offer two Indigenous Development Scholarships in 2014, with applications closing on 23 April 2014. For more information contact Jo-Anne Ruscoe (02 6285 0400, jo-anne.ruscoe@frdc.com.au). F



# DISHED UP: REDISCOVERING SEAWEED LINKS IN FOOD CHAIN

Algae is one of the rising stars on the aquaculture horizon, but scientist Pia Winberg has been working to consolidate its role as an essential link in sustainable food production for more than a decade

**F**or Swedish-born Pia Winberg, the time has come to step out of the world of academic research and to 'join the fray' of commercial development. Since 1998 she has been working with algae and researching its potential in food production systems.

For the past five years it has been part of her role as director of the Shoalhaven Marine and Freshwater Centre (SMFC) at the University of Wollongong. But this year she is making the move into a commercial venture, with the aim of putting the ideas developed during research into action. Venus Shell Systems Pty Ltd is her newly formed company, which will focus on the land-based production of seaweed biomass.

The company has secured a site in the Shoalhaven region on the New South Wales north coast for pilot-scale production of three tonnes of seaweed this year. Her long-term goal is for commercial-scale production of seaweed for high-value bioactive ingredients for use in food and other products.

## Early inspiration

Pia Winberg credits her journey into marine science to two childhood experiences: studying science at school and snorkelling, where she marvelled at the new world available to her under water. But it was in 1998, enrolled as an honours student at Stockholm University in Sweden and

researching processes in a Tiger Prawn farm in Sri Lanka, that she became fascinated with algae.

She became aware of the potential in building a mini-ecosystem by matching species that use each others' waste streams and in which seaweed is one of the most important components.

"At the prawn farm in Sri Lanka, we were looking to overcome white spot disease by using a closed-loop production system that was isolated from polluted lagoon water. I was measuring the water-quality dynamics in this new, integrated, multi-trophic aquaculture farm; looking at where the nitrogen went from prawn waste to sediments and to other species such as Milkfish (*Chanos chanos*) and Tilapia (*Oreochromis mossambica*), mussels and seaweeds. It was an eye-opener for me about how we can make aquaculture more sustainable."

This growing awareness helped develop what was to become one of Pia Winberg's major research interests: marine food production systems that are sustainably integrated with the coastal and marine environment. In 2008, she graduated from the University of Wollongong with a doctorate in marine conservation ecology.

She was then appointed director of SMFC, where her focus has been on the development of seaweed cultivation systems for Australia, determining which species of seaweed are suited to Australian conditions.

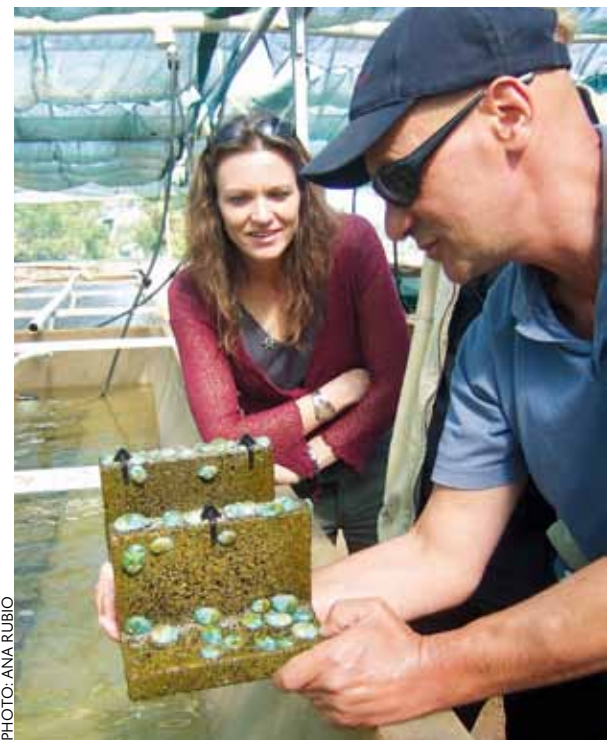


PHOTO: ANA RUBIO

Nick Savva, manager at the AbTas abalone farm in Clarence Point, Tasmania, showing Pia Winberg juvenile abalone fed a weaning diet of seaweed to increase growth rate and condition.

The seaweeds selected must 'tick the boxes' for good productivity and remediation, consistent biomass and consistent quality, and offer opportunities for new high-value markets in Australia.

## Marine food chain

Pia Winberg says production of these seaweeds can be attached to other aquaculture systems to remediate nutrient-rich water, and there are some projects in Australia already focused on this. Used in this way, seaweed has a role in bioremediation, where it strips out nitrogen, phosphorus and carbon, and re-oxygenates and buffers water. "We've achieved 90 per cent recirculation in a marine fish and seaweed integrated, multi-trophic aquaculture system. The value of the seaweed in reconditioning the water for fish is excellent."

Seaweed can also be used as an ingredient in aquaculture feeds because it is high in protein and has omega-3 fatty acids as well as bioactive carbohydrates. "The global trend is to use soybean meal in aquaculture feeds, but there are other ways

## INTERNATIONAL CONFERENCE

Phycology is the study of algae and from 22 to 27 June 2014, 600 national and international delegates are expected to attend the 5th Congress of the International Society for Applied Phycology at Australian Technology Park in Sydney.

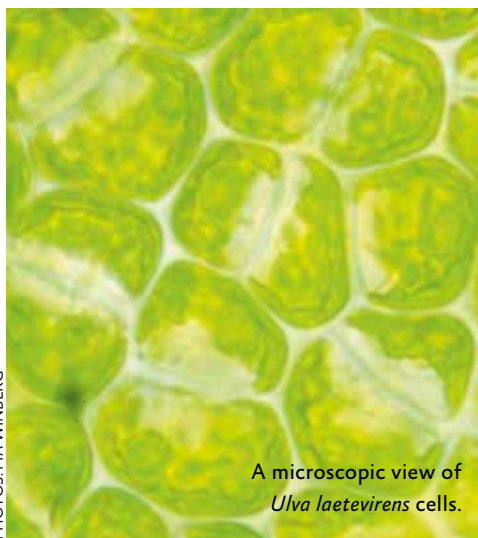
Pia Winberg is a co-convenor of the event and says she is looking forward to the conference, which has the theme 'Exploring real-world applications of algae'. A main focus of the conference will be the high-value components of all types of both macro-algae (seaweeds) and micro-algae (phytoplankton) and will also include a BioMarine Thinktank session looking at how new marine industries can attract investment, develop and progress. The event will also include the 'Great Biofuels Debate', to reflect on the reality of algal biofuels.



*Ulva australis*, a seaweed used as an abalone feed.



*Ulva lactevirens*, a species of sea lettuce that grows in Australia.



A microscopic view of *Ulva lactevirens* cells.

PHOTOS: PIA WINBERG



A species of sea lettuce, *Ulva lactevirens*, in culture experiments for bioremediation.

**"It has been a challenge getting people to open their eyes to the scope and opportunities in seaweed. People think that sushi and miso soup are all you can do with it."**

**– PIA WINBERG**

to incorporate protein and nutrition that keep the marine food chain intact," she says.

Will Mulvaney, a PhD candidate working with Pia Winberg, has shown that abalone production improves when seaweed replaces at least part of the formulated plant-based feeds.

"Seaweed is currently missing in our food chain," she says. Her vision is to incorporate cultivated seaweed biomass into soil, and as food for animals and people, to improve sustainable industry opportunities for good population health.

### High-tech applications

The extraction of unique molecules from seaweeds, in particular gel or dietary fibre molecules, is one opportunity for the emerging industry. "These are molecules used by the seaweeds for structure and flexibility and also for protection against bacteria, fungi, viruses and other stressors of the ocean environment. When extracted, they can be purified to deliver high-value compounds that also function in a similar way in soils, animals and humans."

Pia Winberg says in Australia seaweed has an image as "fluffy and alternative".

"It has been a challenge getting people to open their eyes to the scope and opportunities in seaweed. People think that sushi and miso soup are all you can do with it," Pia Winberg says.

However, seaweeds are already recognised in scientific fields as being nutritionally and medically important. There are small pockets of research and industry in Australia where seaweed gels are central to the progress of very high-tech medical research that Pia Winberg describes as "groundbreaking". For example, stem cell culture and even new biological 3-D printing for medical implants will rely heavily on seaweed extracts, which are often highly cell compatible and also have the appropriate gel texture to make such high-tech materials.

### An ancient crop

Analysis of 14,000-year-old middens in Chile has shown that seaweed was nutritionally important and valued and one of the oldest food crops, but that knowledge has been lost, Pia Winberg says.

The global status of the \$6 billion seaweed industry is important, but as a crop it is not as sophisticated as land crop industries. Issues such as genetic bottlenecks are starting to emerge, as well as lost opportunity through low species diversity or a lack of knowledge of the new and emerging markets.

"Some of our most important neighbouring countries such as Indonesia and the Philippines developed seaweed industries as recently as the 1980s. Now there are dedicated seaweed villages where the income provides the resources for educating children. In some regions, seaweed has become vital for hundreds of thousands of families.

"It will be very important for Australia to engage with these nations to cooperate and serve the collective interests in the development of sustainable marine industries. A first step could be offering help to re-establish seaweed farms that were hit by the recent typhoon in the Philippines – seaweed farms can be a cost-efficient and rapid road to recovery as seaweed crops are fast growing." **F**

# FUEL FOR THE FUTURE

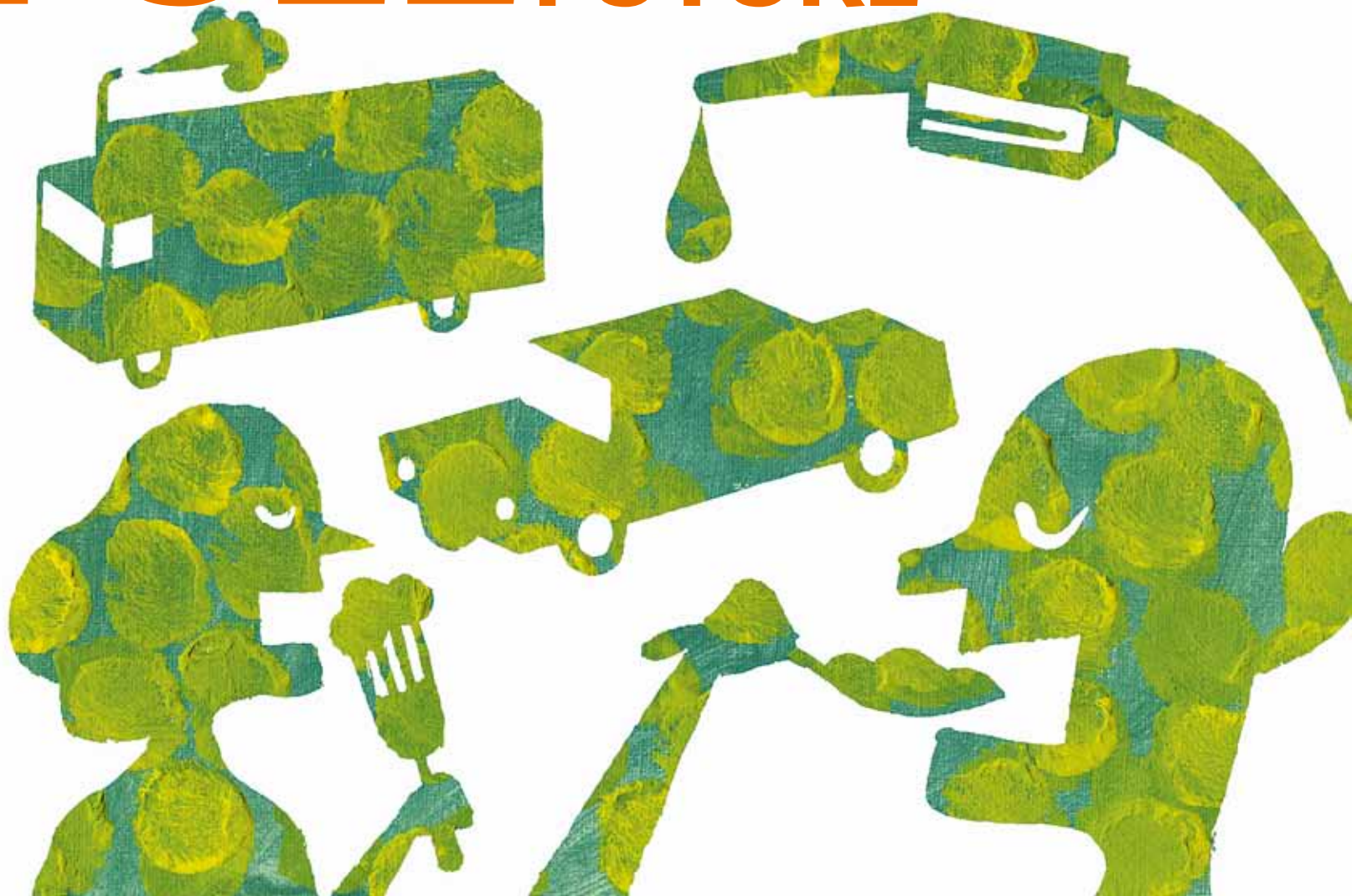


ILLUSTRATION: PAUL DICKENSON

The diverse potential of algae across fuel and food production industries should make them a top priority for research and development globally

**A** dramatically expanded algal aquaculture industry could secure Australia's transport future, and contribute to its long-term agricultural and dietary needs, says a prominent commentator on food security.

Julian Cribb, an adjunct professor at the University of Technology, Sydney, presented a discussion paper on the potential value of an Australian algal industry for Future

Directions International, an independent, not-for-profit research institute based in Perth, Western Australia. The aim of his paper was to stimulate debate about the potential role of algal biofuels and the role of aquaculture. Future Directions International conducts independent strategic analysis and research into issues Australia will face in the medium to long term.

Julian Cribb argues that, given the country's reliance on road-based transportation for food distribution, wide-scale algae farming for biofuels offers a viable energy risk-management strategy. There are also potential applications for both micro and macro-algae species in nutrition, waste disposal and plastic production.

"Algae are not a 'silver bullet' – there is no such thing in the energy and food

industries,” Julian Cribb says. “However, they are a new, highly promising option for Australian farmers, resources companies, investors, governments and young people to consider as we plan a more prosperous, sustainable and secure future in an insecure and fast-changing world.

“Where algae have an advantage over existing industries is in their ability to provide enduring solutions to real threats to national security, both of food and fuel. They have particular suitability to the climate and geography of Australia, and to the technical skills and positive outlook of its people.”

Julian Cribb has calculated that an expanded algal industry could generate \$50 billion in new revenue and create more than 50,000 new jobs, particularly in regional Australia. But to seize the opportunity, Australia must accelerate its national research and development effort into algae culture and biofuels, he argues.

### Boosting biofuels

“Petroleum is primarily a biological product, produced over millions of years by the breakdown of organic matter (chiefly from algae) and its reprocessing by geological heat and pressure,” he explains. “Oil is also produced renewably every day by living plants, using sunlight as their main energy source, in forms that can be used in all the ways we now use petroleum – and many more.”

Julian Cribb says the United Nations Food and Agriculture Organization’s research has found that “the most productive source of ‘fresh’ oil is green algae ... these produce over 100 times more oil than do land plants (such as canola, sunflowers or soybeans) because they do not have to divert energy to producing roots, stems, flowers, seeds and leaves”.

There are 72,500 known algal species and the oil content of each plant as a proportion of dry weight for wild species can be as high as 77 per cent for *Schizochytrium* and 42 per cent for *Dunaliella*.

Australia is uniquely positioned for algal farming because of its land mass and sunshine, according to Julian Cribb. “Algal fuel and food is ‘bottled sunshine’. The energy from the sun is converted by tiny plants using photosynthesis and stored as oil, proteins and carbohydrates ... thanks to our mid-latitude location and relatively cloudless skies,

Australia receives more sunlight per square metre ... than almost any country on Earth.”

Based on current literature on oil yields, he says it would be feasible to produce enough algae for Australia’s fuel needs from 6000 square kilometres of ponds, about 0.07 per cent of Australia’s land surface area. But the ‘ponds’ could take on versatile forms.

“Algae, being water plants, can also be grown at sea and in bays in floating tanks or plastic bags, so the actual area required for fuel self-sufficiency may be as low as 0.03 per cent of Australia’s sovereign land and ocean territory.

“Intensive algal production may take as little as a tenth of the land required for ponds, and can be carried out on individual farms, factories, mine sites, urban wasteland or industrial land, providing renewable local fuel right where industry most needs it. There is no reason for algae culture to compete for land area with food production or wilderness.”

### Smarter water and nutrient use

Large amounts of water would be a prerequisite for algal farming, but this industry need not compete with current uses for water, particularly as algae grow in salty, marine or brackish water not fit for drinking, livestock or industry, Julian Cribb says.

“Algae farms can be located in bays and bights, in tidal inlets and in salt flats and salt lake beds, on abandoned farming or grazing lands, or contaminated industrial sites. Most algae farms recycle their water, so losses are mainly confined to evaporation. In intensive algae culture, most water used can be recycled.

“Algae farms can also make use of sewage effluent and other urban or industrial wastewaters, or groundwater released by mine dewatering or oil and gas production. The bioremediation of these sources is a significant opportunity to clean the water for reuse and offset the costs of fuel production as well as reducing costs to the polluting industry.”

Nourishment for algal crops could be from the \$3 to \$4 billion worth of food Australians throw away each year, and other organic wastes from factories and abattoirs, garden and park clippings, and most of the nutrients in its sewage system.

“All these nutrients can readily be recycled to nourish algae, which in turn will yield fuel, fertiliser and feed for animals and fish.”

As part of a national algal farming strategy, Australia could adopt similar organic waste-recycling systems to those operating in parts of Europe, with sewage biosolids and effluent also recycled.

“Algae farming, in other words, offers a cure for a major waste-disposal headache for Australia by reusing nutrients currently considered too contaminated to use in food production. This will reduce the flow of material into landfill, and eliminate ocean and river pollution by effluent. Algae thus provide the ‘missing link’ in Australia’s nutrient-management chain, encourage recycling and reduce national exposure to imported fertilisers (from global sources as risky as oil).”

### Eating algae

Julian Cribb foresees a growing role for Australian cultured algae in both human and animal foods.

“An important aspect of a widely dispersed algal feed production is that yields are less likely to be adversely affected by climate extremes than broadacre grain production, especially the closed intensive algal systems. Algae therefore represent a far more climate-stable and reliable source of feed (and food) at a time of growing climatic instability, and hence a genuine national response to climate change adaptation,” he says.

“As grain production becomes less reliable due to a changing climate and more grain is required for human food, the potential to feed the world’s meat animals, poultry and fish on a diet based on algae will grow dramatically. Up to half the by-product of algae grown for oil consists of vegetable protein and carbohydrates highly suitable as animal and fish feeds. This in turn holds major benefits for Australia’s livestock and aquaculture sectors.”

Unlike traditional agricultural sectors, an expanded algae industry could also slot seamlessly into the urban environment, helping to create greener cities, he says.

“Algae (both micro and macro) can be integrated in many creative ways with the production of vegetables, fish, fruits, health foods and small livestock as part of the emerging urban agriculture, both to recycle wastes and to create new products.” **F**

Healthy Blue Mussel reefs still exist in Gippsland and could be restored in areas such as Port Phillip Bay.

# Habitat: a high-yielding investment

Improving the productivity of fisheries is one thing commercial, recreational and Indigenous fishers are all in favour of – repairing estuaries provides the opportunity to do just that

PHOTO BRENT WOMERSLEY

A \$350 million investment in estuarine habitat restoration would be recouped in five years through increased fisheries productivity according to a new cost-benefit analysis that identifies a national program of priority works.

The report *Revitalising Australia's Estuaries* uses three case studies to estimate potential returns on investment. The scope of potential works outlined in the report includes more than just those in the case study regions, and overall return on investment would be much greater than the case study estimates alone.

For the report's senior author, Colin Creighton, such an investment represents infrastructure development as much as it does environmental restoration, with long-term returns to fishers, jobs and the Australian community.

"This is not surprising when it is recognised that our estuaries are our most productive ecosystems and the demand for food, for enhanced recreational experiences, for Indigenous take and for improved biodiversity are all growing," he says.

The case study fisheries are the Coorong at the mouth of the River Murray in South Australia, the floodplains of the Great

Barrier Reef in Queensland, and New South Wales' major estuaries.

In addition to more productive fisheries, habitat restoration would improve coastal water quality, enhance catchment hydrology and repair coastal biodiversity. It would also finetune flood control, re-establish carbon sequestration and reinforce foreshore buffering against extreme events. None of these additional benefits have been costed.

"Our estimates suggest a break-even for investment just from increased fisheries product is well less than five years and from then on benefits of more seafood exceed costs forever."

The analysis, which was funded by the FRDC and the Australian Government Biodiversity Fund, received widespread support and input from state and federal fisheries and conservation agencies, as well as the fishing industry, and research and Indigenous groups.

The bulk of the proposed investment – \$238 million – would be spent on infrastructure works to restore connectivity of estuarine systems, such as fish passages, wetland acquisition and repair, and complementary works to ensure smarter floodplain and estuarine systems.

Planning, monitoring and communication are included in the cost estimate, along with funding to support the development of consistent policy and regulations in each state for estuarine and nearshore habitat protection, repair and for development offsets.

## Coorong

In the Coorong, the financial analysis, led by Justin Brookes from the University of Adelaide, has been based on increased returns from potential increases in Mulloway (*Argyrosomus hololepidotus*), Yelloweye Mullet (*Aldrichetta forsteri*), Black Bream (*Acanthopagrus butcheri*) and Greenback Flounder (*Rhombosolea tapirina*). Numerous other species, including Pipis (*Donax* spp.), could also be expected to benefit. The Coorong commercial fishery has a current annual economic value of \$5.7 million.

Estimated fishery productivity improvements of 20 per cent across all key species could lead to comparable increases in the annual economic value. "While the fishery is comparatively small, the economic and employment benefits to the regional community are substantial," Justin Brookes says. "The total estimated increase in the

value of productivity for these selected species following the completion of identified works is at least \$260,000 a year.”

Other major benefits would include increased fisheries productivity for recreational fishers, protection of the biodiversity in this listed World Heritage Area, increased tourism and protection of Indigenous cultural values.

### NSW floodplain estuaries

The NSW analysis, led by Pia Weinberg from the University of Wollongong, includes the subtropical floodplain-dominated estuaries – essentially concentrating on the state’s major estuaries while recognising that benefits would also accrue to south-east Queensland and to the Gippsland Lakes.

Sydney Rock Oyster (*Saccostrea glomerata*), Mullet and School Prawn (*Metapenaeus* spp.) are the three species used to calculate the potential cost-benefits. Total estimated productivity value increase for these selected species is at least \$94 million a year. Other key commercial species not valued in terms of productivity improvements but likely to benefit from estuary repair include Eastern King Prawn, Yellowfin Bream (*Acanthopagrus australis*), Dusky Flathead (*Platycephalus fuscus*), Luderick (*Girella tricuspidata*), Mulloway, Garfish, eels and Whiting.

Other benefits from investment in NSW include: a reduction in, and severity of, disease or fish kills resulting from low-dissolved-oxygen, acidic blackwater; reduced methane emissions from deteriorating wetlands; improved carbon sequestration; and improved flood control.

### Great Barrier Reef

Marcus Sheaves, from James Cook University, says the Great Barrier Reef is far more than just the coral reef – seagrasses, mangroves, salt marshes and brackish to freshwater wetlands are all essential parts of the reef ecology.

A lack of detailed history has made it difficult to separate habitat influences on the decline in fisheries productivity in the Great Barrier Reef region from other causes. Using catch data dating back to 1990, Tiger Prawns and Banana Prawns have been the species used in calculating improvements from habitat works, estimated to be \$45 million a year. However, many other popular commercial recreation and commercial species including Barramundi (*Lates calcarifer*), Red Emperor (*Lutjanus sebae*) and Mangrove Jack (*Lutjanus argentimaculatus*) also have larval or juvenile phases inshore or nearshore and could be expected to benefit.

## A REEF TO CALL HOME

The re-establishment of shellfish reefs to improve the productivity of fisheries has been identified as a priority for large embayments from Moreton Bay in south-east Queensland through to Victoria and Tasmania and across to Albany Harbour in south-west Western Australia.

Studies in several estuary systems worldwide have indicated that shellfish beds are a significant part of the food chain, provide important structural habitats for a large variety of invertebrate and fish species and provide increased protection from predators of juvenile fish.

Research in the US has demonstrated that once the water quality is improved, increasing the area of oyster beds can increase net fisheries production, and oyster reefs have been defined as ‘essential fish habitat’. On the east coast of the US, one project in Chesapeake Bay used shell to rebuild the reef structures over 34 hectares. Native oysters repopulated these reefs, resulting in a 57-fold increase in the population to an astonishing 185 million oysters within five years.

In addition to their value as fish habitat, shellfish reefs provide nutrient cycling, water filtration, benthic–pelagic coupling, substrates for settlement of other invertebrate and algal species (the building blocks for biological reefs), sediment stabilisation and potentially even carbon sequestration.

Fisheries scientist Paul Hamer, from Fisheries Victoria, says recreational and professional fishers have long lamented the loss of shellfish beds in Port Phillip Bay. The reefs were seen as providing important feeding and nursery habitats for fish, particularly Snapper (*Pagrus auratus*).

Sedimentation, pollution and the introduction of exotic species, as well as periods of intense dredge fishing for shellfish, have all contributed to the decline or loss of shellfish reefs. Paul Hamer says a big issue with re-establishing shellfish beds is the lack of existing hard substrates, such as old shell beds, for the shellfish to attach to, as the historic shell beds were removed or buried.

Independently of the *Revitalising Australia’s Estuaries* report, a pilot project has been developed for Port Phillip Bay to trial the use of various man-made substrates seeded with oyster and/or mussel spat, and planting out established adult oysters in re-establishing Native Oyster (*Ostrea angasi*) and mussel reefs.

Projects in the US have used oyster shells collected from restaurants to successfully reconstruct reef, with almost immediate improvements in fishery productivity. One project in Mobile Bay, Alabama, resulted in a 297 per cent increase in the Blue Crab population, a 108 per cent increase in Red Drum and 79 per cent increase in Flounder within five years.

Port Phillip Bay is well placed to implement such a similar fisheries rejuvenation project, which would benefit both professional and recreational fishers.

Other projects identified in *Revitalising Australia’s Estuaries* include re-establishing Sydney Rock Oyster (*Saccostrea glomerata*) reefs in sheltered intertidal and subtidal zones in south-eastern Queensland, particularly around Moreton Bay, and rebuilding remnant reefs of Native Oysters in Georges Bay, Tasmania, and south-west Western Australia.

**More information:** Paul Hamer, 03 5258 0111, paul.hamer@depi.vic.gov.au



PHOTO: JOHN MERCER

Juvenile Native Oysters attached to grow-out ropes, Port Phillip Bay.

Marcus Sheaves says additional benefits from improvements in the Great Barrier Reef fisheries include increased productivity for recreational fishers across almost all popular species and supporting the Great Barrier Reef's \$4 to \$5 billion tourism industry. General improvements to estuarine habitats would flow through the reef biodiversity, including iconic species such as dugongs and turtles.

Protecting Indigenous cultures and communities in the region and greater carbon sequestration and protection of the Great Barrier Reef's World Heritage values have been identified as likely benefits.

### Valuations

The project uses retail prices as the basis for fisheries values, but no non-market values or estimates of recreational fishing benefit have been included. "All dollar values are deliberately conservative. This project leaves it to others to speculate on dollar values for what this analysis regards as 'externalities', including the flow-on benefits to tackle shops, tourism, marine centres and so on," Colin Creighton says.

He identifies several types of repair opportunities across both public and private sectors, including:

- ponded pastures and the interface between grazing land and wetlands;
- bunds and weirs that may block tidal or flood flows;
- wetland drainage, floodgates and levee amendments to allow fish passage and restore wetland functions;
- infrastructure redesign to factor in floods, enhance tidal flows and fish passage;
- restoration of riparian landscapes; and
- re-establishment of estuary seagrasses and oyster and mussel shell beds.

The report identifies priority works in each state. Further planning and local approval processes will be needed on a case-by-case basis to ensure stakeholder agreement and to maximise return on investment in terms of improved fisheries productivity.

### State priorities

In Western Australia, proposed works include: reconnected waterways in the Peel-Harvey catchment to the main estuary, especially the Serpentine River; identifying

alternative outfalls for stormwater and drainage flows in the Leschenault region; and rehabilitation of the Point Souro foreshore. Reconnecting the upper Sabena River to the estuary system in the Vasse-Wonnerup region and the Marbelup Brook in the Torbay/Lake Powell system has also been suggested.

Proposed work in SA focuses on improving freshwater flows through the lower Murray River and Coorong systems, re-establishing seagrass beds now that there is better management of terrestrial run-off in Gulf St Vincent and Spencer Gulf, and providing fish passages and improving tidal flows through the south-east-coast lakes system including Lake Bonney SE and Lake George.

There are 24 modified and four highly modified estuaries in Victoria identified for works. Re-establishing oyster and mussel shellfish beds as the basic building block for multi-species fisheries is a priority for Port Phillip Bay and Western Port Bay. Re-establishing lateral connectivity in floodplain wetlands and salt marshes, rationalising drainage, restricting cattle access to salt marshes and reducing the risk of acidic anoxic water discharge from acid sulfate soils to estuaries have also been identified for works.

Native Oyster spat produced at the Queenscliff commercial shellfish hatchery.



PHOTO: JOHN MERCER

In Tasmania, re-creating multi-species fisheries in the D'entrecasteaux Channel and east coast estuaries based on re-establishing oyster beds has been identified as a priority. Re-establishing fish passage and tidal flows across all key estuaries, repairing salt marshes and sedge lands by restricting cattle and relocating drainage outflows have also been recommended, along with reducing

siltation of the Tamar estuary and increasing flows to enhance the flushing of estuaries.

Significant works have already been undertaken in NSW to restore wetland processes and tidal flows, rebuilding fisheries productivity most notably in Hexham Swamp, Hunter River, Yarrahappini wetland, Macleay River, and Darawakh Swamp, Wallamba River. Much remains to be done. The many large floodplain systems in NSW provide multiple opportunities to increase fisheries productivity. Priority opportunities identified are:

- Tweed Estuary and Cudgen Lake, Richmond River and catchments including the Tuckean Swamp, Rocky Mouth Creek and Bungawalbin Creek wetlands;
- Clarence River system, including Everlasting Swamp, Shark Creek and Coldstream wetland processes, Wooloweyah Lagoon and Lower Estuary, and Broadwater;
- Bellingen and Nambucca catchments;
- Macleay catchment including Swan Pool, Belmore and Frogmore Swamps, and Clybucca wetland;
- Lake Innes;
- Manning catchment including the Cattai wetlands, Moto Swamp;
- Hunter River, including Woodberry Swamp, Purgatory Creek and Seaham Weir; and
- Shoalhaven floodplain wetlands.

Proposed works in Queensland outside the Great Barrier Reef catchment focus on re-establishing high-priority oyster reefs as the key to south-east Queensland fisheries productivity. Investment in repair is recommended for wetlands and nearshore seagrasses in the Great Sandy Strait, changes to boat mooring practices to reduce impacts on seagrass beds, and restoring fish passage wherever possible without compromising flood control and other instream developments such as irrigation water supply.

Of the 150 estuaries in the Northern Territory most are in near-pristine condition. Only three are 'modified' and only two are 'extensively modified'. The emphasis of any investment in habitat within the Northern Territory is aimed more at protection than repair. This includes support for further policy formulation to maximise habitat protection while recognising that further development will occur. **F**

FRDC Research Code: 2012/401

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## Shared perspectives broaden leadership skills

**N**ow in its 14th year, the National Seafood Industry Leadership Program (NSILP) is going from strength to strength, with graduates taking leadership roles in a number of state and national industry and government organisations.

One of the most valuable aspects of the program has proven to be the diversity of participants, and the opportunity to share their perspectives of the industry, says program leader Jill Briggs, of Rural Training Initiatives.

She says it is a specific strategy, in choosing the 15 or so candidates for the program each year, to include people from a variety of sectors within the industry, including wild catch, aquaculture, recreational, Indigenous, processing, retailing, research, government and training. "That way everyone gets a broader understanding of the industry, and can see that they are part of a much bigger picture."

The 2013 graduating class is a good example of this cross-sectoral approach, including:

- Kelly Buchanan, director of the International Fisheries Section in the Department of Agriculture;
- Tony Charles, hatchery manager at Australian Prawn Farms, in Mackay, Queensland;
- Ben Cobbing, a Tasmanian abalone diver based at Smithton and director of the Tasmanian Abalone Council;
- Bruce Davey, a long-time fisher based in Darwin, Northern Territory, fishing in the Gulf of Carpentaria;
- John Cordin, business development and sales manager for Austral Fisheries;
- Dan French, a fisheries researcher and director of Frenchenviro, a consultancy specialising in sustainability, environmental assessment and ecosystem design;
- Matt Gillett, policy officer with Recfishwest, the peak body for recreational fishers in Western Australia;
- Steve Groom, finance manager and company secretary of Sydney Fish Market;
- Dimitri Hari, retail operations manager for Transtasman Fisheries, based at Sydney Fish Market;

NSILP graduates Kelly Buchanan (left) and Bruce Davey (right) with program co-ordinator Chris Calogeras.



- Chadd Mumme, aquaculture lecturer for Trades and Primary Industries at Charles Darwin University;
- Andy Myers, OceanWatch Australia extension officer for New South Wales;
- Matt Osborne, an Indigenous development consultant with the public sector agency Rural Solutions SA;
- Scott Parkinson, breeding manager at Shellfish Culture Ltd, Clifton Beach, Tasmania;
- Clive Perryman, a Tasmanian rocklobster fisher, board member of the Tasmanian Rock Lobster Fishermen's Association, and fisher participant in the Seafood Industry Partnerships in Schools program;
- Katie Scutt, who works with the Australian Fisheries Management Authority in Canberra, focusing on northern and western Commonwealth fisheries; and
- James Ward, general manager of the NSW Fishing Industry Training Committee.

The program requires participants (and their businesses or employers) to commit nine days to the program. Funding for the training is provided by the FRDC and co-sponsoring industry partners. Sydney Fish Market is the program's gold sponsor. In addition to learning leadership skills and having access to industry networks, participants also break into groups to undertake a specific research project.

There was one whole-of-team mission and four smaller group projects in 2013. One group identified the need for a 'blue sky think tank' for the fisheries industry to generate new ideas and research directions;

a grant application has been developed to support this proposal. A second project involved interviews with 300 people to identify communication barriers between peak bodies and national and state agencies, and the grassroots members of the fishing industry. The group found that information was not filtering through as effectively as it could.

A third project looked at the potential for QR codes to provide information about the source of seafood as it progressed through the supply chain, and determined that they provided a highly effective means for linking relevant information with products. The fourth project (before the 2013 federal election) prepared a communication strategy to ensure the new minister responsible for fisheries was aware of key industry issues. This resulted in members of the group working on this project securing a meeting with the senior adviser to the Minister for Agriculture following the election.

Jill Briggs says the leadership program has been designed in consultation with the seafood industry and focuses on developing the skills of its participants at three key levels – personal, business and national industry. Handling conflict, improved communication techniques, high-performance team building, change management and media training are also part of the program.

The 2014 program is in the process of being finalised. Applications for the 2015 program will open in November 2014. **F**



# Conversations to build relations

Researchers investigate public perceptions of wild-catch fishers and suggest new approaches to improve trust in the industry

**W**hen controversies arise in any industry, so too, can a compelling urge to flood the media with information that will “correct the public’s attitude”. Yet ‘public opinion’ represents a vast convoy of competing interests and influences, ever shifting and difficult to define, social researcher Nicki Mazur says.

In the wild-catch commercial fishing sector, both specific controversies and the ongoing issue of fishery sustainability have sparked this informational overload response from industry. However, Nicki Mazur's research suggests a long-term approach based on building relationships, could be more effective in building a positive platform from which to operate and influence decision-makers in the future.

She has led the FRDC-funded project 'Let's Talk Fish' along with her Charles Sturt University colleague Allan Curtis and Andy Bodsworth from Cobalt Marine Resource Management. They have tackled the challenge of identifying how public perceptions about the sustainability of the wild-catch sector are formed, and how 'potent' or strongly held those perceptions are.

"These perceptions underpin the social acceptability of the sector, or the social licence to operate. 'Social acceptability' is a valuable currency across many sectors. Public debate can influence community support and decision-makers alike, presenting the potential to alter the viability of the industry," Nicki Mazur says.

She says if the wild-catch industry is to prosper, regulations governing access to fish and marine resources must in part reflect a sense that the sector is operating with the widespread approval of society.

### Approval rating

To investigate current levels of social acceptability felt towards the sector and the motivations driving these judgements, researchers developed a mail survey and distributed it to a random sample of residents across Brisbane, Sydney and Melbourne.

The survey results revealed widespread public approval for a wild-catch fishing sector in Australia, but it was conditional on the belief that the sector was being effectively regulated and acting in an environmentally sustainable manner.

While the largest number of respondents elected to 'disagree' with positive statements about being able to rely on the wild-catch commercial fishing industry to act sustainably and in the interests of the environment, almost as many declared themselves to be 'unsure'.

"Public trust is critical to social acceptability for primary industries and for governments alike," Nicki Mazur says. "We wanted to find out to what degree respondents thought this industry is prepared to act in the public's interest, not just its own interests, and how able it is to fish sustainably."

In designing the survey, the research team consulted with the project steering committee and representatives from fisheries management, the fishing industry, the research community and the environmental non-government organisation (NGO) sector.

Questions were refined to ensure the tone and nature of the survey would elicit a distinct response as well as measure a respondent's values, beliefs and norms, perception of risk, and trust in and attitude towards the industry, as well as government.

To address the possibility that the respondents might not be representative of the wider public, researchers tested the selection against Australian Bureau of Statistics household and population data for age and education.

"The sample did appear to be composed of slightly older Australians with slightly higher levels of education," Nicki Mazur explains, "but there weren't any significant differences when tested against social acceptability judgements."

### A question of trust

To gauge how trustworthy respondents felt the industry was in terms of fishing sustainably, researchers included questions about the sector's benevolence, integrity and ability to adopt best-practice methods and work towards a sustainable future.

Most respondents identified themselves as having strong environmental values and demonstrated a belief that the sector can and does have a negative impact on marine habitat, animals and birdlife, recreational fishing and the availability of fish species for seafood in the future.

While respondents consistently favoured Australian seafood over imported products, they also wanted more funds invested in preventing harm to marine animals and birds, and in better understanding the impact of recreational and commercial fishing on the environment.

Nicki Mazur acknowledges that the survey did not measure the importance of the environment relative to other issues, but says that the findings nonetheless suggest that strong environmental values exist in the public sphere.

"Overall, the low level of trust in the sector is an area of concern," Nicki Mazur says. "One of our key recommendations is for the industry to improve its engagement with the public but, to an even greater degree, with stakeholders."

In the wild-catch commercial fishing industry, stakeholders can represent a range of interests and experiences, from decision-makers to environmental NGOs, industry groups to recreational fishers and fisheries.

### Influence over access

Researchers were keen to investigate the influence of social acceptability factors on key access decisions in the industry. They conducted more detailed interviews with a range of stakeholders to examine the factors those stakeholders thought influenced decisions about and perceptions of the industry, from different standpoints.

Four different fisheries-access decisions were used as case studies for the interviews. Decision-makers and fisheries and interest group representatives were asked to identify factors of influence as well as the extent to which these factors impacted access decisions in Australia. The case studies included:

- establishment of the South-west Commonwealth Marine Reserves Network;
- New South Wales Government buyback of commercial fishing licences and establishment of recreational havens;
- changes to the *Environmental Protection and Biodiversity Conservation Act 1999* to reinstate recreational fishing for migratory Mako sharks; and
- development and implementation of the Commonwealth Fisheries Harvest Strategy Policy.

Interviewees suggested a broad range of factors influenced access decisions, including policy commitments, scientific frameworks, consultation processes, policy issues and controversies, and separation of fisheries management and conservation agencies.

The values and beliefs of influential people within the fishing industry, interest groups and government decision-makers also influenced decisions.

When asked to identify to what extent they thought each decision was influenced by interest groups, public opinion and the media, interviewees spoke of the role of environmental NGOs and public campaigns in raising awareness and encouraging the public to take action.

The interview data pointed to the ability of interest groups to rally parts of the public with similar values and beliefs to their own. In turn, decision-makers have to decide how representative those responses are of the wider public and to what extent and in what way policy should be changed to reflect those interests.

### Interests align

Nicki Mazur says that in all four case studies interest groups, decision-makers and the fishing industry had all tried to understand how and to what extent public opinion aligned with their respective interests.

While this might seem an obvious goal for stakeholders to pursue, it confirms the complex nature of the challenges facing the industry. However, there is hope. “We believe that our research confirms the importance of these issues and that some of our findings shed new light on the subject,” Nicki Mazur says. “But these results are only a snapshot. Social acceptability is dynamic and always changing.”

The researchers presented the findings in a workshop at Seafood Directions, the Australian seafood industry national conference held in South Australia in October 2013. It was a delicate task but one that was met with interest and energy from participants.

“We really wanted to consult as widely as possible,” Nicki Mazur says. “Our workshop was about focusing on the problem and what the implications might be when it comes to creating an engagement strategy for the future. It was a diverse audience and that was important. We worked with an insightful group of fisheries government managers and industry association leaders, as well as representatives from conservation interest groups.”

Nick Rayns, executive manager of the Australian Fisheries Management Authority and a member of the project steering committee, attended the workshop and found the discussion valuable in capturing different perspectives.

“It was good to talk through the perspectives the industry has and other jurisdictions too, in terms of what they thought of the research,” he says. “There was discussion about having a peak body for the industry where this dialogue could take place and deal with some of these issues.”

While agreeing on issues might sound simple, it is a complex and integral step needed before tackling how the industry can engage differently with key stakeholders and the public and build a sense of trust. Some of the participants suggested revising the language used to describe the industry, using ‘wild harvest’ and ‘professional’ instead of ‘wild catch’ and ‘commercial’ to better reflect the setting and skills required to fish sustainably.

Nick Rayns admits that phrases such as ‘exploiting fish stock’ tend to conjure up confronting images, but cautions against changing language to disguise actions. “In the end, industry and in many cases the government have to be honest about the fact that when you harvest fish you often accidentally kill other marine wildlife, seals, dolphins,” he says. “In the minds of many members of the public, they think, ‘Why is that happening and what are you doing about it?’ I think those are fair questions that deserve an honest answer.”

Since facilitating workshops at Seafood Directions and with the Women’s Industry Network for Seafood Community, the researchers have arrived at a set of guidelines on which to build an engagement strategy for the sector.

“The general public is a broad, diffuse target,” Nicki Mazur says. “Likewise, the fishing industry is not one homogenous group; it is made up of many distinct sectors and groups that are spread across Australia so it makes targeting ‘the public’ very difficult.

“We know from previous work that in times of low trust it is better to start to build genuine engagement and dialogue with government decision-makers, members of interest groups and their local communities,

### GUIDELINES FOR MORE EFFECTIVE ENGAGEMENT

- Focus on engaging rather than communicating with stakeholders.
- Build a positive vision for the industry’s future.
- Avoid information wars and build stakeholder relationships.
- Selectively communicate with the public.
- Improve understanding of the policy process and manage expectations.
- Engage internally to help people move forward.
- Seek professional assistance and continue to build engagement capacity.
- Identify the roles and responsibilities of every person in the industry.

than engaging in expensive information war in the media after a controversial issue has erupted,” she says.

The report notes it takes time to build relationships and that sectors should focus on identifying and engaging with those who have significant influence in decision-making contexts and the ability to galvanise parts of society with similar interests. “If you don’t understand the values and beliefs of your audience,” Nicki Mazur says, “just telling them that you can be trusted isn’t sufficient.”

Nick Rayns agrees: “The public won’t trust you unless you’re honest with them. That’s why part of the debate needs to be around what sort of approach could be used to gain the public’s trust.

“It’s a tough debate but it has to be had if the wild-catch industry is going to thrive in the future.”

The *Let’s Talk Fish* final report also recommends that the industry establishes a strategic vision or aspirational goals consistent with predominant social values and demonstrating a commitment to environmental sustainability.

“We by no means suggest that you just turn around and make friends with people,” Nicki Mazur says. “It’s just not that straightforward. But we do feel that the industry would benefit from repositioning its strategies to focus on relationship building, and that’s not a simple thing to do.” **F**

FRDC Research Code: 2010/313

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## Fish, humans seek more omega-3s

**W**hile the latest research continues to identify the health benefits of omega-3 in fish oil for people, the impacts of the increased demand for fish oil on the global seafood industry also featured at an omega-3 symposium held in Newcastle, New South Wales, in November 2013.

The symposium was jointly hosted by the Omega-3 Centre and the Australasian section of the American Oil Chemists' Society. More than 115 scientists, researchers and industry representatives attended the day-long event.

Several presentations reflected the need for increased omega-3 consumption, primarily through fish and seafood, for specific health benefits.

Cardiovascular disease is one of the leading causes of death in Australia, with one Australian dying from the disease every 12 minutes. Keynote speaker Clemens von Schacky, from the Preventive Cardiology Unit at the Ludwig Maximilian University of Munich in Germany, discussed how heart health could be matched to the HS-Omega-3 Index®, which he developed in collaboration with William Harris from the US.

The index can be used to measure the efficacy of omega-3 supplementation and is expected to provide a more powerful biomarker for cardiovascular disease than cholesterol testing. However, Clemens von Schacky said it may take five years or more before doctors begin recommending omega-3 index testing as part of regular check-ups and blood testing.

Also supporting the need for increased fish and seafood consumption for heart health was David Colquhoun, a cardiovascular surgeon at the Wesley Hospital and Greenslopes Private Hospital and a professor at the University of Queensland.

He is also on the scientific advisory board of the National Heart Foundation. David Colquhoun said the National Heart Foundation continues to endorse consumption of one gram a day of docosahexaenoic acid and eicosapentaenoic

acid – the important long-chain fatty acids found in fish oil, known as DHA and EPA – for coronary heart disease sufferers, and 500 milligrams DHA/EPA a day for everyone else as a preventative measure for heart health.

Other presenters covered the latest research on the health benefits of omega-3. Increased consumption of long-chain omega-3 fatty acids, either through fish or seafood consumption or omega-3 fish oil or krill oil supplementation, has provided positive benefits for heart health, cognitive function, rheumatoid arthritis, asthma and eye health.

Adam Ismail from the Global Organization for EPA and DHA Omega-3 (GOED) highlighted the increasing use of omega-3s in new pharmaceutical medicines and the challenges of the omega-3 industry to increase demand while simultaneously increasing the supply of a global natural resource.

Giovanni Turchini, a professor at Deakin University and a global expert in aquaculture, discussed the changing balance between wild-catch and aquaculture production of fish and seafood and the implications for fisheries and omega-3 production. He said while the harvest of wild seafood has remained relatively static for many years, aquaculture production has been increasing rapidly. Globally, it now provides more fish and seafood than the wild-catch industry.

“Some sectors of the highly diverse aquaculture industry contributed positively to global seafood availability. Others that relied on aquafeeds incorporating wild-caught fish could have a negative impact on the global supply, and consequently, on omega-3 availability.”

To address concerns about the use of wild-caught fish in fish farming, the aquaculture industry has been trying to reduce the amount of marine fish in feeds. However, Peter Nichols project leader – Omega-3 Oils in Aquaculture CSIRO Food Futures Flagship, noted that changing the composition of feeds can result in reduced levels of omega-3 in the end

product. This is because fish and seafood cannot produce omega-3s, rather they need to obtain it through their diet, eating small fish and crustaceans that have eaten krill and microalgae.

In 2002, the FRDC funded the two volume guide Seafood – the Good Food, which analysed the omega-3 composition of Australian wild and farmed fish species.

The aquafeed industry is always refining their formulations looking for suitable raw material alternatives for feeds that could maximise omega-3 intake. Peter Nichols notes in the future this may include plants that have been enriched with omega-3s.

Peter Nichols's report was followed by presentations on alternative sources of long-chain omega-3s, including krill oil, algal EPA/DHA oils and, in the future, genetically modified EPA/DHA plant oils. **F**

\* Kevin Krail is executive director of the Omega-3 Centre. The FRDC is a sponsor of the centre.



Blue Mackerel



Yellowfin Tuna

PHOTOS: FRDC

The Banded Stingaree (*Urolophus cruciatus*) is endemic to south-eastern Australia, including Tasmania. Its status is of 'Least Concern' under the IUCN Red List, partially due to a lack of trawling in much of its preferred habitat.

# THE SHARK & RAY REPORT

A new report card will provide government and industry decision-makers with a single access point to the highest-quality and most up-to-date information on Australia's shark and ray species

PHOTO: AUSTRALIAN NATIONAL FISH COLLECTION

**S**harks are familiar ocean predators and some species have a fierce reputation, yet they are profoundly vulnerable to exploitation, Australian shark specialist Colin Simpfendorfer says. They tend to be less productive than bony fish and invertebrates; unlike fauna further down the food chain, they make a big investment in a small number of young.

As higher-level predators, sharks also have populations that are naturally smaller than prey species, so the risk of shark exploitation is greater. This means that where fishing mortality is poorly controlled, shark populations can decline rapidly and recovery is slow, Colin Simpfendorfer says.

Australia has one of the most diverse shark and ray faunas in the world, with 322 species occurring in Australian waters. Of these, 181 are sharks, 127 are rays and the rest are chimaeras (ghost sharks). More than a quarter of these species are endemic.

The main difference between sharks and rays is the shape of the pectoral fins and the position of the gills.

Rays have pectoral fins attached to the sides of their heads in front of their gill slits, forming flat wings, with the gill slits located underneath the head. Sharks have distinct pectoral fins and the gills are located on the sides of the body.

There is considerable diversity in the life cycle of Australia's sharks and rays. For example, the Australian Sharpnose Shark (*Rhizoprionodon taylori*) lives fewer than 10 years, while the Dusky Whaler (*Carcharhinus obscurus*) may live for more than 40 years. Because of this, some species can be fished sustainably in relatively high numbers while others decline rapidly with only limited fishing. This diversity makes it challenging for fisheries, biodiversity managers and decision-makers to understand where a species is on a spectrum of vulnerability.

Comprehensive, accurate and up-to-date information is needed to make decisions that will optimise the health and longevity of a species. However, even when it exists, Colin Simpfendorfer says it has often been difficult for policymakers and fisheries managers to find or interpret it, and to understand the implications of this information within a broader context.

## Shark futures report card

To address these issues, the FRDC is funding the project 'Shark Futures: A Report Card for Australia's Sharks and Rays'. The idea is to design and populate a database to compile all the existing literature available, and make high-quality and locally relevant information available to stakeholders. The two-year project kicked off in August 2013.

The project will aim to link with and build on the work that has already been undertaken in the development of the

Status of Australian Fish Stocks Reports and website – [www.fish.gov.au](http://www.fish.gov.au) – which contains assessments undertaken on Blacktip, Dusky, Gummy, Sandbar and School Sharks.

Colin Simpfendorfer, who is director of the Centre for Sustainable Tropical Fisheries and Aquaculture at James Cook University (JCU) in Townsville, Queensland, is leading the project. JCU has an applied research program that endeavours to improve management of sharks and rays globally.

Colin Simpfendorfer says the idea for the report card came about when he realised that government and other key personnel were not able to access the best available information when developing policy.

“We would sit in meetings with policy makers giving them information and they would ask, ‘Why didn’t we know this five years ago when we started developing a plan?’ I thought it would be good to get all the information into a central location.”

William White from CSIRO is also working on the project with JCU postdoctoral scientist Andrew Chin, who Colin Simpfendorfer says is doing most of the “heavy lifting” with assistance from JCU students and volunteers.

“Later in the year, a team of experts will help us finalise the report card. They will meet over three or four days and look at all the available information to make sure there is a consensus,” he says.

### Report card

The data for each species will be summarised in a report card that provides the status of the species. It will identify those most at risk, those that require management intervention, gaps in management and research priorities.

It aims to provide a simple framework for interpreting the wide range of information collated during the project to make it easy to understand by a wide range of stakeholders and the public.

## REPORT CARD USES

The information available within a ‘report card’ for Australia’s Sharks and Rays will be critical for a wide range of government processes, including:

### Domestic fisheries management

- Development of state and federal fishery management plans.
- Bycatch management plans.
- Ecologically sustainable development.

### Domestic biodiversity management

- Wildlife trade operation approval processes.
- Federal and state endangered species listings.
- Marine park management.

### International treaty obligations and processes

- Food and Agriculture Organization International Plan of Action for Sharks (Shark-plan 2).
- Convention for the International Trade in Endangered Species of Wild Fauna and Flora.
- Convention on Migratory Species.

### Identifying research priorities

Colin Simpfendorfer says the potential for the report card to help better manage Australia’s sharks and rays should not be underestimated.

“A few shark species get a lot of attention – makos, whites and Tiger Sharks – but there are another 319 species that also need research to level the playing field. Understanding the impact of fisheries, habitat loss ... all of this will help to identify future research priorities.”

Ultimately, he hopes the report card will provide a model for other countries looking to strengthen the management of their own shark populations. “Australia already does a fantastic job of managing its shark population in general, compared to most other countries. One of the aims of the report card is to show how we are going with management across all 322 species.” **F**



PHOTO: AUSTRALIAN NATIONAL FISH COLLECTION

A Smooth Stingray (*Dasyatis brevicaudata*) at Rottnest Island, Western Australia. This ray species occurs in a wide variety of habitats and is found in New Zealand, Mozambique and South Africa, as well as in Australian waters.

Harrison’s Dogfish (*Centrophorus harrissoni*) immediately prior to release following tagging aboard *FV SARDA* north-east of Flinders Island, Tasmania. Harrison’s Dogfish numbers have been heavily depleted in some parts of Australia and it is now endangered.



PHOTO: CSIRO

## HARRISSON’S DOGFISH

**Status:** Conservation Dependent (*Environment Protection and Biodiversity Conservation Act*); Endangered (IUCN Red List of Threatened Species).

Harrison’s Dogfish is a small grey shark that ranges along the east coast of Australia from southern Queensland to the south-east cape of Tasmania. It also occurs in New Zealand waters. The species is greyish in colour and both dorsal fins have a dark central blotch and often a white outer margin. It grows to about 1.15 metres in length and has green eyes. The posterior tips of the pectoral fins are elongated and the second dorsal fin is slightly smaller than the first. The species has been severely impacted by commercial trawl and line-fishing methods from the 1970s. Collaborative investigations resulted in the implementation of a comprehensive management strategy in 2013. The strategy includes a network of spatial closures, with the aim of supporting population recovery.

## AUSTRALIA WELL PLACED IN IUCN SHARK REPORT

The latest assessment by the International Union for the Conservation of Nature (IUCN) on the world’s sharks and rays shows Australia was rated highly for management. However, this does not downplay the need to continue and improve on these efforts.

The study comes at the start of the year marking the 50th anniversary of the IUCN Red List of Threatened Species. It analyses the conservation status of 1041 shark, ray and closely related chimaera species, and was published in the journal *eLIFE*. The study provides a global assessment for each species. However, the status can and does vary considerably across a species’ range internationally. As such, the results shown are the average across the global range.

From the report it is clear that Australia is a leader in the management and conservation of sharks and rays. It has put in place science-based management recovery plans for threatened species (White Shark, Grey Nurse Shark, Whale Shark, Gulper Sharks, School Shark) and will soon have plans in place for others (sawfish, river sharks).

# FISH BIOLOGY AND FRESHWATER SCIENCE JOIN FORCES

Improved science and greater collaboration in research and management can emerge from opportunities for scientists and managers from different fields to share their work

**T**he Australian Society for Fish Biology (ASFB) will hold its 40th annual conference this year at the Darwin Convention Centre. This landmark conference, to be held from 30 June to 4 July, will be the first to be jointly held with the Australian Society for Limnology (ASL).

The ASFB promotes research, education and management of fish and fisheries in Australasia, and provides networks and knowledge exchange for scientists and managers working with all aspects of freshwater and marine fish and invertebrates. The ASL is focused on the study of freshwater systems.

ASFB president Gary Jackson says Darwin provides an ideal location to bring together researchers from the two societies, with a conference theme of 'Indigenous participation in research and management of aquatic ecosystems'.

Speakers from North America, New Zealand and Australia will showcase the roles indigenous people are playing in aquatic research and management worldwide. "The presentations will highlight the benefits of involving indigenous people in research, and detail the most productive

## ABOUT THE ASFB

The Australian Society for Fish Biology (ASFB) was founded in 1971 and is now Australasia's premier professional body, representing more than 500 fish biologists and fishery scientists. The society aims to promote research, education and management of fish and fisheries in Australasia and to provide a forum for the exchange of information.

Its first conference was held in Port Stephens, New South Wales, in 1975. To enhance research, conservation and management of fish and their habitats in Australia, the ASFB introduced workshops on specific topics of regional or national significance in conjunction with its annual conferences in 1985. Proceedings of the workshops were usually produced separately as special publications, many of which are available on the website ([www.asfb.org.au](http://www.asfb.org.au)). The ASFB also publishes newsletters twice a year.

The ASFB is a founding member of the World Council of Fisheries Societies and hosted the World Fisheries Congress in 1996. The World Fisheries Congress is held every four years and will next be in Busan, South Korea, in 2016. The ASFB will assist with the planning of this major international event.



ways of working across cultures to achieve successful outcomes,” Gary Jackson says.

“Other presentations and workshops during the four-day event will feature work that might be of specific interest to the members of either the ASFB or ASL, although there are some issues that are of interest to both, as some researchers are members of both organisations.”

One of the main aims of the ASFB annual conference each year is to provide opportunities for students and early-career researchers to present their work and to establish networks within the research community that they will be able to draw on throughout their careers.

While the FRDC has been a strong supporter of ASFB events since the late-1980s, in recent times the focus has been to provide travel awards and substantial prizes to encourage students and early-career researchers to attend.

The Kay Radway Allen Award is the ASFB’s most prestigious award and is given in recognition of an outstanding contribution to fish or fisheries research. The award was presented to John Stevens from CSIRO in 2013. He will be among the keynote speakers in Darwin in 2014, providing an overview of his lifetime’s work on research on sharks, skates and rays.

Gary Jackson says the nature of some conference presentations has changed over time, with changes in fisheries management approaches and the emergence of new issues and challenges. In recent years these have included the effectiveness of marine protected areas and other management approaches, restocking and stock enhancement, a greater focus on the broader ecological and biodiversity impacts of fishing, climate change and emerging biosecurity concerns. Although these issues can sometimes prove highly political, the ASFB works hard to maintain its focus as a scientific society.

“It is all about the science, which can then be used as the basis for developing policy and supporting the decision-making process,” Gary Jackson says. **F**

More information can be found on the ASFB & ASL Congress website ([www.asfbasf.org.au](http://www.asfbasf.org.au)). For more information on the ASFB, awards and travel grants, visit the ASFB website ([www.asfb.org.au](http://www.asfb.org.au)).

## FISHERIES SCIENCE LEADERS AND ACHIEVERS

The premier award of the Australian Society for Fish Biology (ASFB) is named after leading international fisheries scientist Kenneth ‘Kay’ Radway Allen, who was one of the society’s earliest members. Originally from the UK, Kay Radway Allen spent much of his research career in New Zealand, rising to become director of research of the New Zealand Fisheries Research Branch. He was also a member of the International Whaling Commission’s scientific committee for 20 years, which provided advice on the management of whale populations. In 1964, he joined the Fisheries Research Board of Canada, before returning to the Southern Hemisphere as chief of the Division of Fisheries and Oceanography at CSIRO in 1972.

### Award winners

The Kay Radway Allen Award was introduced in 1995, but is not presented every year. Recipients to date are:



**1995 – PETER C. YOUNG:** Chief of CSIRO’s Division of Fisheries from 1990 to 1996, Peter Young’s research career began in the UK in the field of parasitology, before he moved to Australia with CSIRO’s Division of Fisheries. Initially working in Queensland, where he identified critical links between habitat and fisheries productivity, he later became chief of the Fisheries Division, overseeing CSIRO fisheries research nationally. Peter Young was a former president of the ASFB.



**1997 – JOHN PAXTON:** Senior curator and principal research scientist of the Australian fish collection for the Australian Museum, John Paxton was also a founding member and former president of the ASFB. At the museum he was responsible for increasing the fish collection from 80,000 specimens to more than one million over the course of his career, creating the largest collection in Australia and third-largest collection of marine fish specimens in the world.



**1999 – ANDRE PUNT:** A mathematician and computer scientist, Andre Punt came to Australia in 1994 to work as a resource modeller for CSIRO, where he made a significant contribution to a large number of stock assessments. The methods he developed are used by national and international fisheries organisations to provide quantitative scientific advice for fisheries and wildlife management.



**2003 – GERRY ALLEN:** A former president of the ASFB, Gerry Allen is one of Australia’s prominent fish scientists, a specialist in the systematics, biogeography and ecology of Indo-Pacific coral reef fishes and freshwater fishes of Australia and Papua New Guinea. A long-time curator at the Western Australian Museum, he also worked with Conservation International, undertaking coral reef fish surveys in Papua New Guinea, Indonesia and the Philippines.



**2005 – NORMAN HALL:** With a career spanning 40 years, working with the Western Australian Department of Fisheries, and Murdoch University’s Centre for Fish and Fisheries Research, Norman Hall is widely recognised as one of Australia’s leading fisheries modellers and stock-assessment scientists.



**2008 – JEFF LEIS:** A pioneer in unravelling the taxonomy, early life history dynamics and behaviour of larval fishes, Jeff Leis challenged the paradigm that fish larvae are essentially ‘biological drift cards’ moving passively on ocean currents. His work has led to dispersal and connectivity models to provide more-accurate approximations of the patterns of settlement and recruitment in fish populations.



**2009 – PETER LAST:** A senior taxonomist with CSIRO, Peter Last has made major contributions to the Indo-Pacific study of fish, particularly within the fields of systematics, biodiversity and biogeography. He is regarded as a world authority on the taxonomy of sharks, rays and skates and Indo-Pacific deep-water fish.



**2011 – ROD LENANTON:** Working for more than 45 years for the Western Australian Department of Fisheries, Rod Lenanton is one of Australia’s most highly regarded finfish fishery scientists. A long-time supporter of collaborative research, he has worked closely with Murdoch University and also advocated the need for research into recreational fishing.



**2013 – JOHN STEVENS:** Co-author, with Peter Last, of the definitive reference *Sharks and Rays of Australia*, John Stevens has more than 30 years of experience, mostly with CSIRO, working on the systematics, biology, ecology, fisheries and conservation biology of sharks, rays and skates.

# ACHIEVEMENTS AND CHALLENGES 2012–13

The FRDC's annual report highlights progress in several industry areas while identifying challenges for the future

Overall, Australia's fishing and aquaculture industry continues to demonstrate a high level of performance, stewardship and focus on best practice. Despite this, the community perception of the (global) fishing industry remains poor.

Concerns continue to be raised by the community on issues such as catching methods, the use of small fish in fish feed, the effect on marine environments from climate change – spikes in water temperature and algal blooms – and interactions with marine mammals and sharks. The FRDC has sought to provide robust scientific information to inform the wider community on these issues.

The fishing industry has had its own concerns, with the effects of changes to climate, changes to access and fishing grounds, and sharing of the resource between sectors continuing to cause tension. Adaptation to climate variability, in particular, will require industry to look to implement long-term planning and changes to management and operational practice.

## Aquaculture expansion

During the year the Australian Government approved the expansion and future development of the Atlantic Salmon (*Salmo salar*) industry in Macquarie Harbour on the west coast of Tasmania. This allows salmonid farming leases to increase from 2.0 per cent to 3.3 per cent of the total water space, although only a fraction of the area will actually be farmed.

An environmental impact statement – underpinned by scientific data and research,

sampling, modelling and local community consultation – supported the application. The expansion is expected to create more than 100 jobs during construction and a further 160 production and processing jobs.

Overall, the value of aquaculture and volume of production increased in 2012–13, underpinned by research and development advances in genetic breeding, feeds and animal health.

## Biotoxin event

In October 2012, a shipment of mussels that came from the east coast of Tasmania was rejected by Japanese import authorities due to the presence of unacceptable levels of paralytic shellfish toxins. This was caused by the mussels feeding on a bloom of the dinoflagellate algae (*Alexandrium tamarense*), a naturally occurring algae found worldwide.

The FRDC, with support from the Tasmanian Government and industry, commissioned SafeFish to review the event. The overarching recommendation from the review, which has national implications for biotoxin risk management, is the critical need to reform the national regulatory framework and associated policies to ensure the Australian Shellfish Quality Assurance Program provides the foundation for internationally acceptable public health protection and ongoing market access.

## Fisheries management

The year has seen major work undertaken that will underpin and help advance Australian fisheries management. The Australian Fisheries Management Forum,

with support from the FRDC, initiated a project to develop a set of National Fishery Harvest Strategy Guidelines. The guidelines were completed during 2012–13 and will allow for the creation of harvest strategies across the full range of fisheries. They provide practical assistance to help overcome challenges such as multi-jurisdictional, data-poor recreational and customary fisheries, which may have had difficulties developing and implementing harvest plans in the past.

Comprehensive reviews of the *Commonwealth Fisheries Harvest Strategy: Policy and Guidelines* (2007) and the *Commonwealth Policy on Fisheries Bycatch* (2000) were also completed during the past year with final reports released in May.

The level of recreational fishing participation has been a core focus for sector representatives as well as fisheries managers. The lack of quantifiable data on participation and catch rates for this sector will need to be addressed in the coming two years; several states have started recreational surveys.

## Fish status reports

Following 18 months of work between the FRDC, the Australian Bureau of Agricultural and Resource Economics and Sciences, and state and territory fisheries management agencies, the first *Status of Key Australian Fish Stocks Report* was completed.

The reports and associated website ([www.fish.gov.au](http://www.fish.gov.au)) were launched on 10 December 2012 and are a significant step forward for transparency and reporting of fish stock health.

### Seafood CRC

The FRDC is a core participant in the Australian Seafood Cooperative Research Centre (Seafood CRC) and will invest more than \$24 million during its life. The end of the 2012–13 financial year marked the fifth year of the Seafood CRC. The Seafood CRC successfully applied for a one-year extension, to improve the impact of proposed legacy projects.

### FRDC board

Three new directors were appointed to the FRDC board in September. The board, chaired by the Hon. Harry Woods, welcomes Bruce Mapstone, Peter O'Brien and David Thomason who join the reappointed Heather Brayford, Renata Brooks and Brett McCallum. The board was selected under a process established by the *Primary Industries and Energy Research and Development Act 1989*. Harry Woods has since been reappointed as the board's chair.

### Science and best practice

In November 2011, the FRDC board endorsed developing a strategy to promote the science and best practice that underpins the Australian seafood and angling industry, and to work with stakeholders to



implement that strategy. The strategy aims to respond to poor community perception of the seafood industry by proactively promoting the results of research to the Australian community, media outlets and seafood consumers, and to formally respond to factually incorrect media stories, or information in the public arena.

The strategy continued in 2012–13 and has delivered a range of outcomes including responding to inaccurate media articles about the Australian seafood industry and generating new information sources including the seafood consumer education website ([www.fishfiles.com.au](http://www.fishfiles.com.au)).

### People development

In December 2012, the FRDC completed a review of its five-year (2008–13) People

Development Program, which supports ongoing investment in people development with a focus on integrating it with the FRDC's existing program areas of environment, industry, communities, and extension and adoption.

A new 'People development plan' has been developed and will run for two years (2013–15), which will allow these activities to align with the FRDC's five-year strategic research, development and extension plan.

### Performance evaluation

The FRDC began economic evaluations of randomly selected clusters of its project investments in 2010. Projects were grouped into clusters that focused on a similar issue, (for example, supply chains or genetics) (Table 1). In 2012–13, the next phase of the evaluations was completed with eight clusters evaluated.

When all eight clusters are aggregated, the benefit-cost ratio for the \$99.3 million investment by the FRDC and its partners is 2.5:1, with present value benefits of \$251.7 million and net present values of \$152.4 million. The FRDC's component comprised \$32.9 million in present-value terms with a net present value of \$48 million (Table 2). **F**

**TABLE 1 FINANCIAL INDICATORS OF R&D INVESTMENT**

| Expenditure                                      | 2010–11      | 2011–12      | 2012–13      |
|--------------------------------------------------|--------------|--------------|--------------|
|                                                  | \$ million   | \$ million   | \$ million   |
| <b>Total expenditure</b>                         | <b>25.76</b> | <b>29.68</b> | <b>25.69</b> |
| <b>Total of R&amp;D projects</b>                 | <b>21.56</b> | <b>25.98</b> | <b>22.14</b> |
| R&D Program 1 (Environment)                      | 10.14        | 11.80        | 8.25         |
| R&D Program 2 (Industry)                         | 8.34         | 9.47         | 9.57         |
| R&D Program 3 (Communities)                      | 0.16         | 0.47         | 0.74         |
| R&D Program 4 (People Development)               | 1.90         | 2.12         | 1.80         |
| R&D Program 5 (Extension and Adoption)           | 1.02         | 2.12         | 1.78         |
| Management and Accountability                    | 3.40         | 3.71         | 3.55         |
| Number of approved new projects                  | 141          | 146          | 123          |
| Total number of active projects under management | 412          | 483          | 476          |
| Number of final reports completed                | 111          | 129          | 138          |

**TABLE 2 INCOME TO THE FRDC**

|                                             | 2010–11    | 2011–12    | 2012–13    |
|---------------------------------------------|------------|------------|------------|
|                                             | \$ million | \$ million | \$ million |
| Industry contributions                      | 8.46       | 7.70       | 7.98       |
| Maximum matchable (government) contribution | 5.50       | 5.56       | 5.83       |
| Actual government matched                   | 5.50       | 5.51       | 5.57       |
| Government unmatched                        | 11.03      | 11.22      | 11.66      |
| Total government contributions              | 16.53      | 16.63      | 17.23      |
| Project funds from other parties            | 1.12       | 0.46       | 0.48       |

Inspired by their visit with professional fishers Paul and Richie Bagnato at Sydney Fish Market, students from Glebe Public School in Sydney created fish-themed artworks on their return to the classroom.

# Back to school for NSW fishers

An FRDC-funded program facilitating an introduction to the seafood industry for schoolchildren has provided benefits to schools and professional fishers alike

**M**any people have very little understanding of what is involved in bringing high-quality seafood into homes and restaurants. However, with funding from the FRDC, OceanWatch Australia has developed the Seafood Industry Partnerships in Schools (SIPS) program.

Through the program, the fishing industry has started a conversation with schoolchildren and teachers in New South Wales and Tasmania about some of the great work going on in the industry. SIPS involves real-world professional fishers and aquaculture farmers visiting schools, or hosting visits from students at their places of work. The fishers and farmers talk to children about the steps required to bring seafood from the ocean or estuaries through to the table.

Through SIPS, more than 30 seafood industry partners have become involved with their local school communities. While the project has been successful in raising

awareness of the industry among those participating, it has also provided a platform for the fishers to showcase their work to an enthusiastic audience.

One participating fisher commented: "I think the community needs to know that we care about the resource as much as we care about making a living. SIPS brings the community and fishermen together ... it fits in the middle of that gap."

An oyster farmer added, "It's important to engage with the community, as they are waterway stakeholders. They need to be on-side and understand that the industry is environmentally conscious."

## Aims of SIPS

OceanWatch devised SIPS as a way to educate the broader community about the importance of the seafood industry and how it is being managed to ensure its future sustainability.

The program has three aims:

- to facilitate educational partnerships between schools and industry operators;
- to increase community understanding about the complexity of managing marine resources; and
- to increase the capacity for the seafood industry to tell its stories to the community.

Schools represent an ideal target audience for SIPS, because an overarching goal of the program is to change community attitudes towards a more positive, engaged view of the seafood industry.

Schoolchildren are often open-minded in their views and opinions, and their willingness to learn can have an influence on the attitudes and beliefs of friends and family. The program aims to educate children about the life of professional fishers and their efforts to conserve the resources that they depend on for their livelihoods.



Students from Great Lakes College, Forster Tuncurry, New South Wales, listen to a presentation during their visit to the Coffs Harbour Fishermen's Co-operative.

## ONLINE RESOURCES:

### OceanWatch Australia

Contains links to several great fisheries websites for kids.

[www.oceanwatch.org.au/kids-stuff](http://www.oceanwatch.org.au/kids-stuff)

### Fish'n'Kids

Fun things for children from the New South Wales Department of Primary Industries.

<http://fishnkids.dpi.nsw.gov.au>

### Marine Links

A marine and fisheries resource kit for use by teachers in Tasmanian schools.

[www.dpiw.tas.gov.au/inter-nsf/WebPages/SWIS-8HC88D?open](http://www.dpiw.tas.gov.au/inter-nsf/WebPages/SWIS-8HC88D?open)

### MarineWATERs

A marine and fisheries resource kit for use by teachers in Western Australian schools.

<http://marinewaters.fish.wa.gov.au>

### PrimeZone

Access to a range of primary industries education resources for teachers.

[www.primezone.edu.au/school-resources/all-school-resources.html](http://www.primezone.edu.au/school-resources/all-school-resources.html)

## The SIPS Model

SIPS began in Tasmania in 2010 and its success there saw the program expanded into NSW in 2012. Tasmania was chosen as the pilot site because of the size and significance of its seafood industry and the proximity of so many facilities to participating schools.

NSW provided a different profile for OceanWatch. Its largely urban population is quite removed from the seafood industry, even when schools are located in fishing and aquaculture-farming areas.

School groups who signed up for SIPS were partnered with a seafood industry worker, such as a commercial fisher or an oyster farmer. Partnerships were tailored to suit the needs of the school and program partner, and included classroom visits, excursions (to a wharf, aquaculture facility, processing facility or seafood business) and ongoing contact between partners. Every excursion offered something different to the

students participating. In Tasmania, a primary-school class visited the Hobart docks with a rocklobster fisher and boarded a vessel before eating a seafood lunch, while a secondary-school class visited the Tassal salmon hatchery in the Huon Valley.

In NSW, one primary school on the mid-north coast visited an oyster farm, and another secondary school visited a fishermen's co-op, where they held a Mud Crab and a large Mahi Mahi, and tasted seaweed.

## Evaluation

The effectiveness, impact, appropriateness, efficiency and legacy of the program were all evaluated by OceanWatch and information compiled into a report, using feedback from teachers, students, industry personnel and the SIPS Steering Committee.

The majority of teachers rated the program as 'Excellent' or 'Very good'. The hands-on activities, such as mending nets, holding a Mud Crab (tied up), looking over fishing vessels and handling seafood were the most popular.

Michelle Biles, a Marine Studies teacher from Shoalhaven High School in NSW, said: "The more hands-on experiential learning and community involvement, the more the students can see the relevance and importance of what they are learning."

The teachers who were surveyed unanimously agreed that the SIPS activities in which they participated were an effective way for the seafood industry to engage with schools. "It's obvious from personal interaction with the fishers that they talk and live sustainability," one teacher said.

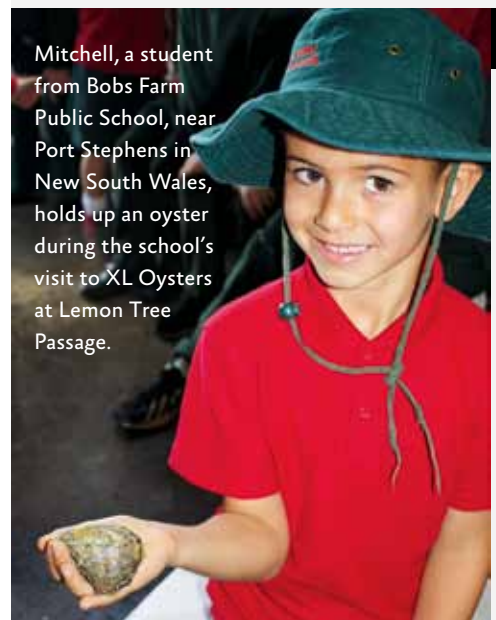
The professional fishers involved also appreciated the opportunity the program provided to improve the image of the industry and demonstrate the pride with which they do their jobs. "Showing kids what we do ... they can have a positive outlook on industry. SIPS gives them that kickstart," one industry partner said. "So in the future, when that negativity comes to them, they can say: 'One second, I've met that fisher, and I know the reason he is out there catching fish. He's not only making a living for himself, he's looking after the environment and making sure the product is still going to be there in the future'."

Another said: "It makes me feel good to let people know what we do and that we care for the resource. It makes me feel warm. It is something we all stand to benefit from, to better educate and show what fishers offer."

## Future

While the SIPS program has finished, OceanWatch hopes that participants will

Mitchell, a student from Bobs Farm Public School, near Port Stephens in New South Wales, holds up an oyster during the school's visit to XL Oysters at Lemon Tree Passage.



"We had a wonderful day at the wharf. I wish we could have stayed longer."

– HILARY SEYMOUR, TEACHER

"I am feeling far more connected with my local fishing industry."

– ELEANOR WARD, TEACHER

"Your family's passion and extensive knowledge of environmentally sustainable oyster growing was obvious."

– WENDY PRIDDLE, TEACHER

"The kids loved the live Mud Crabs, and the talk and stories were spot on."

– ANNETTE SAUNDERS, TEACHER

"I now have some VERY enthusiastic students in this marine studies area."

– LAUCHLAN BELL, TEACHER

PARTICIPANT FEEDBACK FROM OCEANWATCH AUSTRALIA'S SIPS PROJECT EVALUATION

be better equipped for future community engagement. OceanWatch Australia's Lowri Pryce says, "I hope the professional fishers who were involved encourage their colleagues to take up similar opportunities in the future. There is no shortage of interest from schools. It would be great to see the industry now pick up the SIPS model and take it further." **F**



A thank-you note sent from a Glebe Public School student following a visit to Sydney Fish Market.

The Western Australian Fishing Industry Council has elected **ARNO VERBOON** as chair of WAFIC for the next year.

The board of the Western Rock Lobster Council Inc. has appointed **JOHN McMATH** as chief executive officer. He assumed the role of CEO of Australia's most valuable wild-harvest fishery on 3 February 2014.

There has been some movement at Seafood Industry Victoria with **ASHLEY OLIVER** leaving and **RENEE VAJTAUER** taking up the position of executive officer at the Commonwealth Fisheries Association.

Former FRDC director **STUART RICHEY** has been involved in the fishing industry for many decades and has now been named one of 10 members of the new Agriculture Industry Advisory Council. The council will give agricultural industries a clear line to government and will assist in efforts to reduce regulation in the rural sector. Stuart Richey says he will represent the fishing industry Australia-wide and is keen to tackle the issue of red tape for fishers. The 10 members of the council include representatives from the livestock, viticulture, forestry, dairy, grains, wool, horticulture and banking industry. The council will make recommendations to the Federal Minister for Agriculture, Barnaby Joyce. The council members are:

- **LUKE BOWEN**, executive director, Northern Territory Cattlemen's Association, Northern Territory;
- **ELIZA BROWN**, CEO/director, Peter R. Brown Family Vineyards, Victoria;
- **ROB DE FEGELY**, chair, Cloudy Bay Sustainable Forestry, New South Wales;
- **LENORE JOHNSTONE**, grazier, Ilfracombe, Queensland;
- **HAMISH McLAREN**, woolgrower, Nerstane Merino Stud, New South Wales;
- **DAVID MOON**, vegetables/horticulture and managing director, Moonrocks, Queensland;
- **STUART RICHEY**, managing director, Richey Fishing, Tasmania;
- **KEVIN SORGIOVANNI**, horticulture, wine and dairy, and director, Harvey Fresh, Western Australia;
- **DEAN WORMALD**, grain grower and director, Mallee Sustainable Farming, South Australia; and
- **SUSAN BOWER**, head of agribusiness, Australian Financial Services, Westpac.

**FEEDBACK**  
FRDC welcomes your  
comments  
[frdc@frdc.com.au](mailto:frdc@frdc.com.au)

**MOVERS WE'VE MISSED?**  
INFO PLEASE TO  
Julie Haldane, 02 6285 0415,  
[julie.haldane@frdc.com.au](mailto:julie.haldane@frdc.com.au)

## CALENDAR OF EVENTS

| DATE              | EVENT                                                                                                                                  | MORE INFORMATION                                                                                              |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| 4 to 5 March      | 2014 Outlook Conference, National Convention Centre, Canberra                                                                          | <a href="http://www.daff.gov.au/ABARES/outlook-2014/">www.daff.gov.au/ABARES/outlook-2014/</a>                |
| 5 to 6 April      | Family Fishing Show, Parramatta Park, New South Wales                                                                                  | <a href="http://www.familyfishingshow.com.au">www.familyfishingshow.com.au</a>                                |
| 15 to 16 April    | FRDC Board Meeting, Brisbane                                                                                                           | 02 6285 0400                                                                                                  |
| 12 to 16 May      | ECSA54 Coastal systems under change: tuning assessment and management tools, Sesimbra, Portugal                                        | <a href="http://ecsa54.fc.ul.pt">http://ecsa54.fc.ul.pt</a>                                                   |
| 2 to 6 June       | 2nd SHARKS International Symposium, Durban, South Africa                                                                               | <a href="http://www.sharksinternational.org">www.sharksinternational.org</a>                                  |
| 5 to 7 June       | Future Fish Eurasia, International Izmir Fair Centre, Izmir, Turkey                                                                    | <a href="http://www.eurasiafairs.com">www.eurasiafairs.com</a>                                                |
| 7 to 11 June      | World Aquaculture Adelaide 2014, Adelaide                                                                                              | <a href="http://www.aquaculture.org.au">www.aquaculture.org.au</a>                                            |
| 22 to 25 June     | Foodpro, Melbourne Convention and Exhibition Centre, Melbourne                                                                         | <a href="http://www.foodproexh.com">www.foodproexh.com</a>                                                    |
| 22 to 27 June     | 5th Congress of the International Society for Applied Phycology, Australia Technology Park, Sydney                                     | <a href="http://www.isap2014.com">www.isap2014.com</a>                                                        |
| 24 to 25 June     | FRDC Board Meeting, Adelaide                                                                                                           | 02 6285 0400                                                                                                  |
| 30 June to 4 July | Australian Society for Fish Biology and Australian Society for Limnology Joint Congress, Darwin Convention Centre                      | <a href="http://www.asfbasl.org.au">www.asfbasl.org.au</a>                                                    |
| 1 to 4 July       | Joint meetings of the Australian Conference of Economists and Econometric Society Australasian Meeting, University of Tasmania, Hobart | <a href="http://www.esamace2014.com.au">www.esamace2014.com.au</a>                                            |
| 6 to 10 July      | AMSA2014, Investigating our Marine Nation, National Convention Centre, Canberra                                                        | <a href="http://www.amsaconference.com.au">www.amsaconference.com.au</a>                                      |
| 7 to 11 July      | International Institute of Fisheries Economics and Trade Conference 2014, Queensland University of Technology, Brisbane                | <a href="http://iifet2014.org">http://iifet2014.org</a>                                                       |
| 26 to 27 August   | FRDC Board Meeting, Canberra                                                                                                           | 02 6285 0400                                                                                                  |
| 20 to 24 October  | 5th International Otolith Symposium 2014, Mallorca Balearic Islands, Spain                                                             | <a href="http://ices.dk/news-and-events/symposia/otolith">http://ices.dk/news-and-events/symposia/otolith</a> |
| 11 to 12 November | FRDC Board Meeting, Canberra                                                                                                           | 02 6285 0400                                                                                                  |
| 12 to 19 November | IUCN World Parks Congress, Sydney 2014, Sydney Olympic Park                                                                            | <a href="http://worldparkscongress.org">http://worldparkscongress.org</a>                                     |

## OPTIMISING BLUE MUSSEL SUPPLY 2008/202

The key outcomes of this project for the mussel industry are reliable physical and biological data and resources from which current hatchery practices can be assessed and modified to improve the reliability of supply of juvenile Blue Mussels (*Mytilus galloprovincialis*) and reduce reliance on wild spat. Collection of mussel spat from the wild imposes critical limits on the capacity of the mussel aquaculture industry to increase production and to control product quality and timing of supply to markets. Reliance on wild spat leaves the industry vulnerable to recruitment failure, restricts production to seasonal availability and limits capacity to develop selective breeding programs.

These are major issues given the significance of the mussel industry in Australia. In 2009-10, Australia produced 3462 tonnes of mussels worth \$10.1 million, with 70 per cent of production in South Australia and Tasmania, followed by Victoria and Western Australia producing approximately 15 per cent of the total each. Australia imported an additional 70 per cent of local consumption, mainly from New Zealand, indicating that increased local production is warranted.

**More information:** Chris Bolch, University of Tasmania, 03 6324 3815

## ASSESSING QUEENSLAND'S DEEPWATER LINE FISHERIES 2010/053

Changes in regulations since the early 1990s have seen a progressive increase in deepwater fishing in Queensland. This, paired with generic logbook entries by the commercial sector and an increased recreational effort, has raised concerns about the sustainability of Queensland's deepwater line fisheries.

This report was prepared to review the available information about these fisheries and to assess the likely impact of each line-fishing sector on vulnerable stocks. The impact of improved fishing technology is also analysed and the findings will contribute to stakeholder workshops aimed at producing a risk assessment for the fishery.

Biological and fisheries information on species targeted by deepwater fishers was collected and it will be incorporated into future risk assessments, enabling the improved monitoring and sustainable management of species fished by deepwater line fishers.

In addition, technology information will be included in catch standardisations in the next snapper stock assessment due later this year and will form an important part of catch data standardisations in other offshore line-fishery assessments in southern Queensland.

**More information:** Wayne Sumpton, Queensland Department of Agriculture, Fisheries and Forestry, 07 3817 9584

## INDIGENOUS INVOLVEMENT IN FISHERIES 2008/326

Indigenous Territorians have been consulting with the Northern Territory Government for several years on their strong desire to be more involved in fisheries management and seafood business opportunities.

2011 FRDC Indigenous Development Scholarship recipient Robert Carne used this opportunity to increase his knowledge of various governance models relating to fisheries management and businesses that are owned or operated by Indigenous peoples. He was also able to gain an insight into how fishing co-operatives can work, particularly for assisting Indigenous commercial fishing operations.

Through his findings, Robert Carne now has a greater understanding of

how to improve the role of government in supporting Indigenous engagement in fisheries management and economic-development-related activities. He has an increased ability to provide informed advice to Indigenous Territorians relating to key attributes of successful governance structures and has established a 'mentoring' relationship between the NT Department of Primary Industry and Fisheries and the International Indigenous fishing council.

Robert Carne travelled to New South Wales, Canada and the US to gain further information, which was then used to assist the establishment of an Indigenous fisheries corporation in East Arnhem Land. This model will now be promoted across Australia, with the NT being identified as the leader in Indigenous engagement in fisheries activities.

**More information:** Bo Carne, NT Department of Primary Industry and Fisheries, 08 8999 2164

## EXCHANGING GENOMICS EXPERTISE 2008/328

Visiting expert Sigbjørn Lien, of the Centre for Integrative Genetics (CIGENE) in Norway, travelled to Brisbane and the Sunshine Coast in Queensland, Armidale in New South Wales and Hobart in Tasmania during his three-week visit. He talked to staff, students and industry representatives and gave five seminars covering the developments in the salmon genome project and developments in molecular technologies by CIGENE.

During his visit, Sigbjørn Lien was able to exchange knowledge and experience within genomics and bioinformatics and discuss practical implementation of genomic information to advance the aquaculture industry.

**More information:** Sigbjørn Lien, CIGENE, +47 6496 5288

## FRAMEWORK FOR CLIMATE RESPONSES 2009/073

Changes to fisheries management and governance arrangements will form an important part of climate change adaptation responses in south-east Australia and will impact on various aspects of fishery systems and on their associated values. The ability to comprehensively evaluate management changes requires clear definition of a framework of objectives and of the relative importance of these often competing objectives.

This project provides weighted fisheries management objectives frameworks for each of four key fisheries species in south-eastern Australia (abalone, Blue Grenadier, snapper and Southern Rocklobster) and for a general fishery group. Providing these frameworks will enable selected management adaptation options and will also assist in the identification of areas of potential conflict that might act as barriers to the adoption of management changes across diverse fisheries.

Developing objective hierarchies and participating in the objective weighting survey has also served as a capacity-building process as individuals involved were forced to consider the trade-offs between environmental, social and economic objectives as is required in fisheries management.

**More information:** Sarah Jennings, University of Tasmania, 03 6226 2828

## FISH STOCK STATUS REPORT 2011/513

In 2012, the first *Status of Key Australian Fish Stocks Reports* was produced by the Australian Bureau of Agricultural and Resource Economics and Sciences and it is available on the FRDC website ([www.fish.gov.au](http://www.fish.gov.au)). This document will improve confidence in the status determination of fish stocks around Australia as well as improving awareness of the sustainability of Australian fish stocks.

Australian seafood consumers will be able to make more informed decisions, potentially increasing demand in existing markets where stocks are found to be sustainable.

The reports allow for greater consistency in stock status determination and improved collaboration and communication between jurisdictions on issues relating to stock status determination. The production of the first edition of the reports has provided a catalyst for discussions on how to secure the longevity of national status reporting.

The project has also identified areas for improvement including where uncertainties exist due to a lack of data and where joint assessments are required to determine biological stock status.

**More information:** Matthew Flood, ABARES, 02 6272 3838

## SOUTHERN SEA RANGER PROGRAM 2012/215

Aboriginal Coastal Nations of South Australia, SA Government representatives and experienced sea rangers from other jurisdictions were brought together to discuss and develop a model for Sea Country management by Indigenous SA people.

Relationships between state government (Primary Industries and Regions SA, PIRSA) and Aboriginal Coastal Nations have been strengthened through this best-practice process of respectful and collaborative engagement and co-design of a statewide model for a sea ranger program. A model for a statewide sea ranger program has been defined and will lead to ongoing collaborative management by Aboriginal Coastal Nations and PIRSA Fisheries and Aquaculture.

**More information:** Jason Downs, South Australian Department for Manufacturing, Innovation, Trade, Resources and Energy, 08 8303 2436

## INVASIVE MARINE WORM IDENTIFIED 2013/402

Every year large numbers of exotic marine species are accidentally introduced into Australian waters as a result of vessel fouling, ballast water release, the aquarium trade, or through aquaculture-associated stock movement. Although the majority of exotics do not establish viable populations, more than 250 aquatic invasives have become notorious pests ([www.marinepests.gov.au](http://www.marinepests.gov.au)) that have significant direct economic impact on aquaculture and fisheries industries. To attempt control, correct identification is essential.

A two-day workshop was held at the Australian Museum on 1 and 2 August 2013 for oyster farmers, consultants, port authorities, and quarantine and fisheries managers on how to accurately identify marine pests.

Recognised polychaete experts provided guidance on identifying particular families. Participants could then compare both live and preserved specimens with the images in the digital guide. Workshop participants were given access to the beta version of the digital guide to invasive worms, which has been developed by the Australian Museum, and their feedback was used in developing the final version, which is now available. Lines of communication were established between experts and these participants and this will facilitate the identification of new introductions as well as ensuring the correct identification of known invasives.

The outcomes are an improved, road-tested, digital guide to invasive marine worms and an increased awareness of the importance of the correct identification of these worms. This guide will be available for sale. Participants at the workshop were given log-in details to access the guide.

**More information:** Pat Hutchings, Australian Museum, 02 9320 6243

## BASS STRAIT FOOD WEB MODELS 2002/028

The overall objective of this study was to develop trophic models that describe the past and present structure and dynamics of the food web of the south-east Australian shelf around eastern Bass Strait. Early results were provided to the National Oceans Office's Regional Marine Plan for the South East Marine Region. The models were used to better understand the complex trophic interactions operating on the shelf and upper slope. While not yet capable of predicting precise magnitudes of change, they provide a means of identifying potential ecosystem responses to changes in environmental conditions or human activities.

**More information:** Catherine Bulman, CSIRO Marine and Atmospheric Research, 03 6232 5222

## THE FLAVOUR WHEEL 2010/228

This project was intended to develop a set of accurate and informative educational tools that could be used to educate customers on the characteristic sensory properties of commercially important seafood products from South Australia's Eyre Peninsula. The Seafood Flavour Wheel developed in this project is suitable for use in connection with seafood from the Eyre Peninsula. The discrete sensory descriptions developed will help address the lack of knowledge and appreciation for the flavours of key seafood species specific to the Eyre Peninsula region. This particular Seafood Flavour Wheel is not intended to be adapted to other regions. However, the principle of a seafood flavour wheel has generated interest in other areas around Australia, and a similarly developed wheel could be useful in promoting the unique seafood flavours of other regions around Australia.

The wheel delivers technical sensory language that accurately and precisely describes the flavour and texture of key seafood species to the seafood industry of the Eyre Peninsula. Industry members and producers have been trained in the sensory properties of their products and are equipped with knowledge of how to apply sensory language to their products for their customers.

The seafood industry of the Eyre Peninsula has embraced the Seafood Flavour Wheel and is already using it in the promotion of their products. In addition, local, national and international seafood producers and end-users have indicated a strong interest in the results and outputs of this project and the potential application of the seafood flavour wheel in their respective businesses. The uptake of the outputs from this project by the industry will support and strengthen the Brand Eyre Peninsula (Seafood Frontier) and increase consumer and customer value for seafood products from this region.

**More information:** Heather Smyth, University of Queensland, 07 3276 6035

## CLOSING THE GAP 2008/015

Historically, Pearl Perch (*Glaucosoma scapulare*) and Teraglin (*Atractoscion aequidens*) were secondary targets for demersal line fishers in south-east Queensland, with snapper the most commonly caught reef-associated species. However, declining snapper catch rates combined with decreasing bag limits have seen Pearl Perch and Teraglin catches increase in the past decade. The prevalence of advanced global positioning system and sonar technology has likely increased the efficiency of vessels accessing the Rocky Reef Finfish Fishery (RRFF), leading to increases in fishing power.

To ensure the sustainability of this new development in the RRFF, this project determined key biological and fisheries parameters for Pearl Perch and Teraglin. These will be incorporated into future stock assessments enabling the improved monitoring and sustainable management of rocky reef species.

Estimates of short-term post-release survival have also been derived for the three main target species of the fishery and the data will be used in future stock assessments. Methods of enhancing survival have also been determined and, with extension to the fishing industry, fishers will be briefed on how to enhance survival rates after release.

The project also identified important habitat areas of Pearl Perch and confirmed the importance of Moreton Bay, Queensland, as a nursery area of juvenile snapper. The absence of Pearl Perch and Teraglin from inshore estuarine areas such as Moreton Bay reinforces the importance of offshore habitat for these two species.

**More information:** Wayne Sumpton, Queensland Department of Agriculture, Fisheries and Forestry, 07 3817 9584

### ASSESSING GULPER SHARKS 2008/065

This report results from a request by the Australian Fisheries Management Authority to the Bureau of Rural Sciences.

The report reviews the research and information available for the three main species of Gulper Shark occurring on the upper-slope habitat of Australia's Southern and Eastern Scalefish and Shark Fishery: *Centrophorus harrissoni* (Harrisson's Dogfish), *C. moluccensis* (Endeavour Dogfish) and *C. zeehaani* (formerly *C. uyato*, Southern Dogfish) with notes on two other species sporadically caught on the upper-slope habitat (*C. westraliensis*, Western Gulper Shark and *C. squamosus*, Leafscale Gulper Shark).

The review of the available fishery-independent research data confirms previous reports of a substantial decline (greater than 90 per cent) in populations of upper-slope Gulper Sharks over the past several decades.

In terms of the three main Gulper Sharks species alone, and not withstanding broader fisheries management objectives, a network of area closures that prohibit fishing of all gear types is considered the best option to reduce the actual number of interactions with Gulper Sharks and to rebuild stocks of these species to viable levels within the fishery.

**More information:** David Wilson, ABARES, 02 6272 2000

### DEALING WITH DATA-POOR FISHERIES 2010/044

This research has provided a means to derive good estimates of economic variable values for use in bioeconomic analyses when some biological models exist but economic data are unavailable. It also allows an estimate of fishing mortality when fisheries data are extremely limited.

During this project, researchers developed and tested a simple catch-rate, gradient-based, harvest control rule for data-poor fisheries. They also established relationships between fishing-mortality-based biological reference points and fish life-history parameters, particularly the natural mortality rate. A statistical method was developed for estimating gear efficiency, biomass and fishing mortality based on catch data alone.

Finally, this project developed methods to estimate catch-based or biomass-based reference points (including virgin biomass, maximum sustainable yield, limit biomass and depletion) using primarily catch history.

These outputs will guide fishery management agencies in development of policies and management rules. The final report will be made available to the relevant management agencies and industry, and findings will be communicated to various stakeholders through seminars, meetings, publications and conferences.

**More information:** Shijie Zhou, CSIRO Marine and Atmospheric Research, 07 3826 7263

### SEA RANCHING GREENLIP ABALONE 2012/220

This project has provided information on the growth and survival of three different year classes of aquaculture-reared Greenlip Abalone (*Haliotis laevigata*) seeded onto artificial reef structures.

The results have revealed the commercial possibilities for sea ranching of abalone in Flinders Bay, Augusta, Western Australia. The promising outcomes from this proof-of-concept trial together with progressive aquaculture policy, could be expected to provide a way forward for orderly expansion of abalone sea ranching in the state.

A key contributor to the potential future success of abalone sea ranching in WA identified from the results of this trial is that once seeded (with two-year-old abalone) and having suffered the initial mortality phase, mortality rates can, with good management, be as low as five to 10 per cent a year. This is a very significant result given that the habitat is non-complex and the abalone are very exposed and therefore visible to predators.

It was also noted that growth rates comparable with abalone in the wild environment can be achieved at relatively high stocking densities on artificial habitat. Another factor that will aid the success of this industry is that the growth and survival rates of seeded abalone are similar in different lease sites within Flinders Bay.

This shows that food availability and sea conditions for abalone sea ranching are suitable over a wide area and that, depending on the success of future commercial ventures, there will be opportunity for government to allow for orderly expansion within Flinders Bay.

**More information:** Brad Adams, Ocean Grown Abalone Pty Ltd, 08 6254 8000

### CO-MANAGING CRABS 2009/050

This project was intended to establish precedence in the fishery rights that enable a fishery to be effectively co-managed. It was anticipated that the small scale of the crab industry would contribute to the success of its co-management; however, a co-management model was not adopted by the commercial sector at the completion of the project. The major limitation to the success of the project, from a commercial harvest perspective, was attributed to unforeseen factors directly related to the fishery opening after a three-year closure.

High variability in harvest levels and disparity in harvest predictions led to the application of a highly precautionary management strategy. The ambiguity in the total allowable commercial catch (TACC) created a knock-on effect that had market implications, resulting in instability of day-to-day fishing operations.

Despite numerous attempts to engage recreational stakeholders, considerable consultation prior to and during the 2009-10 season and assistance from the representative body RecFishWest, recreational involvement was at best sporadic.

The proposed 'quota-by-numbers' system was predicted to produce an economically and ecologically sustainable harvest of crabs from Cockburn Sound, Western Australia, while maintaining social benefits. However, high variability in the size, class and quantity of Blue Swimmer Crabs (*Portunus armatus*) harvested over two consecutive seasons made the adoption of a quota-by-numbers system very difficult. With greater consistency in harvest and greater size across size classes, a quota-by-numbers approach would be more likely to be adopted.

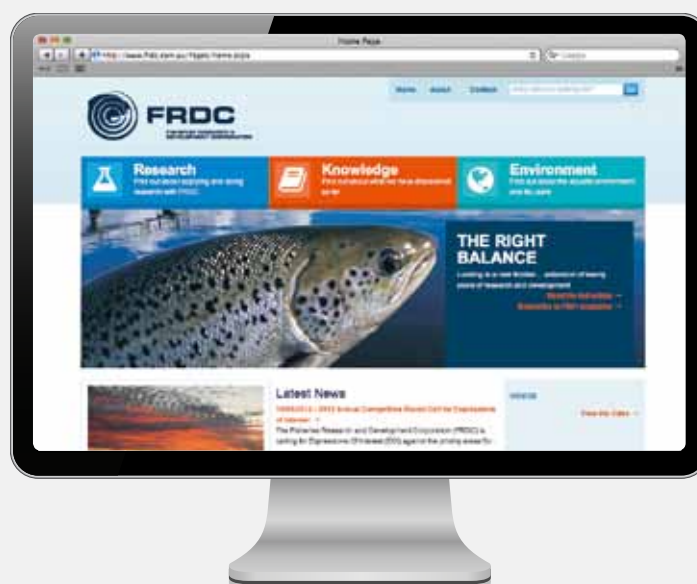
**More information:** Neil MacGuffie, Western Australian Fishing Industry Council, 08 9432 7715



## FINDING KNOWLEDGE

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The central point  
for all fisheries R&D  
information



## SHARING KNOWLEDGE

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