FISH

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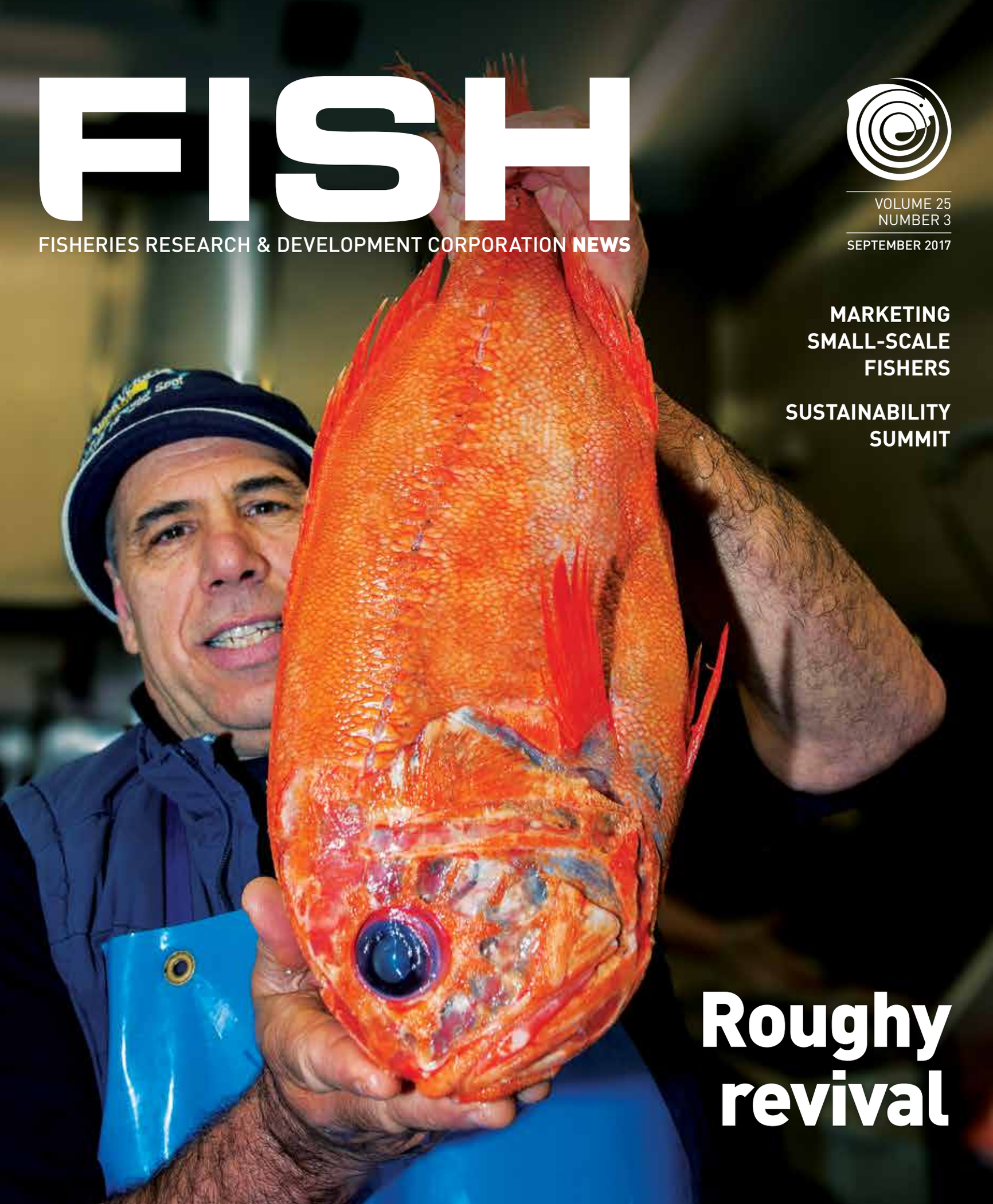
MARKETING SMALL-SCALE FISHERS

SUSTAINABILITY SUMMIT



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FRDC

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Community key for small fishers

A tour of the South Australian coast examines the potential of a different marketing approach for Australia's small-scale commercial fishers

Story and photos by **Annabel Boyer**

At a series of meetings with fishers in South Australia to talk about community supported fisheries (CSFs) in the US, Joshua Stoll always starts with his own story.

In 2008, commercial fishers in North Carolina were facing plenty of challenges: low prices for their catch, competition from cheaper imports and public mistrust in relation to the welfare of endangered sea turtles. Add the pressures of ageing boats and gear, competition over waterfront usage and competition with recreational fishers and the commercial fishers were facing a perfect storm.

But the crisis that could have triggered their demise instead proved a crucial opportunity for transformation. Out of it came the Walking Fish initiative, using an approach that has revolutionised the seafood supply chain in its own small North Carolina community.

Walking Fish offered its community the opportunity to 'subscribe' to a season of fresh and seasonally caught local fish. This allowed fishers to get a better price for their catch and, crucially, reconnected them with their communities. While the subscription model used by Walking Fish is one approach, the key innovation lies in reducing the distance between fisher and consumer, Joshua Stoll says. A CSF is a fishery connected to and supported by its local community.

Growing movement

What's more, it's a model that is proving successful in many locations and forms across the US and elsewhere. The CSF network has 75 members connected online via LocalCatch.org.

In 2015, influential author of *Four Fish: The Future of the Last Wild Food* Paul Greenberg named CSFs as an important trend. Fish 2.0, an engine for business growth in the fisheries sector, has projected that CSFs could generate hundreds of millions of dollars for the US economy.

"People love the idea of fresh local seafood, but for many people it was about putting their money back into a place where they knew it was going into supporting their local community," Joshua Stoll says.

CSFs have been on the FRDC's radar for some time. In 2015, the FRDC sponsored Joshua Stoll, founder of Walking Fish and LocalCatch.org, to travel to Australia and speak at Seafood Directions. Last year, several Australian fishers headed over to the US to learn more (*FISH* June 2016, page 22 to 24).

In June 2017, Primary Industries and Regions SA (PIRSA) and the FRDC again sponsored Joshua Stoll to meet fishers here to discuss whether CSFs could provide an answer to some of the challenges SA's small-scale fisheries face.

Jonathan McPhail, fisheries manager with PIRSA Fisheries and Aquaculture, says that SA's small inshore commercial fisheries are facing significant challenges exacerbated by the consumer's lack of awareness about commercial fishing practices.

Above Local catch being auctioned at the South Australian Fisherman's Co-operative Limited.

As Joshua Stoll discusses the challenges faced by fishers in North Carolina, much of what he describes sounds familiar to many of those he meets. Swap sea turtles for Long-nosed Fur Seals, and Flounders and Mullet, and you have the situation faced by fishers in the Lakes and Coorong fishery, which was the first fisheries stop on his tour.

Travelling hundreds of kilometres over several days in June, he also visited Port Lincoln, Port Wakefield and Wallaroo. All the fishers he speaks with can relate to rising operational costs, a lack of trust in commercial fishing and pressures related to access and allocation.

Connecting with communities

Joshua Stoll says that while fishers in North Carolina were initially motivated to participate in the CSF to get a better price for their catch, the benefits have been far greater than a short-term bounce in the bottom line. The CSF model also provides crucial opportunities for fishers to tell their stories and educate their communities about what they do and how they do it.

"People are losing that connection with seafood in their communities and, as a result of that, are losing an understanding of the importance of the commercial fishing sector, both from an economic and a social standpoint," Joshua Stoll says.

Walking Fish in North Carolina has 400 subscribers who get weekly deliveries of fresh fish. This provides both a local marketplace and a powerful opportunity to educate people. As part of a subscription, Walking Fish provides customers with information on gear, species and where the fish are caught. It has also partnered with local restaurants to offer recipes for particular species.

Joshua Stoll with Craig Fletcher, who fishes in the Marine Scalefish Fishery off Wallaroo, SA.

CALL FOR INPUT

Wildcatch Fisheries SA (WFSA) has launched a project to develop South Australia's own community supported fishery (CSF). The project team wants to hear from people interested in being part of the project, learning more about CSFs or providing input as the project develops. To register your interest, to find out more or to be part of WFSA's project visit its website (www.wfsa.org.au/csf.html) or email csf@wfsa.org.au.

The project will include the development of a smartphone-based app to connect fishers with their customers – be they chefs, restaurants or individuals. It will allow customers to buy local catch and also help the public learn more about fishers, their catches and commercial fishing in SA. The targeted customer base is in the scoping stage and could include restaurants or even large retail chains. The app is expected to be launched in May 2018.

"People are losing that connection with seafood in their communities and, as a result of that, are losing an understanding of the importance of the commercial fishing sector, both from an economic and a social standpoint."

Joshua Stoll

Being able to talk to people and send information provides an opportunity to dispel myths about commercial fishing. There is also the opportunity to provide research and personal stories, Joshua Stoll says. This is particularly valuable for small-scale fishers who have an interest in selling the merit of what they do and getting prices for catch that is local, small-scale and uses fishing methods that are low impact.

Market opportunities

During a visit to the South Australian Fisherman's Co-operative Limited (SAFCOL), fresh local catch is auctioned off to retailers and wholesalers. Auction prices for the morning's catch – King George Whiting, Snapper and Garfish – are low compared with retail and restaurant prices for the same fish.

The price gap seems inexplicable when many of the small-scale fishers who catch the fish are struggling to survive financially.

Joshua Stoll says that the combination of low volumes and a diverse array of relatively unknown and undervalued species in SA's small fisheries provides a situation ripe for the disruption of traditional supply chains.

In a CSF fishers control what the consumer gets, which provides an opportunity to introduce consumers to species they either did not know or may not have considered eating. Walking Fish has asked its customers to rank the species of fish they were given according to how much they liked them and to indicate which species they had never had before. It found that triggerfish (similar to Leatherjackets), a local fish that many people had never had before, was people's favourite fish. And while many people

were resistant to trying a fish such as Mullet, often considered a baitfish, customers ranked it above average on a scale of how much they liked it.

Local perspectives

Nathan Bicknell, executive officer of the Marine Fishers Association, agrees that one of the key advantages of the CSF model is to introduce people to types of fish they might not buy normally or might not have previously tried.

Joining the meeting of the Marine Scalefish Fishery net association in Port Wakefield, he announced that Wildcatch Fisheries SA received Australian Government funding to trial a SA CSF, which, he said, could be a great opportunity for fishers of the Marine Scalefish Fishery. The project, in its scoping stage, is considering a variety of options. These could include partnering with SAFCOL for storage or integrating with the Port Adelaide redevelopment as a way of making a new seafood offering to the public.

"We are looking at broadening people's experience, by making an offering of a range of different species, both high and low value," he says.

Many of the people Joshua Stoll spoke with have already gone some way to implementing local marketing strategies. At Goolwa, there are barbecued pipis, cooked on the back of a bicycle. In summer, it is pedalled up and down and coast – an innovative and fun way to introduce Australians to a product many are still unfamiliar with.

Tracy and Glenn Hill, in developing their brand Coorong Wild Seafood, have created niche products and branding that emphasises their products as local and sustainable. They have even renovated their house to provide a space for people to learn and experience their products. Having visited the US last year to learn about CSFs they are enthusiastic about the concept, yet they remain sceptical that it can work in their own small community.

Although enthusiastic, each group of fishers has its own concerns and questions about the model. How do you manage the innate fluctuations in catch and keep your customers happy? How do you decide who gets what? Where does the capability for all these new activities come from?

New ways of working

Joshua Stoll says that pivotal to the success of the Walking Fish CSF was the cooperation needed to collect and organise information. This includes keeping records of who catches what and the prices it is sold for – vital for a profit-sharing enterprise where profits are distributed at the end of the season. The maintenance of a detailed customer database is also vital; it helps to learn what customers like, vary what they are supplied with and is an invaluable communication tool. Joshua Stoll says that Walking Fish has been able to employ a coordinator part time to take care of much of the administration.

At the outset fishers design an operating agreement to ensure cooperation and clear understanding. At the beginning of each season, fishers go through a planning process, anticipating their catch and the species to be targeted. The offering is then built around that seasonality and catch.

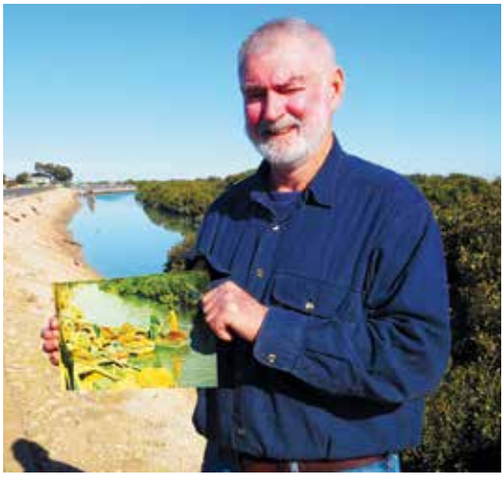
Few fishers are wholly depending on CSFs to sell their catch. They continue to make decisions about what to supply to the CSF and what can go elsewhere, depending on demand. It is also important to note that the community relationship at the heart of the success of CSFs requires commitment and longevity.

Many of the SA fishers were concerned about the disruption to existing supply chains and relationships with processors and retailers. In the US, many CSFs have worked to supply their customers with processed fish – partnering with processors.

Olaf Hansen cooking pipis on his bike barbecue in Goolwa, SA.

In Port Lincoln, Gavin Wise of Myers Seafood has begun structuring his business around the diversity and seasonality of local catch, qualities he views as an advantage. Previously a processor and retailer of mostly mussels, he says that relationships with local fishers are key to the success of the venture.

"We have to look after our fishers," he says, "because without them there is no product." The fact is that without fresh local catch and fishers there is no supply chain. F



A disappearing way of life

Port Wakefield lies more than 100 kilometres north of Adelaide at the top of the Yorke Peninsula and St Vincent Gulf. Sixty-three-year-old Bob Butson is a second-generation fisher and he took Joshua Stoll on a tour of his hometown, where he has lived and fished for most of his life.

The photo he holds shows his father unloading a catch at Port Wakefield's wharf. The channel is full of fishing boats tied several boats abreast. But on the day Joshua Stoll visited the channel was almost empty; a single young fisher was cleaning out his boat after a night out on the water.

Over the past 15 years, the number of active fishers in South Australia's Marine Scalefish Fishery has shrunk from 300 to about 35. Bob Butson says while he supported his sons' decisions to become fishers 20 years ago, today he is unsure whether there is a future for the way of life he has known. "It feels like we are in our death throes," he says of the future of net fishing in Port Wakefield.

As the president of the Marine Fishers Association Inc. Bob Butson's son Bart puts communication and visibility at the heart of the problem. These days, boats are taken home rather than left tied up in the channel. Catches are packed and sent elsewhere rather than being sold fresh off the water to the inhabitants of the town. Fishing has become all but invisible to the local community.

'Good' rating on oceans

The *Australia State of the Environment* 2016 report, released earlier this year, has provided a 'good' overall rating for the marine habitats, communities and species groups assessed, with stable or improving trends. The FRDC contributed to the Marine Environment report, which found that fewer fish stocks were "overfished" due to management efforts over the past decade.

In a comparison of the leading 53 commercial fishing nations, Australia's management ranked equal fourth overall and second for sustainability. However, the report also found no marine species had been removed from the national threatened species list since 2011, eight species and one ecological community had been added, and two species had moved up the list.

Other findings include the following.

- The main environmental pressures are the same as in 2011: climate change, land-use change, habitat fragmentation and degradation, and invasive species.
- Anthropogenic ocean warming and ocean acidification added to natural climate variations threatening Australia's marine habitats, communities and species.
- Sea surface temperatures continue to increase seven times faster in the 21st century than they did in the 20th century, and the frequency of extreme sea surface temperatures is increasing.
- Climate change, ocean acidification and changes to ocean currents have resulted in significant shifts in the ranges of various invertebrates and fish.
- Litter affecting coastal and marine ecosystems and food webs is an emerging pressure.
- Microplastics and nanoparticles are a new pollutant threat but are largely unregulated and their effects are poorly understood.
- While fisheries management and reporting has improved, efforts in the marine sector remain generally poorly coordinated across jurisdictions despite high spatial overlap. This makes it difficult to assess cumulative management impact.

More information:
www.soe.environment.gov.au

SAFS reports update

The Status of Australian Fish Stock (SAFS) is a relatively new reporting tool that brings together the best available biological, catch and effort information to determine the status of Australia's wild-catch fish stocks against a nationally agreed reporting framework. The SAFS Advisory Group has held several meetings this year to progress the production of SAFS 2018.

- **Increase in species numbers:** Since the inaugural 2012 SAFS reports, each new edition has broadened its scope. The SAFS Advisory Group, which governs the reports, has agreed that the next edition, to be released in December 2018, will include 37 new species, bringing the total to 120 (up from the current 83 species across 294 stocks).
- **Reduction in species classified as 'undefined':** A reduction in the percentage of species classified as 'undefined' is a key goal of SAFS. To help address this issue workshops will be held in each jurisdiction to train local staff in suitable data-poor stock assessment methods.
- **Tracking progress of species recovery:** The SAFS reports provide a road map for the recovery of stocks for fisheries management, industry and research. Research gaps, to address overfished and transitionally recovering stocks (stocks at biological risk), have been identified by the SAFS Advisory Group and are being considered by the FRDC's Research Advisory Councils as potential research priorities to inform stock recovery plans.
- **2018 Classification Framework:** The SAFS Advisory Group has endorsed changes to the SAFS Classification Framework to be released for SAFS 2018.
- **Independent audit:** An independent audit of the SAFS reports was commissioned by the FRDC in March 2017. It was found that all fisheries agencies continue to support SAFS and that the SAFS reports have achieved major successes in gaining the support and cooperation of all jurisdictions in developing an agreed, common framework for stock status reporting. The recommendations of the audit are available on the FRDC website (http://frdc.com.au/research/final-reports/Pages/2016-143-DLD.aspx).

The 2016 SAFS reports can be viewed at www.fish.gov.au

More information: Carolyn Stewardson, carolyn.stewardson@frdc.com.au

QUEEN'S HONOUR FOR GAIL RICHEY

Tasmania's Gail Richey was awarded a Member of the Order of Australia (AM) in the General Division as part of the Queen's Birthday honours in June, recognising her 30-year contribution to the fishing industry.

Gail Richey began her career in the industry with the Australian Fisheries Service in 1984 – the predecessor to the Australian Fisheries Management Authority (AFMA) – and then established her own fisheries consultancy company, Trawline, in 1989.

She was instrumental in setting up the South East Trawl Fishing Industry Association in 1990, operating as secretary and a board member before becoming executive officer in 1993 until 2015.

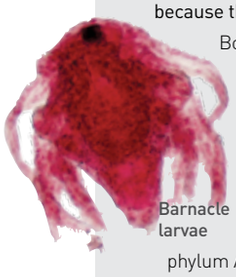
In 2002, Gail Richey and several other industry leaders saw a need for an association to represent fishers operating in Commonwealth managed fisheries and the Commonwealth Fisheries Association (CFA) was formed. Gail Richey was executive officer of CFA from 2002 until her retirement in 2015. CFA is now enshrined in government legislation as the peak body for consultation on Commonwealth fisheries issues. Gail Richey has also provided ongoing advice and expertise to several AFMA management advisory committees.

WORD WISE

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

CRUSTACEAN VS MOLLUSC

Perhaps these two are commonly confused because they can both be called shellfish. Both are invertebrates and include animals whose squishy interiors are protected by a hard outer casing (exoskeleton). Many of them are also aquatic, but there the similarities end.



Barnacle larvae

While crustaceans are a part of phylum Arthropoda, molluscs make up an entire phylum with many more species than crustaceans.

Crustaceans include crabs, shrimps and lobsters. They have segmented bodies, appendages and an exoskeleton. Compared with other arthropods their defining feature is that they have two pairs of antennae.

Some molluscs have bodies enclosed in a calcareous shell, but this is not true for all of them. Their defining characteristic is the thick layer of skin on their dorsal side. In some cases this has modified into a shell, as in the case of snails, oysters and clams. But slugs and octopuses do not have shells. Molluscs do not have antennae, segmented bodies or the appendages of crustaceans.

Curiously, while barnacles were originally classified under phylum Mollusca an examination of their larvae led to a reclassification under the class Crustacea of the phylum Arthropoda. The confusing case of the barnacle led Charles Darwin to make an extensive study of it, underlining the detailed study required to correctly categorise organisms.

Photo: Shutterstock

ECOLOGY

Photo: 123rf

HUMPBACK MOMENTUM

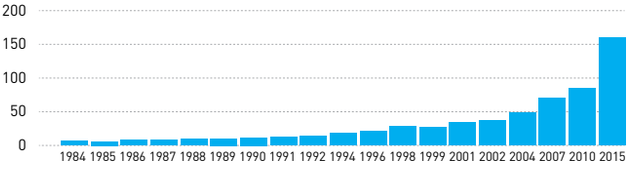
Humpback whale populations were under threat 40 years ago, but their populations have been rebuilding strongly. Commercial harvesting of humpback whales in Australian waters was officially banned in 1962, and internationally in 1972, when numbers were believed to be just one per cent of their pre-harvest populations.

Species decline was attributed to intensive whaling, including extensive illegal harvesting, following World War II. However, scientific surveys undertaken since the 1980s show the species population has rebounded, possibly to pre-harvest levels.

Michael Noad at the University of Queensland says there has been a "surprisingly rapid and consistent increase in numbers of 10 to 11 per cent a year". He says the 30,000 humpback whales estimated to have migrated this year along Australia's east coast between their Antarctic feeding grounds and more tropical breeding grounds are likely to be matched by similar numbers along the west coast.

More information: Michael Noad, mnoad@uq.edu.au

Long-term increase in peak daily humpback whale migration at Point Lookout, Stradbroke Island in Queensland.



ONLINE CHECK OUT MY BOAT

If you are not sure of the legal requirements of your vessel under the nationalisation of marine safety, the Australian Maritime Safety Authority has a new free online application that can help: My Boat.

The application is designed to help the domestic commercial vessel industry understand and comply with vessel survey requirements, including designers, builders, surveyors, owners and operators.

You can enter the details of your vessel and, based on the National Standards for Commercial Vessels, Marine Orders and National Law exemptions, My Boat will produce general results about a vessel of that type.

If you join up and become a member of My Boat, there are extra features available, including saving your projects for later review and sharing your saved projects with other members.

More information: apps.amsa.gov.au/MyBoat

TECHNOLOGY

A collaboration involving Nuseed (a subsidiary of Nufarm Ltd), CSIRO and the Grains Research and Development Corporation (GRDC) has developed a proprietary, genetically modified (GM) canola that provides long-chain omega-3 oils similar to those found in fish oil.

Long-chain omega-3 docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) are essential for human and fish health. This new proprietary product aims to help relieve pressure on wild fish stocks, which are the current source for omega-3 oil. One hectare of this GM canola has the potential to provide the omega-3 yield from 10,000 kilograms of fish.

Submissions for regulatory approval to commercialise the crop have been made in Australia, the US and Canada. Regulatory submissions are being made: to the Office of the Gene Technology Regulator and Food Standards Australia New Zealand in Australia; to the Canadian Food Inspection Agency and Health Canada in Canada; and to the US Department of Agriculture and the Food and Drug Administration in the US.

Commercial brands for the resulting oil product, specific to key end-use markets, are Aquaterra™ for aquaculture feed uses and Nutriterra™ for human nutrition application.

More information: nuseed.com/au

MORE INFORMATION
Australian Marine Sciences Association, www.amsa.asn.au
FRDC RESEARCH CODE: 2010-205

Tropical topics reel in the awards

Research students from the north take the lead in this year's Australian Marine Sciences conference

By **Catherine Norwood**

Left Catherine Kim **Above** Samantha Nowland

Tropical rock oyster aquaculture and coral reef biodiversity were the topics of two winning student presentations at the Australian Marine Sciences Association (AMSA) conference in Darwin in July 2017.

Samantha Nowland won the FRDC-sponsored award for the best student oral presentation, which outlined an Indigenous economic development project in the Northern Territory focusing on the native Black-lip Oyster (*Saccostrea mytiloides*). The presentation was part of her research as a PhD candidate with the University of the Sunshine Coast. She also works as an aquaculture research scientist at the Darwin Aquaculture Centre, which has been involved in the oyster project since 2009.

Indigenous oysters

Samantha Nowland says the aim of the project is to develop an aquaculture industry that would allow the remote Warruwi community on South Goulburn Island and the Pirlangimpi community on Melville Island to undertake small-scale wild harvesting of oysters. Production would target premium local markets.

Challenges include the lack of basic species information, which is linked to an unreliable supply of oyster spat. Monitoring for water and meat quality – essential in producing a commercially marketable product – is also ongoing.

The project's successes include:

- developing a suitable grow-out system for remote communities that can be easily maintained by local people;
- incorporating training and capacity building into all aspects of oyster grow-out, with an emphasis on practical, on-country delivery; and
- establishing research partnerships with Charles Darwin University to investigate socio-cultural issues, engagement and governance arrangements.

Samantha Nowland says the project has established a productive partnership with the local Yagbani Aboriginal Corporation, gathering the multidisciplinary skills needed to support the fledgling industry. Success will lie in long-term, cooperative partnerships that are based on trust and driven by the community.

Coral reef diversity

The winner of the FRDC's student poster presentation, PhD candidate Catherine Kim, focused on the marine cryptofauna, or invertebrates, of the Timor-Leste coral reefs. Her work highlights the lack of data on cryptofauna and how they relate to other important groups, such as reef fishes, and benthic composition.

Timor-Leste is one of six member states of the Coral Triangle, which is the epicentre of marine biodiversity globally. It is also one of Australia's closest neighbours and is heavily reliant on small-scale fisheries for food security.

Understanding coral reef composition and associated fauna is important to help sustain Timorese reefs for their biodiversity, economic value and fish resources.

Catherine Kim was able to DNA barcode a range of brachyuran crabs or 'true' crabs (as opposed to hermit crabs) – crustaceans of the infraorder *Brachyura*. These had been collected from US sampling units on the north coast of Timor-Leste from 2012 to 2014. She found 37 per cent of the 75 species identified were unique to Timor-Leste. Most crabs collected were classified as 'rare' with only one known sample of 45 per cent of the species identified.

As an XL Catlin Ocean PhD scholar, part of her PhD research at the University of Queensland, she is also assessing kilometre-scale benthic composition (www.globalreefrecord.org), reef fish biodiversity and biomass data of Timorese reefs.

Other awards

Other awards presented at the AMSA conference included the Jubilee Award for Excellence to Peter Steinberg, director of the Sydney Institute of Marine Sciences, an expert in marine ecology and biochemistry.

The AMSA Technical Award went to Brett Womersley, chief technical officer for Fisheries Victoria, who has coordinated and assisted with field research throughout the state for the past decade.

The Allen Award to assist a postgraduate student with travel costs went to Paige Kelly at the Institute for Marine and Antarctic Studies, who will attend two international symposiums related to her work on krill. F

MORE INFORMATION
Seafood Industry Australia, www.seafoodindustryaustraliacom.au

United advocacy for seafood

Australia's seafood industry celebrates the launch of its new peak body

By **Peter Horvat**

A new national peak body for Australia's seafood industry, Seafood Industry Australia (SIA), was launched in Adelaide on 9 June 2017. About 100 business representatives and political leaders from across Australia attended the launch of SIA.

The chair of the inaugural SIA board, Veronica Papacosta, said the formation of SIA was the culmination of two years of hard work by many people to establish a united voice for the Australian seafood industry.

Voluntary pledges of more than $600,000 have been made from 95 businesses – both individuals and organisations – who have signed on as financial members, and this number continues to grow.

"SIA exists for its members, to produce outcomes that are real, measurable and valued by industry businesses," Veronica Papacosta says. "It will leverage all its resources, members and their organisations to achieve scale and influence for the industry, while maximising operational efficiency."

Veronica Papacosta noted that while the formation of SIA has been an industry-led process, it had been assisted by the Australian Government with a $500,000 grant to develop the organisation. The seafood industry also had unwavering support from the Assistant Minister for Agriculture and Water Resources, Senator Anne Ruston, and her predecessor the Honourable Richard Colbeck.

Senator Anne Ruston spoke at the launch about how work with the commercial seafood sector has now seen this key commitment achieved. She emphasised the opportunity for SIA to promote the seafood sector to the wider Australian community, and to gauge public sentiment about fishing activities and the management of Australia's marine environment.

The chair of the FRDC, Ron Boswell, said the FRDC was also pleased to be at the launch event and looked forward to working with SIA in the future.

Above (From left) FRDC board member John Harrison, Senator Cory Bernardi, Senator Anne Ruston (Assistant Minister for Agriculture and Water Resources) and Grahame Turk from Sydney Fish Market.
Photo: Andy Steven Photography

Above The inaugural SIA board: (from left) Chauncey Hammond, Marshall Betzel, Belinda Wilson, Mark Ryan, Veronica Papacosta, Dennis Holder and Marcus Stehr.
Photo: Andy Steven Photography

"It is important that the Australian seafood industry has a unified voice: one that can be decisive in representing the needs and best interests of the wide range of members it represents," he said.

The formation of a national peak body to represent the common needs of the seafood sector has been a long-running ambition for many in this diverse sector.

During the long and challenging development process, the establishment task force, led by its chair Martin Exel, consulted widely with the many players in the sector. Brian Ramsay and the Inovact Consulting team, who managed the United Seafood Industries Project, were also pivotal in the establishment of the new peak body.

The new board members of the SIA represent the diversity of the seafood sector. They are: Marshall Betzel, president of the Queensland Seafood Marketers Association; Chauncey Hammond of the Northern Territory Seafood Council; Dennis Holder from Wildcatch Fisheries SA; Veronica Papacosta (chair elect), managing director of Sydney Fresh Seafood Group; Mark Ryan, CEO of Atlantic Salmon producer Tassal; Marcus Stehr, director of Clean Seas; and Belinda Wilson, CEO of Port Phillip Bay Scallops.

The SIA will advocate on the behalf of the sector to ensure the continued well-being and development of Australia's seafood sector. F

From water to waiter – marketing starts on the boat

A Queensland symposium shows the seafood sector is serious about better marketing

By **Peter Horvat**

To help industry better understand some of the key concepts around marketing, the Queensland Seafood Marketers Association (QSMA) this year organised and ran the first Seafood Marketing Symposium: 'Whole Chain – from water to waiter'.

The event acknowledges that marketing is more than simply coming up with an advertisement.

The symposium was held on Friday 30 June 2017 at Rydges South Bank in Brisbane prior to the Queensland Seafood Industry awards night and celebrations. Linking the two events worked well, with more than 60 people at the symposium and 80 at the state awards dinner.

Scott Spencer, deputy director-general fisheries and forestry, Queensland Department of Agriculture and Fisheries, outlined the value of the fishing industry to Queensland in his opening address. He also spoke of the work underway to improve Queensland's fisheries.

John Connelly, president of the US National Fisheries Institute, was the international keynote speaker for the symposium and gave a talk titled 'How does industry reputation and perception impact brands?'

He outlined the importance of language when communicating with consumers and stakeholders and how this can have an impact on the perception of seafood and the industry as a whole.

For example, he said the industry describes the catch in tonnes, but no one eats seafood in tonnes; they eat meals. Using words that the consumer can relate to places seafood in the centre of their experience, demonstrates how it is part of life, rather than as some inexplicable, remote or industrialised process.

Management matters

John Connelly's other key message was the important role fisheries managers have in educating the community about the sector, a message reinforced by the findings of the FRDC's recent community perceptions survey (see page 12).

He advocated a simple flow of news and information about fisheries management to the community. He said communicating about the management of fisheries would be of benefit to everyone – including fisheries managers.

Diverse players from the sector featured strongly with eight presentations at the symposium from fishers, processors, retailers and marketers. All presentations can be viewed online at the QSMA website (www.queenslandseafoodmarketers.com.au/symposium-program).

Further action

FRDC executive director Patrick Hone says the symposium showed the effort and rigour being applied to improve local and national marketing issues around Australia, and several presentations used FRDC research to inform their marketing approach.

"If only two companies leave the symposium and do something different, then the symposium will be a great success," Patrick Hone said. "My feeling is that many more than that will take learnings into their business or sector body."

QSMA president Marshall Betzel said positive feedback from delegates indicated that presentations on the day were particularly informative.

He says the symposium brought key participants in the value chain together to present their points of view and processes to others.

Another marketing symposium has been proposed for next year and the QSMA plans to discussion the potential for similar events in other states. F

US PRESIDENT VISITS

Keynote speaker for the Queensland Seafood Marketing Symposium John Connelly is president of the US National Fisheries Institute (NFI), a non-profit trade lobby group representing the seafood industry. The institute is also member of the International Coalition of Fisheries Associations.

While in Australia, John Connelly met with the newly formed peak body, Seafood Industry Australia (SIA), food-service distributor Bidfood, staff from the Australian Department of Agriculture and Water Resources and the Australian Fisheries Management Authority, and Assistant Minister for Agriculture and Water Resources Senator Anne Ruston.

SIA chair Veronica Papacosta says many of the national issues Australia was facing are mirrored in the US experience. "John Connelly not only provided insight into how NFI has handled and continues to manage many of the common national issues facing the industry but he also took the time to offer advice on our homegrown issues." The SIA will work with the NFI in the promotion, protection and development of respective seafood industries, she says.

MORE INFORMATION
Peter Horvat, peter.horvat@frdc.com.au
frdc.com.au/research/market_research/Pages/default.aspx

Familiarity breeds positive perceptions

A new survey finds that more people now view the Australian seafood sector as sustainable – but there is still much to do

By **Catherine Norwood**

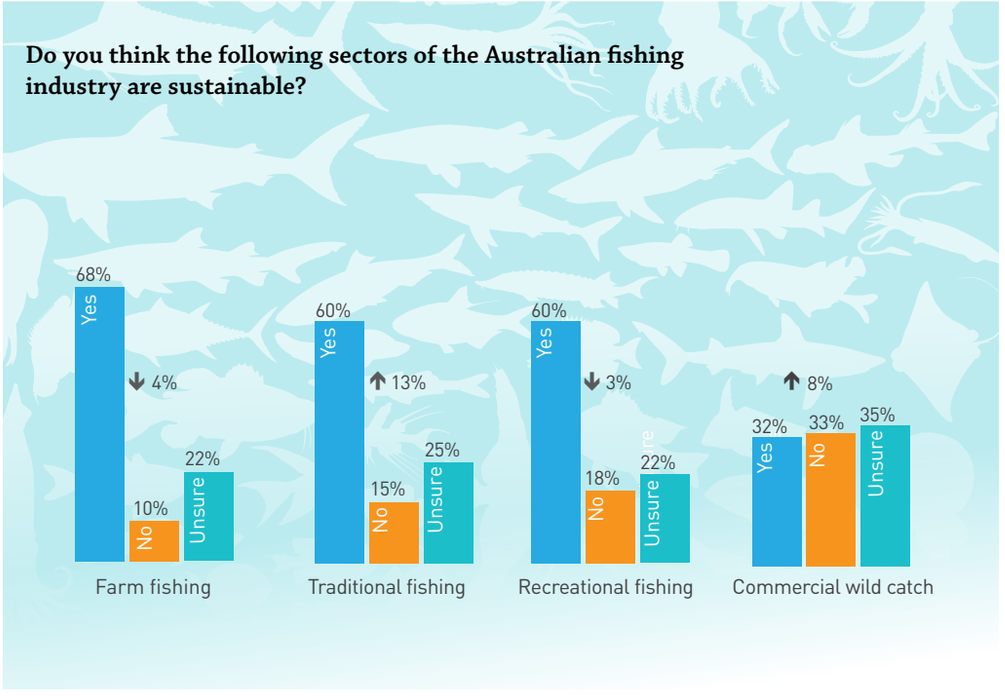
Forget the 'no news is good news' approach. The latest community perceptions report commissioned by the FRDC shows Australia's seafood sector is viewed as more sustainable than it was two years ago, but the report also highlights the need for long-term, regular engagement between the fisheries sector, the media and local communities.

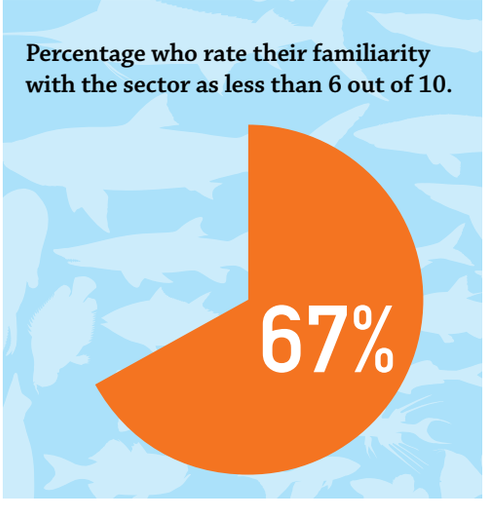
The FRDC's 2017 community perceptions research surveyed 1007 people in June – a demographically representative sample of the population – finding that 41 per cent of Australians believe the Australian seafood sector is sustainable, an increase of three percentage points on the 2015 survey, and four percentage points on the 2011 survey.

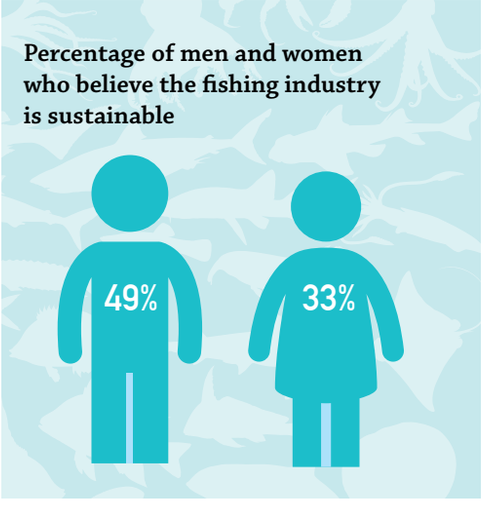
However, the proportion who believe the fisheries sector is unsustainable has remained relatively steady since that first 2011 survey, at about one in five respondents; 21 per cent was the official response this year, which is up one per cent on 2015.

Those declaring themselves "unsure" this year made up 38 per cent of respondents. According to Innovative Solutions, the firm commissioned to conduct the survey, further analysis of this group's other answers suggested many lean towards a negative view of fisheries sustainability. Women and people aged under 35 years were also generally more critical in their responses.

Of the 38 per cent of "unsure" respondents, 18 per cent were "hopeful and confident" the sector would be sustainable. Combined with the 41 per cent of respondents who already view it as sustainable, this brings the total of "positively inclined" respondents to 59 per cent. The authors suggest these two groups should be the







priority for continued communication efforts.

The FRDC's manager of communications, trade and marketing, Peter Horvat, says the general trend is positive and reflects the efforts of many in the sector to improve perceptions of the Australian seafood sector.

Areas identified for further improvement include awareness about fisheries management and increasing the profile of fishers in their local communities. There was a strong correlation in the survey responses between those who viewed the sector as sustainable and those who had some awareness of fisheries management. Those who regularly ate seafood were also more likely to rate the sector as sustainable.

"There is a clear role for fisheries managers here," Peter Horvat says. "We have eight fisheries jurisdictions, and if each of those produces just one story a week, that's more than 400 stories in a year – a constant feed of messages for a broader audience. We're not talking about a big 'splash' campaign, but a long-term, steady presence that reinforces the importance and value of our fisheries and raises the profile of fisheries in the community."

The survey also found a clear correlation between familiarity with the commercial sector and perceptions of sustainability of the industry overall. "The more familiar people are, the more likely they are to think the industry overall is sustainable," the report states. "The challenge in driving overall community perceptions of sustainability will then likely reside in the industry's ability to build a stronger awareness with the commercial sector."

The report suggests that improving perceptions about the sustainability of wild-catch fisheries would have the greatest impact on perceptions of Australian seafood overall, attributing a 57 per cent share of influence to the wild-catch sector. Aquaculture had a 22 per cent share of influence, with 19 per cent for recreational fishing and two per cent for traditional fishing. It is also important to better understand the obstacles preventing people from considering the commercial wild-catch sector to be sustainable.

Four themes emerged from responses about commercial challenges: concerns around running out of fish; illegal fishing or fishing without regard for the environment; fishing practices that damage the environment; and fishing as an unprofitable enterprise.

Results also indicated that Australians believe sustainability is a shared responsibility across government, commercial and community interests. Governments and commercial fishers are seen as the primary custodians, with the greatest potential to influence perceptions of the sector overall. Almost two-thirds of respondents (64 per cent) viewed Australian fisheries as more sustainable than fisheries in other countries.

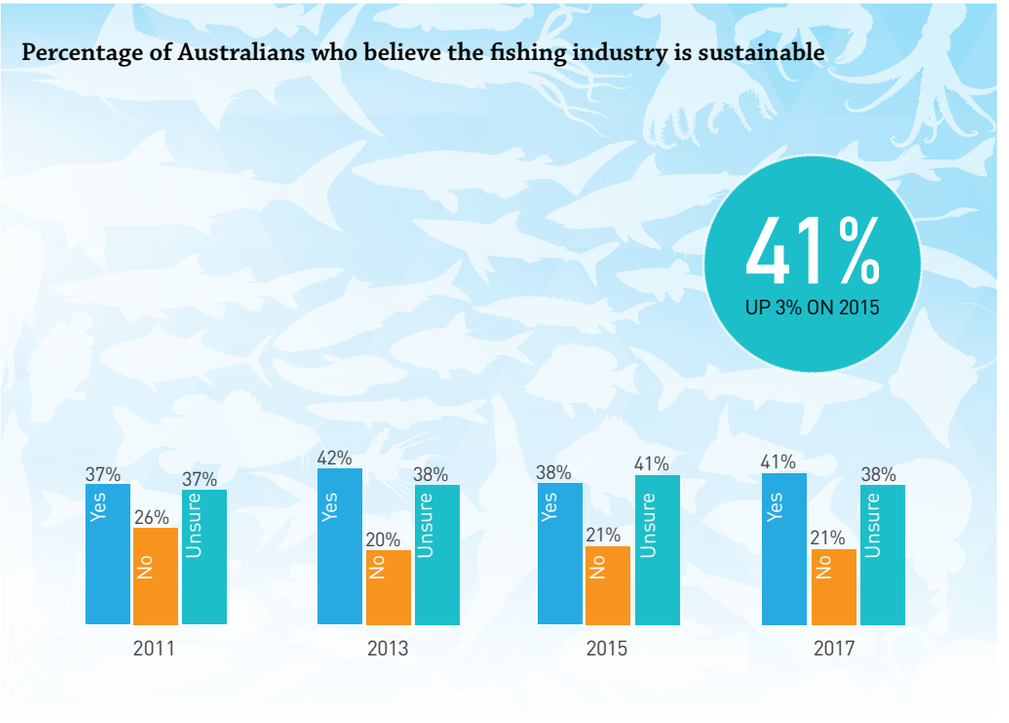
The FRDC's 2017 community perceptions survey found general support for country-of-origin labelling on seafood. More than 70 per cent of respondents agreed that "country-of-origin labelling allows you to make a more-informed choice about the seafood you buy" with scores of eight or more out of a possible 10.

Peter Horvat says the FRDC has conducted community perception surveys every two years since 2011, but is now planning annual surveys from 2017 to 2020 to measure performance against its National Priority 1: Ensuring that Australian fishing and aquaculture products are sustainable and acknowledged to be so.

"Our aim is to track whether the sector is seen to be sustainable, how the Australian seafood sector benchmarks against other countries and industries; and the impact of efforts to raise knowledge and awareness of the sector," he says.

The FRDC's initiatives in line with sustainability perceptions include the coordination of the Status of Australian Fish Stocks Reports, which continues to expand the species it evaluates and reports on, and the FRDC's FishFiles website (www.fishfiles.com.au), which provides a portal for information about seafood including species information, recipes and seafood-related events. F

The full *Community perceptions of the sustainability of the Australian fishing industry – 2017* research report is available from the FRDC website (www.frdc.com.au/research/market_research).



Sustainability is defined as: the industry having the necessary practices and policies in place to ensure the future of fish species and the marine environment while providing a sufficient supply of fish for commercial and recreational fishing needs.

MORE INFORMATION
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FRDC RESEARCH CODE: 2015-022

Tagging study sheds light on the elusive Swordfish

Swordfish survival is the focus of research in an emerging Tasmanian recreational fishery

By **Bianca Nogrady**

If there is a holy grail of recreational fishing, it's the Swordfish. Anglers talk about it in almost mythical terms: the unicorn of the sea, the Mount Everest of angling, the ultimate test of man versus (marine) beast. Even its scientific name – *Xiphias gladius* – translates from ancient Greek and Latin as 'sword sword'.

Until recently, the Swordfish was thought to be all but out of reach for recreational fishers in Australia. One or two may have been hooked through sheer luck, but no amount of persistence was able to coax this elusive creature out from the depths.

But anglers finally appear to have 'cracked the code', and a recreational Swordfish fishery is growing around Tasmania and off the south-east coast of Australia. The numbers are still minuscule compared with commercial catch of Swordfish, but it is putting Australia on the recreational fishing map for the species.

While apex predators such as Swordfish make an attractive hunting target, there is always the conundrum of whether these magnificent creatures are killed as part of the hunt or whether they should be released safely after capture.

Keep or release

"It's been very controversial, with the general public but also within the recreational sector as well, about whether these fish should be being retained and weighed – that trophy concept – versus being released," says Sean Tracey, a researcher at the University of Tasmania.

Marlin – another big game fish – is treated as a catch-and-release fishery. One of the main differences here is that Marlin are not considered to be good eating, whereas Swordfish are highly sought after for the dinner table.

Declaring that all Swordfish caught by recreational fishers should be released is not so simple when it comes to the animals' welfare either.

Catching a Swordfish is a marathon effort both for the fisher and the fish. In some cases, a larger fish can fight on the line for several hours. By the end of that, the fish can be exhausted. The fish might also be suffering barotrauma – the damage done by expanding gases in the fish's body as it is brought up from as much as half a kilometre below the sea surface.

Sean Tracey has set out to explore just what happens to Swordfish after they are caught and released, using satellite tags that collect data on a fish's movements for up to 250 days after capture.

Tracking survival

The tags, which are attached to the muscle near the fish's dorsal fin, record information such as water temperature, depth and light intensity on a daily basis. If the fish survives the tag remains attached for up to 250 days then automatically detaches and is brought to the surface by an in-built flotation device. From there, it transmits its data via satellite.

The tag is able to detect if the fish has died – for example, if the tag records that it has stayed at the same depth for several days in a row, whether that be the surface or the sea floor – and will then automatically detach, float to the surface, and send back the data it has recorded.

"The primary point of the project is using satellite tags to determine, once the fish has been caught by a recreational fisher and then released, whether they actually survive," Sean Tracey says.

"The benefit of using the tag, for the ones that do survive, is that we get a lot of information on the movements and behaviour of the animal for a long period of time as well," he says.

The pilot project, which has so far deployed eight of the 10 satellite tags, is already delivering a treasure-trove of data on the movements of these fish, some of which can weigh more than 300 kilograms.

For example, there has long been debate over whether the Swordfish actually reside year round in the cooler waters around Australia's southern coastline, or whether they are simply migrating down from the Coral Sea, where the main Swordfish populations are found and where the commercial fishery plies its trade.

The satellite tag data showed that some of these southern-caught Swordfish were travelling huge distances up and down eastern Australia – in one case, as far north as the Solomon Islands. One fish even travelled up to the mid-north coast of Queensland and then journeyed back down to Tasmania.

"It would suggest the there's something bringing them back down here – it's not just that they've ventured down here and got lost," Sean Tracey says.

There was also the suggestion that some of the smaller fish were hanging around the NSW and Victorian coast, rather than returning up north.

"That may be related to the fact that the ones that did travel back up north were quite large fish and likely to be spawning fish, and spawning is known to occur in the Coral Sea."

But more importantly, Sean Tracey's research suggests that a blanket catch-and-release policy is not necessarily the best approach.

Joining the research team, recreational fisher Paul Worsteling from IFISH TV releases a tagged Swordfish.
Photo: Sean Tracey, University of Tasmania

While many of the Swordfish caught and tagged so far appear to have survived the experience, Sean Tracey points out there were some fish that the team decided not to tag because they could see from the fish's physical state that it was unlikely to survive.

Informed decision

"We've got a series of things we observe, like an Apgar test with a baby; we do the same thing with the fish to determine whether it's in good condition," Sean Tracey says. When the fish is brought to the boat, the tag is put in, then the fish is 'resuscitated', which involves moving the boat slowly forward while the fish is held alongside, allowing water to flow over its gills as it rests – a common practice for many large pelagic species prior to release.

Once this is done for a period of time, the researchers do another assessment to see if its condition has improved enough to release it.

"Generally we're doing everything we can to release them, because that's the objective of the project, but we have had some that have died prior to release," he says. This makes for a more complicated scenario than a simple catch-and-release: it is likely to require recreational fishers to complete an assessment of the fish's physical state before deciding whether to release it.

A fish released when it was unlikely to survive would be a waste and a poor outcome. A better outcome, if the fish is in poor condition, would be to quickly and humanely dispatch it, and ice it down so the meat is in good condition for eating.

Paul Worsteling is a recreational angler and host of *IFISH TV* who supports a catch-and-release approach. "I always like to try to give the fish the chance for release first, and if release doesn't work, then I'm happy to take the fish home and eat it because I love eating fish," he says.

Paul Worsteling has spent more than two decades trying to capture a Swordfish, and has now caught several – including a 350-kilogram monster that he caught with Sean Tracey and the team.

"Even after five hours and 10 minutes of driving and pulling, it nearly broke me, but that fish just pulled the hook out, swam away, and it's still swimming along merrily and that's why they're the most epic creature ever," he says. That fish has been swimming around for three months with a satellite tag attached and Sean Tracey says the team are looking forward to getting the data back later this year.

In all that time, Paul Worsteling has only ever taken home one Swordfish when it was clear the fish was not going to survive. He argues that Swordfish should be given a chance to survive after being caught.

Sean Tracey says things such as hook choice could improve the chances of a fish surviving – for example, using a circle hook instead of a 'j' hook – and is also interested in tactics that might cut down on fight time.

"The issues currently lie more around responsible fishing practices and making sure we understand how the fish responds to the recreational catch, so if someone chooses to release one, they have fact-based information on hand to decide whether it is the right thing to do on a case-by-case basis." F

MORE INFORMATION
Seafood Directions, www.seafooddirectionsconference.com
Women's Industry Network Seafood Community, http://winsc.org.au

Towards seafood's future

The seafood sector's national conference Seafood Directions will examine what the future of fishing in Australia could look like – and how to get there

By Catherine Norwood

This year's Seafood Directions conference, Sea the Future, will be held in Sydney from Wednesday 27 September to Friday 29 September 2017.

The Assistant Minister for Agriculture and Water Resources, Senator Anne Ruston, will officially launch the conference proper at the International Convention Centre, Sydney, on Thursday, following the welcome reception on Wednesday evening.

The opening keynote speaker will be Craig Rispin, who will set the scene for presentations and discussion to follow with some 'blue-sky' thinking about what could be possible for the seafood sector in five, 10 and 20 years.

Originally from the US, Craig Rispin is a Sydney-based business futurist and innovation expert, helping to identify emerging business, people and technology trends – think drones, 3D printing fish fillets – and how companies can profit from them.

Several presentations during the conference are designed to prompt discussion by presenting ideas from other sectors or from seafood sectors in other countries.

These include:

- marketing lessons from the pork industry from Peter Haydon, general manager of marketing for Australian Pork Ltd;
- rebuilding New Zealand's Orange Roughy fisheries and links to new reputation-related initiatives outlined by Tim Pankhurst, chief executive of Seafood New Zealand (see page 20); and
- the experience of health supplements manufacturer Blackmores in exporting to China from Blackmores chief operating officer Richard Henfrey.

A session on health and safety and gear technologies will run concurrently with a session on community and consumers on Thursday afternoon, followed by a combined session focused on efforts to improve the productivity and reduce the environmental impact of fishing.

The potential to harvest fisheries data for improved performance, management and marketing will feature in Friday's opening session. This will include presentations from KPMG's Jono Gregory, who was previously executive director of business operations with the New South Wales Department of Primary Industries, which incorporates the seafood sector.

KPMG is also an investor in Australian agtech company The Yield, which has developed a sensor network and software program providing information for Australian oyster farmers and regulators about water quality and potential harvest closures. The Yield was a finalist in the 2017 Microsoft Global Partner of the Year Awards, and company founder and managing director Ros Harvey will also present at the conference.

Visiting from the US, founder of SmartCatch Mark Dahm will discuss precision fishing and digital management systems designed to support sustainable commercial fishing.

Far left Ros Harvey, founder and managing director of The Yield.
Left Sydney-based business futurist Craig Rispin will deliver the opening keynote address at this year's Seafood Directions conference.

Industry recognition

Seafood Directions will showcase the best of the Australian seafood industry, including industry leaders who will be recognised across a broad range of activities at the National Seafood Awards. The presentation dinner on Thursday evening will be held at the Convention Centre's Grand Ballroom.

Award categories include: best primary producer; best business (large and small); safety; research, development and extension; environment; people development; promotion; restaurant; takeaway fish and chips; young achiever; and industry ambassador. New inductees to the National Seafood Hall of Fame will also be announced on the night.

Full conference registration is $790, or $490 for a student, and $480 for commercial harvesters (excluding GST). Day registration is available, as are additional tickets for the National Seafood Industry Awards on Thursday evening. F

ECONOMICS PROVIDES COMPETITIVE ADVANTAGE

The leaders of the FRDC's human dimension research subprogram, Sarah Jennings and Emily Ogier, will lead a free pre-conference workshop on Wednesday 27 September at the Sydney Fish Market exhibition room.

Titled 'Economics for a competitive edge', the workshop will provide Seafood Directions delegates with an introduction to economic concepts and tools that could help give seafood sector businesses and organisations an advantage with economic insight.

A series of short presentations, case studies and exercises will demystify many of the core concepts of economic thinking (such as opportunity cost, economic profit and time preference).

The presenters will demonstrate several economic tools, including discounting and elasticity, and unpack selected fisheries and aquaculture sector issues through the lenses of price discrimination, principal-agent analysis and the prisoner's dilemma.

The session will run from 1pm to 4.30pm and will also be an opportunity to learn more about the FRDC's human dimension research aims and activities.

Deed offers disease risk strategy

An emergency disease agreement being drafted aims to bring the marine sector into line with land-based agriculture

By Catherine Norwood

Abalone, oysters, Sardines and prawns: these are just a few of species affected during the past decade by devastating diseases previously unknown in Australian waters.

In the wake of disease outbreaks, the need to protect these species and the industries that rely on them has been the impetus for efforts to establish an aquatic animal disease emergency response agreement, to be called the Aquatic Deed. The deed will promote a greater biosecurity culture and more rapid response to an aquatic disease outbreak including industry representation during the response , agreed compensation for impacted farmers and agreed cost sharing between state and Commonwealth Governments and industry. Work on the project has accelerated following the 2016 outbreak of Pacific Oyster mortality syndrome in Tasmania and white spot disease outbreak in farmed prawns in south-east Queensland last year.

A draft agreement is expected to be ready for stakeholder comment from early 2018. It is being modelled on similar agreements to those in place for land animals and plants.

At the Australian Department of Agriculture and Water Resources, senior policy officer Katie Scutt is part of the team drafting the agreement. She says extensive stakeholder consultation is underway, which includes presentations at a diverse range of seafood sector events, including the national Seafood Directions conference in Sydney from 27 to 29 September.

The Aquatic Deed working group includes representatives from the Abalone, Atlantic Salmon, Barramundi, oyster, pearl, prawn, Southern Bluefin Tuna and wild-capture industries, as well as most state and Commonwealth governments. All levels of government are engaged in the project, up to ministerial level, and agricultural ministers discussed the Aquatic Deed at a meeting on 26 July 2017.

Katie Scutt says the national project officially began in 2014, with a four-year work plan for the agreement. However, this has built on earlier work that followed the first outbreaks of Abalone viral ganglioneuritis in 2006 in Victoria and then 2008 in Tasmania.

Aquatic animal resources are unique in that biosecurity risks are shared across many users, from aquaculture farmers to recreational and wild-capture fishers. Katie Scutt says all sectors will benefit from an effective emergency response and all have a part to play in good biosecurity practices.

The Aquatic Deed is being developed to apply to both farmed and wild stocks on an sector-by-sector basis (for example, Abalone viral ganglioneuritis affected farmed and wild abalone populations).

The president of the Australian Prawn Farmers Association, Matt West, says the prawn sector is acutely aware of the impact of exotic diseases, having just been through the outbreak of white spot disease in Queensland. He says there were many negotiations involved at all levels of government to control the disease, but some decisions could have been fast-tracked had the Aquatic Deed already been in place.

"And while we had good relations with the agencies involved, we did not have a seat at the table when decisions were made, we were basically passive observers. Being party to a deed would effectively have given us more say.

"We would already have agreed on who would do what, and who would pay for what. We would also have known what kind of financial commitment we were looking at, and over what time frame."

Matt West says he believes the certainty of a deed and the inclusion of cost-sharing also raises the stakes in terms of obligations and responsibilities for all parties involved. Knowing the potential financial ramifications can motivate better biosecurity.

"We recognise it's complicated to set up an agreement, which is one reason why it's taken so long to eventuate, but we're committed to being involved," he says.

Once the agreement has been finalised it will require the approval of all state and territory governments and the Australian Government. National industry peak bodies will be able to choose to opt in on behalf of their members, with mutual obligations from industry and government to implement agreed biosecurity practices. F

Katie Scutt will provide an update on the Aquatic Deed on Friday 29 September at the Seafood Directions conference in Sydney.

MORE INFORMATION
Seafood New Zealand, www.seafoodnewzealand.org.nz

Commitment to restore trust

Orange Roughy
Photo: William Meppem

By **Catherine Norwood**

Roughy on the Rise is the name of a new book focusing on a warts-and-all history of New Zealand's Orange Roughy fishery and its "resurrection" from the brink of collapse. It is a remarkable story, says author Tim Pankhurst, which also reflects the history of Australia's own recovering Orange Roughy fisheries.

But for New Zealand in particular, Tim Pankhurst says, the story speaks to the larger issue of public confidence in the behaviour of the seafood sector.

He says *Roughy on the Rise* was produced as an unvarnished account of events at the behest of the seafood sector. A former journalist, editor and publishing industry representative, the book was a sideline to his full-time advocacy role at Seafood New Zealand, the New Zealand fishing sector's peak body, where he has been the chief executive for the past four years.

This July, the body launched a new campaign aimed at developing public trust in New Zealand's seafood industry. Tim Pankhurst says the campaign includes recognition that mistakes were made. It also highlights the initiatives and long-term commitment the industry is making to improve its performance. He says this is the epitome of what has occurred in the fishing of Orange Roughy.

The industry's 'promise' campaign is a three-year project largely funded by Seafood New Zealand's eight largest stakeholders, all of whom are represented on the organisation's board of directors. Smaller quota holders have also seen the worth of the campaign and have contributed.

Lessons learnt

When the Orange Roughy fishery was first discovered in the early 1980s, it was quickly exploited. "It was an instant gold rush and the market just couldn't get enough," Tim Pankhurst says. "Some boats in both New Zealand and Australia were so overloaded with catch they sank. There were extraordinary risks, but also extraordinary rewards."

Acoustic tracking technology to locate schools was initially rudimentary, but fishers quickly learnt through trial and error the best way to target these deep-sea fish, often found at depths of more than one kilometre.

At its peak, New Zealand fishers were catching 63,000 tonnes of Orange Roughy a year. But as catches declined and the science revealed more about the long-lived roughy, several fisheries were closed. Today the total allowable commercial catch across New Zealand's four fishing zones is 8700 tonnes a year.

"We estimate we catch four in every 100 fish, and the population is slowly recovering," Tim Pankhurst says. "We see it as a story of redemption, but also a story of the resilience of the oceans. Well-managed fisheries can and do recover, and this has happened around the world."

In December 2016, the three major Orange Roughy fisheries received certification as sustainable from the Marine Stewardship Council (MSC). In awarding certification, the MSC said it was the "biggest news story ever in the New Zealand fishery".

Tim Pankhurst says although there are still some doubters about the fishery, the MSC process is a rigorous one: all 32 environmental or social criteria must be met. "You don't see Orange Roughy for sale in New Zealand very often, which I think contributes to the perception that it's still at risk, but in reality most of it is exported."

Today the New Zealand fishery is worth $60 million a year, and, in the past four years, China has overtaken the US as the major buyer with a preference for whole fish, which effectively doubles the return to fishers.

At the launch of *Roughy on the Rise* in April 2017, chief executive of New Zealand's Deepwater Group George Clement said the return of Orange Roughy to a sustainable fishery had taken two decades of dedicated work by the industry.

ORANGE ROUGHY (*HOPLOSTETHUS ATLANTICUS*)

Other names: Slimehead, deep sea perch, red roughy, orange ruff.

Description: A bright reddish-orange deep-sea fish, it can grow up to 75 centimetres long and weigh as much as seven kilograms. It is commonly harvested at 1.25 to 2 kilograms and 50 centimetres long.

Life span: More than 100 years; reproductively mature at 27 to 32 years.

Cooking: It has a highly versatile, moist white flesh with a mild and delicate flavour.

The rebuilding of the fishery was the result of a significant change in attitude, from exploitation to a solid commitment from industry to sustainable fishing.

"It has been a long and challenging process. In the late 1990s it was clear that we needed to start from scratch as we attempted to gain reliable, scientific data on the Orange Roughy stocks to establish the sustainable yields and to put in place a management system that allowed the stocks to rebuild in size.

"We're proud of what we have done. The direct investment in science and innovation by industry to ensure the Orange Roughy fisheries are sustainable is around $35 million since 2000."

Public commitment

Tim Pankhurst says the story of Orange Roughy is part of the larger picture of the New Zealand seafood sector's commitment to better manage fisheries resources for the long-term benefit of the public.

The public trust campaign launched in July has been born of the frustration of ongoing negative reporting about issues such as overfishing, bycatch, discards and endangered species, despite significant industry improvement.

"We know our fisheries are well regarded internationally, and quota systems have helped to build sustainable fisheries. The science confirms this.

"But we haven't been able to get this message across. This campaign is a promise to the people of New Zealand that we will do the right thing and we are committed to improving our performance."

He says a film crew and photographer have captured that commitment during a two-week tour of the country visiting fishers and seafood processors who are telling their own stories in their own words.

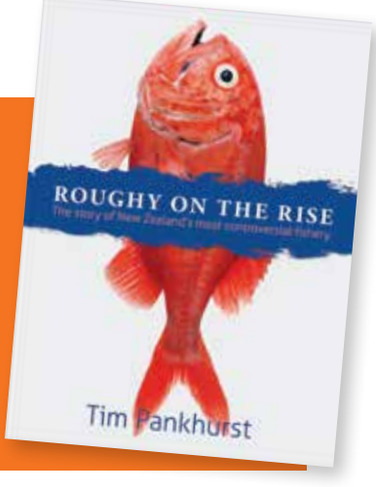
A promotional campaign on television, radio and social media will be complemented with longer web episodes highlighting how important sustainable fisheries are to the fishers themselves, and also the role that fisheries play in supporting communities.

"We will be closely tracking the results and any changes in the public perception of the seafood sector." He says the campaign is entirely industry funded as part of Seafood New Zealand's industry advocacy role. F

As chief executive of Seafood New Zealand Tim Pankhurst will be speak at the national Seafood Directions conference at the International Convention Centre, Sydney, from 27 to 29 September 2017.

"We see it as a story of redemption, but also a story of the resilience of the oceans. Well-managed fisheries can and do recover, and this has happened around the world."

Tim Pankhurst



Left Tim Pankurst. Photo: Seafood New Zealand

MORE INFORMATION
Australian Fisheries Management Authority, www.afma.gov.au; Status of Australian Fish Stocks Reports, www.fish.gov.au; Rudy Kloser, rudy.kloser@csiro.au
FRDC RESEARCH CODES: 93-237, 95-031, 99-111

Australia's rough road to recovery

Research into Orange Roughy has helped inform monitoring and management to assist in the recovery of several of Australia's stocks

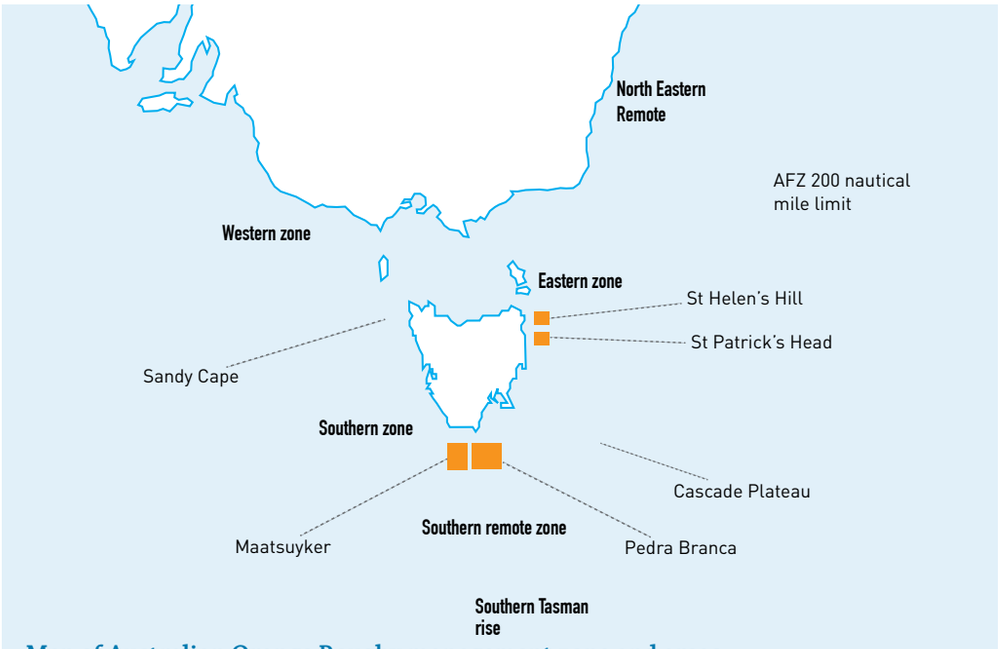
By **Catherine Norwood**

Australia's Orange Roughy fisheries have a history of ups and downs similar to those in New Zealand.

But more rigorous science and improved management have provided the foundations for the ongoing recovery of Orange Roughy populations. This recovery is both a testament to the resilience of the species and to the value of research-based management.

Australia's first large aggregation of Orange Roughy was discovered off Sandy Cape in Tasmania in 1986, and catches quickly increased up to 8000 tonnes by 1988. Following the identification of large spawning aggregations at St Helen's Hill, a seamount off eastern Tasmania, and at Pedra Branca and Maatsuyker off southern Tasmania in 1989, effort and catch expanded exponentially.

Records show 85,000 tonnes of Orange Roughy were landed in four years, with a peak of 35,000 tonnes in 1990, when the estimated value of the fishery was $60 million – the most valuable fishery in Australia at the time. By Australia's standards this is a huge amount (our next largest catch is Australian Sardines); internationally it is small scale.



Map of Australian Orange Roughy management zone and areas

Source: Adapted from Wayte 2007

Conservation moves

As a Commonwealth fishery, Orange Roughy is managed by the Australian Fisheries Management Authority (AFMA), which was formed in 1991.

Despite the introduction of quotas, catches continued to decline and in 2006 Orange Roughy was listed as 'Conservation Dependent' under the *Environment Protection and Biodiversity Conservation Act 1999*.

This triggered a change in the voluntary closure fishers had already introduced in the eastern fishery, making it a formal regulation as part of AFMA's 'Orange Roughy Conservation Program'. This entailed almost a decade of commercial fishing closures, which were continued as part of AFMA's national 'Orange Roughy Rebuilding Strategy' in 2014.

By 2010, regular biomass acoustic surveys funded by the fishing industry were being undertaken to assess eastern Tasmanian Orange Roughy stocks.

Based in Hobart, skipper Jamie Dunkley-Price has been fishing for Orange Roughy for the past 15 years in both Australian and international waters, and he also remembers fishing on St Helen's Hill 25 years ago, when he was working as a deckhand.

"I've seen 60 or 70 boats actually fishing that area during the peak of the spawning – which is June and July and into August. Over the years it slowly declined, and the fleet moved on as quotas were issued and the effort got harder.

"Just before it was closed, if we were fishing outside of the spawning time, we would probably only catch 20 per cent of what we used to. Now they have actually opened up St Helen's Hill again I can see how the fishery has come back," he says.

Orange Roughy is managed and assessed according to four regional management units and two biological stocks. In the Status of Australian Fish Stocks Reports, the Cascade Plateau stock and eastern management zone are now classified as sustainable. Three of the remaining areas are still classified as overfished and one as undefined.

As a result of management in the eastern zone, AFMA has officially reopened fishing in the zone, which includes St Helen's Hill, with a total allowable catch (TAC) of 465 tonnes. It has a TAC of 500 tonnes for the Cascade Plateau

John Yiannatzis from the Seafood Oyster Spot, Queen Victoria Market in Melbourne, holding an Orange Roughy. Photo: Brad Collis

stock, which has been sustainably fished for many years. Minor incidental catch has been allowed in the remaining four areas. These TACs are now in place for three areas until 2017-18.

A University of Tasmania study of Orange Roughy in the eastern zone in 2013, indicates that the recovery of the population may be due to more than simply the cessation of fishing. As a compensatory effect of the removal of older fish, younger fish in the population have become fecund earlier, increasing the reproductive capability of the population and allowing it to recover more quickly than anticipated.

Jamie Dunkley-Price says with the reopening of the eastern zone, the profitability of operating the 32-metre *Saxon Onward* is based on catching smaller quantities of Orange Roughy, year round for the domestic market rather than targeting greater volumes during spawning peaks and export. He supplements this smaller catch with 'table fish' such as Tiger Flathead and Blue Grenadier for the domestic market.

Ongoing acoustic assessments

The South East Trawl Fishing Industry Association (SETFIA), which represents Orange Roughy fishers, has been closely involved in biomass monitoring for the past two decades.

SETFIA executive officer Simon Boag says the industry has been proactive in supporting stock assessments. It has coordinated the recovery monitoring program, contracting CSIRO and fishing vessels to undertake biomass assessments.

The assessments involve the use of CSIRO's acoustic optical system (AOS), which it developed over many years of collaboration with the Australian and New Zealand fishing industries and managers, to make the surveys more robust and cost-effective.

The acoustic optical system is attached to a net that is towed by a fishing vessel above schools of Orange Roughy and uses a multi-frequency approach to get a 'snapshot' of winter-spawning populations.

CSIRO senior research scientist Rudy Kloser has led the multi-frequency acoustics work that underpins this monitoring technology, which received initial funding from the FRDC. He says Orange Roughy is a "stealth-like" species; its wax ester-filled swim bladder is less reflective of soundwaves and harder to detect than the gas-filled bladders of other fish. However, the AOS measures the sound reflectance or 'target strength' of fish at multiple frequencies, with an extra high frequency needed for Orange Roughy.

The system also photographs fish with two cameras as they are herded into a trawl net to visually verify species, their length and orientation. Net captures during the assessments provide biological samples to measure fish size and reproductive condition, as well as otoliths for ageing fish.

Rudy Kloser says the winter 2016 survey supports a consistent increase in spawning populations over time. CSIRO will use the results to update the stock assessment models as part of evaluations used to set TACs for the 2018-19 fishing year.

The CSIRO research team and acoustic optical system technology have been involved in the formal stock assessments for both Australia and New Zealand, documenting the spawning biomass of the fisheries.

"Having such a robust tool was instrumental in assessing spawning stock status and population rebuilding in Australia, and in New Zealand's Marine Stewardship Council certification," Rudy Kloser says. "This really is a great success story."

He says the long-term aim is to develop a robust net-attached AOS system, operated by trained crew on commercial fishing vessels. This could assist with management of sustainable deep-water fisheries around the globe. F

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FRDC RESEARCH CODE: 2014-504

Primed for quality

Young hospitality leaders learn about the challenges of producing and processing premium seafood

By **Annabel Boyer**

South-east Queensland was the destination for this year's Electrolux Appetite for Excellence tour, continuing to engage young leaders in the hospitality industry with the story of Australian seafood.

The FRDC has sponsored the event for more than a decade, recognising that food-service professionals, from chefs to front-of-house staff, are increasingly interested in and advocates for the quality and provenance of what they offer customers.

Every year it gives a group of young chefs, waiters and restaurateurs the opportunity to meet with primary producers. It focuses on primary producers with an edge – something that makes their products special, whether that is quality, innovation or sustainability credentials.

This year the 17-member group met with seafood producers Fraser Isle Spanner Crab (suppliers of Red Claw Crabs) and Walker Seafoods in Mooloolaba, and Urangan Fisheries in Hervey Bay.

Spanner Crab stories

In early July, the group assembled early on the wharf at Mooloolaba to watch the day's catch of Spanner Crab unloaded from the *FV Shadow*. On hand to talk were pioneers of the region's Spanner Crab fishery Les and Lyn App of Fraser Isle Spanner Crab. With tales of near-death experiences and hard work, the Apps spoke of how they had built up their business from scratch.

The challenges of procuring Spanner Crab were not lost on the group members, who asked the fishers how they thought adequate price points could be achieved.

Jason Simpson, manager of Fraser Isle Spanner Crab, said that the role of restaurants and food-service professionals was key.

By using and celebrating high-quality Australian produce they signal to the public that there is value in taking the effort to value a product such as Spanner Crab, which many Australians once considered too finicky to bother with. The company now produces de-shelled packaged crab, both cooked and raw, which has helped to overcome consumer reluctance to deal with shelling crabs themselves.

There were many questions from the group about sustainability, the size and quality of crabs, bait used and closure periods. The group heard about the passive fishing methods employed in the fishery – where a dilly or flat crab pot is dropped on the floor with bait and then drawn up again. The FRDC's Skye Barrett provided scientific background, explaining the advantages of the passive fishing method, which relies on the natural habits of the fish to catch it. In the case of Spanner Crab, the dilly is placed on the bottom of the seafloor with bait. Any crabs inside the dilly when it is pulled up are harvested. This technique also has the advantage of eliminating bycatch.

Making the grade

After touring Fraser Isle Spanner Crab's processing facilities, the group moved on to Walker Seafoods on an adjoining wharf to learn about fishing for tuna, Swordfish and Mahi Mahi in the Eastern Tuna Billfish Fishery from Pavo and Heidi Walker.

As a company director, Pavo Walker told the group that sustainability certification Walker Seafoods had invested in for its catch in the Eastern Tuna Billfish Fishery, such as that provided by the Marine Stewardship Council, added value to the catch.

"It means that our product is in demand from sophisticated markets that demand both quality and sustainability."

At Walker Seafoods, processing manager Daniel Jones provided expert advice about what to look for when selecting premium-grade tuna: clarity in the texture, a deep red colour and high fat content. Making it look easy, he demonstrated how to fillet a whole 70-kilogram Yellowfin Tuna. He challenged group members to give it a go and they found that it was more than difficult than it looked.

Heidi Walker, managing director of Walker Seafoods, said the Appetite for Excellence tour was a great opportunity to address misconceptions people had about the industry and its practices. It was also an opportunity to educate consumers

Clockwise from left
Jason Simpson from Fraser Isle Spanner Crabs holds some freshly caught crab.

Daniel Jones supervises as (2017 Appetite for Excellence Young Waiter Finalist) Morgan Golledge of Blackbird Bar and Grill tries her hand at filleting a Southern Bluefin Tuna.

St Hugo's Young Waiter finalist James Boden gives scallop shucking a go, with help from Joe, professional scalloper with Urangan Fisheries.

Jason Simpson talks Spanner Crabs with Thi Le, Young Restaurateur finalist from Melbourne restaurant Anchovy.

Fresh Hervey Bay scallops on ice.

Photos: Dominique Cherry

"The Appetite for Excellence tour was a great opportunity to address misconceptions people had about the industry and its practices."

Heidi Walker, managing director of Walker Seafoods

about issues such as the seasonality of eating fish such as tuna. While it was popular in summer, she said the fish were actually at their best in winter.

On the wharf surrounded by fishing boats the group ate lunch prepared from some of the local seafood on offer. The menu consisted of freshly caught barbecued Spanner Crab, tuna dressed in chilli, soy and ginger, chilli crab with shallots and ginger, and Swordfish belly salted and grilled, all accompanied by a tomato and red onion salad.

Hervey Bay: Urangan Fisheries

Two days later, the group met up with Paul Hodson of Urangan Fisheries at Hervey Bay and boarded the *Millie Rose*, docked at the wharf with its crew ready to set off for a voyage of several weeks' fishing. It was an opportunity to dispel many misconceptions about trawling, such as the distinction between trawling and dredging.

Pointing to the surveillance cameras on board, Paul Hodson talked about the high regulation in place in the fishery. "Real-time management of the fishery and trigger limits are in place to halt fishing," he said.

The tour visited the Urangan Fisheries processing facility, which handles both scallops and prawns. During the group's visit to the processing facility, scallop processing was underway and again group members had the opportunity to test their skills against those of the professionals.

Owner of Melbourne restaurant Anchovy Thi Le was impressed with the processes at Urangan's facility. "It's good to know that the shells get crushed up and used for fertiliser to reduce waste," she said.

When sourcing ingredients, she said she considered whether a product was local and how environmentally friendly it was, and she was keen to be able to find more information on sustainability for herself.

Several of the group were keen to learn about FRDC resources such as the *Status of Australian Fish Stocks Reports* (fish.gov.au and fishnames.gov.au) as a means to learn more about the ingredients they use. F

MORE INFORMATION
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Fly options for fish feeds

Black soldier flies could provide a solution to the aquaculture feed challenge while offering new business opportunities

Black soldier fly larvae (left) and the fly itself.
Photo: Future Green Solutions

By **Catherine Norwood**

International research, including work in Australia, is investigating the potential of using insect larvae as an alternative protein to the fishmeal used in aquaculture feeds. A reliance on meal and oil produced from wild-harvest fisheries is a major criticism of aquaculture as a sustainable industry.

The non-profit research and development agency WorldFish estimates that up to 17 million tonnes of fish – about one-fifth of the global catch – is used to produce feeds for aquaculture.

In Western Australia, environmental scientist Luke Wheat is one of the founding directors of Future Green Solutions, which is using organic waste to produce black soldier fly (*Hermetia illucens*) larvae as a potential protein alternative to fishmeal.

The fly is native to the African continent but has naturalised as a non-pest species in Australia since it was first identified here in the 1970s. It can eat up to 70 per cent of its own body weight in a day, and 10 kilograms of wet organic waste can produce one kilogram of maggots.

Luke Wheat says he first began working on the potential of fly larvae after hearing about it six years ago. "It really appealed to me because it ticks so many environmental outcomes in one process," he says.

"It reduces waste to landfill and reduces ongoing greenhouse gases from that waste in landfill. As an alternative to fishmeal and fish oil, it reduces reliance on wild-caught fish. And for food security, it allows the production of aquaculture from a sustainable protein source. We are trying to develop oils as well, but meal is the most immediate market," he says.

The business is currently establishing proof of concept and production processes for larger-scale commercialisation, and will move from Geraldton to a new full-time demonstration plant in Perth later this year to increase production. A pilot plant processing 10 to 20 tonnes of waste a day and producing a tonne of protein meal a day could be operating in less than three years.

Luke Wheat says while black soldier fly larvae will eat almost any organic matter, the business is researching which inputs will provide the best growth and nutritional outcomes for use in animal feeds, including aquaculture. This includes research on potential contaminants in inputs such as heavy metals or pathogens.

Potential feed sources include dairy, meat and horticultural wastes. "We have to make sure the product is safe, and fish and the aquaculture industry are even more sensitive to this than other animal industries."

While proteins are the priority for Future Green Solutions, Luke Wheat says he expects further research will investigate the potential for omega-3 oils from insect larvae.

The company is working with the University of Western Australia to fill some of these information gaps, with a cross-disciplinary team that includes biology, entomology and engineering expertise.

Other partners include feed manufacturer Ridley Corporation and the WA Department of Fisheries. Fisheries scientist Craig Lawrence is leading a growth and digestibility trial this year, incorporating insect protein into feeds for Rainbow Trout fingerlings and yearlings. "There's a small trout industry in WA and the species is closely related to Atlantic Salmon, so we think this is a good place to start," Luke Wheat says.

African opportunity

Similar but independent research is also underway in the east African country Tanzania, with the help of the Australian Government international aid initiative InnovationXchange.

The Recycler is a waste-management and recycling company that uses black soldier flies to treat the organic waste it collects, producing an insect-based protein. The business is one of 10 winners to receive a share in the Australian Department of Foreign Affairs and Trade's $3 million Blue Economy Aquaculture Challenge last year.

The Recycler's protein is being trialled in aquaculture feeds in Tanzania, according to a report from project partner SecondMuse. In the report, aquaculture operator Jonathen Arul says the insect protein will make up 25 to 30 per cent of a complete fish feed for trials at Indian Ocean Aquaculture.

These will compare different insect-based formulations fed to Tilapia raised in his company's ponds and recirculated aquaculture systems to maximise its performance before it is put on the market. F

Tariffs fall, seafood sales to Japan rise

Tariff reductions are creating new market opportunities for seafood sales to Japan

By **Free Trade Agreement Division, Department of Foreign Affairs and Trade**

Table 2: Data on Australian seafood exports to Japan, 2014–16.

	Export values ($)		
Product	**2014**	**2015**	**2016**
Live eels	50,353	41,328	102,065
Southern Bluefin Tuna (fresh or chilled)	10,877,980	14,948,600	16,495,030
Yellowfin Tuna (fresh or chilled)	2,393,648	2,961,124	2,687,175
Fish livers and roes (frozen)	915,905	1,423,478	1,443,000
Crabs (frozen and unfrozen)	75,263	288,672	500,331
Cold water shrimps and prawns (frozen)	1,102,690	863,047	1,602,240
Shrimps and prawns (frozen excl. cold water shrimps and prawns)	14,889,801	25,261,205	32,919,062

Source: Department of Foreign Affairs and Trade STARS database and based on ABS catalogue number 5368.0

The value of Australia's seafood exports to Japan are on the rise, and tariff cuts delivered under Australia's free trade agreement with Japan are providing a competitive edge for our seafood exporters.

Japan is Australia's second largest export market and the world's third largest economy. The free trade agreement, known as the Japan–Australia Economic Partnership Agreement (JAEPA), is boosting bilateral trade and investment. JAEPA is Japan's first free trade agreement with a significant agricultural exporter. It came into force in January 2015 and is progressively eliminating many of the tariffs that previously applied to Australian exports.

Japanese tariffs have, for instance, been eliminated on Australian exports of rock lobsters, oysters, shrimps, prawns, fresh and preserved abalone, crabs, fresh and chilled Yellowfin Tuna, smoked salmon, and fresh sea urchins.

Australian suppliers will get more benefits as other seafood tariffs are progressively eliminated (Table 1).

Overall, Australian seafood exports to Japan were valued at $406 million in 2016, an increase of about 8 per cent on 2015. This includes a 46 per cent increase in the value of cold water shrimp and prawn exports, and a 57 per cent increase in the value of frozen fish liver and roe exports. See Table 2 for other examples of increased seafood exports.

International trade can be influenced by a range of factors, such as exchange rates, level of demand, availability of supply, technical market access issues and returns in other export markets. However, the JAEPA tariff cuts over the past two years are clearly providing a competitive boost for our seafood exporters and are contributing to increased sales in Japan of Australian seafood products.

Deputy chair of the Seafood Trade Advisory Group Wayne Haggar says Japan is Australia's second largest seafood export market and the second largest consumer of seafood per capita in the world behind Iceland.

"JAEPA has provided the vehicle for Australian seafood exporters of traditional products to expand their footprint within the market, but has also opened the door to the export of other commercial Australian species. The tariff reductions provide a competitive pricing edge over many competing countries."

The next round of JAEPA tariff cuts will occur on 1 April 2018 and further cuts will occur on 1 April in the following years. These prospective tariff cuts will mean that Australian seafood exporters will get an even greater competitive edge in the Japanese market in the future. To benefit from these JAEPA tariff cuts, Australian exporters need to have JAEPA-related certificate-of-origin documentation to prove the Australian origin of seafood exports. F

Table 1: Examples of Japanese tariffs being eliminated on Australian seafood exports.

Product	Tariffs
Southern Bluefin Tuna (fresh, chilled and frozen)	Prior to JAEPA: 3.5% | Current rate: 2.7% |Elimination date: 1 April 2024
Swordfish (fresh or chilled)	Prior to JAEPA: 3.5% | Current rate: 3.5% | First JAEPA cut – 1 April 2019: to 2.9% | Elimination date: 1 April 2024
Atlantic and Danube Salmon (fresh or chilled)	Prior to JAEPA: 3.5% | Current rate: 3.5% | First JAEPA cut – 1 April 2019: to 2.9% | Elimination date: 1 April 2024
Trout (fresh or chilled)	Prior to JAEPA: 3.5% | Current rate: 2.2% | Elimination date: 1 April 2024

- A Department of Foreign Affairs and Trade (DFAT) guide to trading under JAEPA and accessing these benefits can be found at the DFAT website (http://dfat.gov.au/trade/agreements/jaepa/fact-sheets/Documents/guide-to-using-jaepa-to-export-and-import-goods.pdf).
- More details on future tariff cuts to Australian seafood, and how to use free trade agreements (FTAs) to take advantage of these cuts, are available at DFAT's FTA portal (https://ftaportal.dfat.gov.au).
- For export assistance, refer to the Australian Trade and Investment Commission (www.austrade.gov.au). For export finance help, refer to Efic (www.efic.gov.au).
- For more general information on free trade agreements, refer to the DFAT website (www.fta.gov.au).

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FRDC RESEARCH CODES: 2016-200.40, 2016-117

Kingfish research gathers momentum

From feed to disease, researchers around the country are joining forces with industry partners to enhance aquaculture

By **Catherine Norwood**

The 'Kingfish for Profit' (K4P) initiative is more than half way through a three-year national program and researchers have identified several fish health and nutrition 'signposts' to help improve the viability of Yellowtail Kingfish (*Seriola lalandi*) aquaculture as it continues to expand in Australia.

The $6 million K4P initiative is part of the Australian Government's 'Rural Research and Development for Profit' program, and is coordinated through the FRDC. The aim is to bring an affordable, consistently available farmed 'white' fish to market in Australia – a companion to the increasingly popular Atlantic Salmon.

Evaluations of feed ingredients, feeding strategies for different environmental conditions and growth stages, and health indicators for Yellowtail Kingfish have been the focus of the program's early trials.

The FRDC also funds other Yellowtail Kingfish aquaculture research in line with its national research priority 3: developing new and emerging aquaculture growth opportunities. This continues its historical investment on this species, which has also been partly conducted through the Australian Seafood Cooperative Research Centre (CRC), which recently ceased operations.

The South Australian Research and Development Institute (SARDI) and New South Wales Department of Primary Industries (DPI) are the lead research agencies in the K4P program. Commercial partners include Yellowtail Kingfish producers Clean Seas and Huon Aquaculture and feed manufacturers Ridley Corporation and Skretting Australia.

K4P research findings are already providing advice to improve nutrition and feed management practices, and are also making progress on longer-term industry-wide goals, such as the development of non-invasive health diagnostics. The investment in these areas of research has provided the confidence for industry to further invest capital in the development of the Yellowtail Kingfish farming sector that began in 1998 in SA and continues to expand with commercial ventures in Western Australia and NSW.

Winter feeding

David Stone at SARDI is the principal investigator for the K4P nutrition theme.

Trials centred at the South Australian Aquatic Science Centre at West Beach, in Adelaide, are investigating the needs of fish of one to four kilograms and cover all three K4P project themes: nutrition, feeding strategies and nutritional health.

David Stone says much of the previous feeding research has focused on the needs of fish during the 'summer' growth period, in warmer water. However, the production cycle also requires fish to be cultured throughout winter. He says there is considerable scope to improve profitability of farming by increasing performance of Yellowtail Kingfish using on-farm feeding practices that are designed specifically for winter water temperatures. Many fish species show reduced growth and are less efficient in converting feed to body weight in cold conditions. Seawater temperatures off the SA coast can fall to 10°C and Yellowtail Kingfish being cultured typically lose weight and condition that must be recovered as water temperatures increase in spring.

YELLOWTAIL KINGFISH AQUACULTURE SITES

Yellowtail Kingfish aquaculture ocean trials at the NSW Marine Aquaculture Research Lease in Providence Bay, Port Stephens. Photo: NSW DPI

Clean Seas Yellowtail Kingfish operations in Port Lincoln. Photo: FRDC

Commercial Yellowtail Kingfish winter feeding strategies have previously been based on minimal feeding to reduce the cost of feeds and feeding operations. To address this production issue, a trial was designed to evaluate the potential gains from better feeding regimes specifically for use during winter.

A three-month tank-based trial conducted by SARDI began with fish weighing about 1.4 kilograms and evaluated seven different feeding rates using commercial pellets in water temperatures of between 11.5 and 16°C. Feeding regimes ranged from feeding fish 0.1 per cent of their body weight one day a week, up to a regime that fed fish to their 'satiation' point (when they stopped feeding), for six days a week.

In the trial, the Yellowtail Kingfish that were fed until they were full once a day, six days a week, were able to convert food efficiently and gain weight during winter, compared with fish fed less often. The best-performing fish gained up to 0.1 per cent of body weight a day during the 84 days of the trial, with a final average weight of 1.54 kilograms. These results demonstrate that there is potential for Yellowtail Kingfish to maintain condition and increase growth during winter.

Further evaluation within commercial operations is needed to determine whether the finding transfers from the laboratory to commercial operations conducted in sea cages, but if successful, it could result in significant production gains leading to greater profitability.

David Stone says further work is needed to determine whether Yellowtail Kingfish have 'compensatory' growth capabilities, with accelerated growth in spring to offset otherwise slower growth or weight loss during winter. This could further influence the refinement of feeding strategies.

Microbial indicators

Marty Deveney and Andrew Oxley at SARDI are nutritional health co-theme leaders for the K4P program. The SARDI team has been working to identify microbes that live in the gut of Yellowtail Kingfish and assess correlations between those in the gut and those on the skin and gills, or even in the water in which the fish live.

The aim is to match specific microbes with specific nutritional responses and diseases.

The researchers found that in general the populations of gut microbes of Yellowtail Kingfish differed significantly between fish cultured in the land-based hatchery and those in marine environments – both sea cages and in the wild. The make-up of the microbe populations changed substantially with the onset of conditions such as gut enteritis, suggesting a link during periods of poor health of fish.

Like the gut, the microbial communities of the skin and gills also changed with the changing health status of fish. A series of potential biomarkers has been identified to assess fish health. These include the presence or absence of certain bacteria species and the ratio between 'good' and 'bad' microbes as indicators of health status, or for use as possible probiotic treatments.

Feed ingredients

Trials involving brood stock and fish of less than one kilogram are centred at Port Stephens Fisheries Institute in NSW.

Mark Booth of NSW DPI is based at Port Stephens, where he and his team are researching the nutritional requirements of Yellowtail Kingfish feed ingredients and their digestibility. In contrast to the research in SA, this project is focused on how the fish respond in summer conditions. Mark Booth says the research builds on NSW DPI research undertaken during the past decade under the auspices of the FRDC-funded Aquafin CRC

WESTERN FOCUS

Yellowtail Kingfish research underway in Western Australia focuses on the conditions specific to the growing regions in that state, which include pre-approved finfish aquaculture zones in the state's Kimberley and mid-west coastal zones.

The mid-west zone, around Geraldton, has been developed with Yellowtail Kingfish in mind, with a state funded pilot to grow out the species underway.

A new trial, initiated subsequent to the 'Kingfish for Profit' program, is comparing fish derived from WA and South Australian brood stock, and benchmarking the performance of fish in waters representative of the mid-west coast region.

The lead research agency is South Metropolitan TAFE, with work based at its Fremantle campus; Indian Ocean Fresh Australia at Geraldton is the project's commercial producer partner.

New health-related research will investigate treatments for flukes, including the use of hydrogen peroxide in warm water, and learning more about the bacteria species *Photobacterium damselae*, which has been implicated in Yellowtail Kingfish mortality.

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NSW marine trials through the national 'Kingfish for Profit' initiative.
Photo: NSW DPI

and the Australian Seafood CRC, which developed Yellowtail Kingfish feed formulation models.

"We are looking at the bioenergetics – the protein and energy requirements of the Yellowtail Kingfish under different temperature regimes – and refining some of the feed models that were developed in the past," Mark Booth says. "We can then make these models available to feed manufacturers and farmers, who are most focused on using that information on farm as production management tools."

One laboratory-based experiment has compared the digestibility of various fish, poultry and vegetable raw materials, finding that Yellowtail Kingfish find land-animal protein sources generally more digestible than plant protein sources that contain high levels of carbohydrate. Mark Booth says plant protein concentrates and rendered animal meal are both useful as protein sources.

Fishmeal and fish oil replacement are key areas of research for industry, both in terms of cost-of-production savings and in terms of ongoing industry sustainability as it reduces reliance on wild-harvested feed ingredients.

Other NSW DPI research is focusing on the baseline requirements of essential nutrients and amino acids including choline, histidine and taurine for smaller fish.

"Feeds and feeding strategies for different life stages will allow the animals to make the most efficient use of the feed. This will have direct benefits for on-farm running costs," Mark Booth says.

Another study has investigated the feeding efficiency of Yellowtail Kingfish in low dissolved oxygen environments. Results from this study showed that the negative effects were exacerbated at high feeding levels, suggesting that farmers should restrict feeding in low oxygen environments and monitor both oxygen saturation and concentration levels.

Several of the program's research findings have already been presented at national and international conferences, including the World Aquaculture conference in South Africa in June 2017. F

NSW sets course for a Yellowtail Kingfish future

New South Wales is set to harvest its first Yellowtail Kingfish later this year as part of a five-year joint research and production venture between the New South Wales Department of Primary Industries (DPI) and the Huon Aquaculture Group.

Yellowtail Kingfish aquaculture has been the focus of research at the NSW Port Stephens Fisheries Institute since 2008, and this is being accelerated into marine trials through the national 'Kingfish for Profit' (K4P) initiative launched in 2015. Ocean-based research and emerging commercial aquaculture production has been underway in South Australia since 1988 and in Western Australia since 2008.

Now, NSW has joint ocean trials at the Marine Aquaculture Research Lease (MARL) in Providence Bay, Port Stephens, in a research partnership between NSW DPI and Huon Aquaculture. The lease is about seven kilometres offshore, which allows the use of new technology including larger, deeper and more robust aquaculture pens developed and operated by Huon, suitable for open-ocean aquaculture.

Only fish produced from locally endemic Yellowtail Kingfish brood stock are being used on the MARL, with the first fish stocked in October 2016 – 25,000 fingerlings weighing an average of 30 grams each.

The fingerlings are fed daily, except for brief periods when weather conditions are too rough, and checked for health and growth. Fish survival rates are high and growth is faster than expected.

"We are monitoring the performance of brood stock closely over repeated spawning events to determine the contribution of specific parents to each batch of fingerlings," says NSW DPI senior research scientist Stewart Fielder.

"We are also evaluating larval responses to photoperiod (day-length) and salinity, and how this might influence progress through their life cycle."

Research will include evaluating the effects of growing fingerlings to more than 30 grams before transferring them to sea cages.

Several experiments have also been completed to determine dietary requirements and feeding strategies to promote the fastest growth of Yellowtail Kingfish.

Environmental approvals for the MARL have included ongoing benthic and wildlife monitoring prior to, during and after stocking of the pens, which is being undertaken by the University of Newcastle. This includes interactions with sharks, dolphins and other marine fauna, with no detrimental incidents reported to date.

Water quality and sea floor sampling is undertaken routinely and a remote operating vehicle takes video footage of the sea floor (www.huonaqua.com.au/about/portstephens). Samples are taken from below the proposed sea pen sites, areas outside the boundary of the research lease and at 'reference' sites between the lease and Broughton and Cabbage Tree Islands.

Ian Lyall, NSW DPI's aquaculture manager, says the monitoring has not detected any environmental impacts from the aquaculture operations so far. "We'll be using this data from the MARL and from the Port Stephens facility to help develop a policy platform for aquaculture in NSW marine waters. The research partnership is helping to guide the future of the industry in the state, to ensure it is viable and sustainable," he says.

A tour of Huon's NSW aquaculture operations will be held prior to the Seafood Directions conference on 27 September 2017. For details visit: www.seafooddirectionsconference.com/pages/huon-field-trip-.html

Antarctic opportunities spur joint investigations

Analysing the wealth of data fishers gather is expected to help refine fishery management in Antarctic waters

By **Catherine Norwood**

Australian fishers operating in the most remote of our Southern Ocean fisheries have entered an industry partnership agreement (IPA) with the FRDC to better coordinate and consolidate research efforts, including international collaborations.

Australia's subantarctic fisheries include areas around Heard Island and McDonald Islands, and Macquarie Island. Australia also has fishing rights in the Ross Sea and Amundsen Sea in the Antarctic region, which are managed by the international Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) – of which Australia is a member.

The two Australian companies targeting Patagonian Toothfish and Antarctic Toothfish in these regions are Austral Fisheries and Australian Longline. And while the Amundsen Sea icefish fishery is still considered to be in a 'research' phase of development, the Heard Island and McDonald Islands Toothfish Fishery, Macquarie Island Toothfish Fishery and Ross Sea Toothfish Fishery have received Marine Stewardship Council certification.

The companies have recently entered into an industry partnership agreement with the FRDC for five years. The agreement manages the industry contribution to the FRDC alongside the Australian government's matching contribution to invest in a strategic research, development and extension (RD&E) plan to meet identified needs. This agreement also provides the potential to leverage funds from other Australian and international sources.

The general manager of environment and policy at Austral Fisheries, Martin Exel, says to date the companies have not had a cohesive, focused program of research in the subantarctic or Antarctic regions, although they both participate in a diverse range of projects.

"We hope the IPA will help to generate additional funds through collaborations and achieve some cost and performance efficiencies. I think the FRDC oversight will be beneficial, and while we may give up some control as individual companies, a dedicated project manager is bound to bring new ideas and approaches."

At present, the companies participate in numerous scientific programs, which include fish tagging using data storage tags to collect and record oceanic data. They also conduct acoustic monitoring programs and use cameras and other monitoring equipment to record the seabed, fish harvests and fishing conditions.

"We want to know what is happening out there to ensure it's a sustainable fishery, and we collect mountains of data," Martin Exel says. "But that data itself is of no value until we can get it analysed."

Research partners for future research projects could include the Antarctic Climate and Ecosystems Cooperative Research Centre, the Institute for Marine and Antarctic Studies, the Australian and New Zealand Cooperative Research Centre for Spatial Information, CSIRO and the Integrated Marine Observing System.

There are 15 nations with fishing interests in the Antarctic region, although Australian Longline is the only Australian company active in the Ross and Amundsen seas. It is now also working with Spain, France, Japan and South Korea to research the viability of an Antarctic Toothfish fishery in east Antarctic waters.

Australian Longline managing director Malcolm McNeill says the company tags five fish per tonne as part of a collaborative international research effort that also involves the Australian Antarctic Division. The 2017-18 season will be the company's third year fishing in the area, and he says he hopes this is an area of research for the Antarctic IPA.

One of the first tasks for the new IPA will be the development of a strategic RD&E plan. Once developed, investment in research priorities can begin. Synthesis and analysis of several different datasets to better understand Toothfish is high on the agenda.

The FRDC already has 12 IPAs in place with sector organisations such as Oysters Australia and the Australian Council of Prawn Fisheries. These bodies provide sector-based research to meet industry needs, in line with an agreed industry strategic plan. Each IPA is managed by an FRDC project manager and an executive officer who reports to the participants in the IPA. F

Above Harvesting Patagonian Toothfish. Photo: Austral Fisheries

MORE INFORMATION
FRDC RESEARCH CODE: 2013-017

Ranger research helps protect fishing favourites

Research training provides new information and employment opportunities to improve tropical fisheries management

By **Annabel Boyer**

The need to know more about the stock structure of three vulnerable tropical reef species has been used as an opportunity to build capability in Indigenous communities in the Northern Territory, providing multiple benefits for government agencies and local people.

A collaboration involving the FRDC, the NT Government and several universities and research agencies across northern Australia has resulted in a wealth of new fisheries data to improve the management of Black Jewfish, Golden Snapper and Grass Emperor.

It has also provided a new training curriculum and a successful cohort of graduates, many of whom have already moved into new job roles.

Increased capability in Indigenous communities has the potential to both increase employment opportunities in those communities and reduce the costs of doing research in these remote areas.

Vulnerable species

Black Jewfish (*Protonibea diacanthus*), Golden Snapper (*Lutjanus johnii*) and Grass Emperor (*Lethrinus laticaudis*) are all popular with both commercial and recreational fishers. However, effective management of the three species has been hampered by a lack of knowledge.

All three species are distributed widely in Australia's north and are also found in other parts of the world, but there has been little research into their population structures.

Principal investigator on the project for the NT Department of Primary Industry and Resources Thor Saunders says that reduced numbers of these species in particular parts of NT were first officially noted in 2010. These have paved the way for changes to management of both commercial and recreational fishing of the species.

Course participants dissecting samples of Black Jewfish collected for the stock structure component of the project, (from left) Zelanda Watson, Maxine Wilson, Jade Murphy and Patricia Gibson. Photos: NT DPIR

He says that increases in recreational fishing in recent years are likely to have resulted in reduced numbers in particular areas. The three species are particularly vulnerable because of their behaviour. They tend to spend time in groups, and are easy to target and catch because they are quite habitat-specific. They are all also susceptible to barotrauma, which means they often die even if they are caught and released by recreational fishers.

Additionally, Golden Snapper and Grass Emperor have vulnerable biology; they are relatively slow-growing and late-maturing.

Capacity building

The Northern Territory has 11,000 kilometres of coastline, 84 per cent of which is owned by Indigenous communities. These communities are also keen to develop and manage their own fisheries in the areas where they have rights, and Thor Saunders says it makes sense to build fisheries and research-related skills. This has added benefits in providing employment opportunities in these communities.

The expense and time of travel in the NT is a significant component of research costs. However, this can be reduced or eliminated where community members can collect and analyse samples.

The development and rollout of a nationally recognised Certificate II course in sampling and analysis was developed and completed in Darwin with 17 Indigenous marine rangers undertaking the training. Samples of fish collected and measured by participants during the course were also used in the research to learn more about the three tropical reef species.

Analysis methods

The project used a range of different techniques to gain a detailed picture of how populations of the three target species are structured and interact. Data types collected and analysed included otolith chemistry, parasites and genetic material. Sampling was conducted in a variety of locations along the NT, Western Australian and Queensland coasts.

Thor Saunders says the different analysis types provide information across different time and spatial scales, each giving insights into how populations of the species are structured.

Analysing the microchemistry of an otolith can provide up to 20 years of data and can indicate if a fish spends different parts of its life cycle in different types of environments, for example. Analysis of parasites provides information about the short-term environment

of a fish, such as the body of water in which it has been recently living. Several different parasites were identified during this study and descriptions of these have now been published.

In contrast, genetic analysis provides information over generations, and possibly hundreds of years, and can give broadscale information about how different populations are related and may have dispersed over a longer time period.

Co-management

Experience in sampling and collecting for this research project, which contributed to the Certificate II course, has led all but one course participant to new employment opportunities using those skills.

Three participants, who were Indigenous marine rangers, moved into positions as research technicians in Darwin, allowing others to take up the ranger roles in their communities. Three communities are also participating in scientific monitoring programs on a fee-for-service basis.

Experience from previous training developed for fisheries compliance greatly helped the success of the program (see article in *FISH* September 2010). Thor Saunders says the success of the training program and curriculum hinged on several key factors, the most important of which was to have interested participants.

The training curriculum was developed as a regular training component for the Indigenous marine rangers, but there are plans to train more varied groups in the future, possibly even including secondary school students.

Using highly visual learning aids and practical hands-on materials was another vital component. The training and accommodation for participants at the same location in Darwin, at Nungalinya College, was another important factor.

With the success of the sampling and analysis curriculum, there are plans to develop similar training for fisheries management skills in Indigenous communities.

Thor Saunders says involving communities in the management of resources is the first step to decentralising management in the region. It sets the scene for co-management between Indigenous communities and government and can help ensure the successful development of Indigenous fisheries. F


Black Jewfish


Golden Snapper


Grass Emperor

STOCK INSIGHTS

Black Jewfish, Golden Snapper and Grass Emperor all have a similar stock structure, according to new research in the Northern Territory.

Genetic analysis indicates that populations of each species are connected genetically across hundreds of thousands of kilometres. However, within the broad, genetically connected populations there are smaller-scale, discrete populations groups.

Localised populations exist at scales of only tens of kilometres. Adult and juvenile fish of all three species tend to spend their lives in relatively small 'habitat complexes'. However, larval dispersal accounts for the genetic connectivity over vast distances.

The findings of the research indicate the need for management at a small scale because of the risk of population depletions at these scales. "This analysis showed that these populations take a long time to recover because populations are discrete and self-recruiting," Thor Saunders says. "While closures had already been put in place, this report will further alter the way these stocks are managed."

He says it is likely regulations for all fishers will tighten at some of the key population sites of the species. Given the issues of barotrauma-related mortality, these regulations may include additional seasonal and spatial closures.

Above Ranger graduates with their certificates (from left): Maxine Wilson, Audrey McAlindon (trainer), Jocelyn Yantarrnga, Jade Murphy, Grace Wunungmurra, Zelanda Watson, Patricia Gibson, Chiquita BaraBara, Aleana Talbot, Jermaine Wunungmurra, Keith Lambert, Chris Errity (DPIR), David Barrett, Sean Fitzpatrick, Christopher Barrett, Kurtly Harvey, Thor Saunders (DPIR), Simon Xuereb (DPIR), Elma Yantarrnga, Adrian Butler (trainer), Daryl Lacey, Damien Pracy, Sebastian Evans.

MORE INFORMATION
Iain Ellis, NSW Department of Primary Industries, iain.ellis@dpi.nsw.gov.au

Tar-Ru's native nursery trial

A square mesh screen installed in the right place at the right time helps keep carp at bay and boosts native fish numbers

By **Tom Bicknell**

The Tar-Ru Wetland in western New South Wales, or 'Wetland 780' according to its official Murray–Darling Basin designation, has provided a testing ground for a new strategy to improve native fish nursery habitats.

The 2016 study on the lower Murray River in far-west NSW tested the potential for screens placed on the inlets of dry wetlands to prevent adult carp from re-colonising the wetlands as they were refilled. It also evaluated the quality of habitat in the refilled wetland, compared with those of nearby wetlands where adult carp had not been excluded.

The results were promising according to Iain Ellis, the study's leader and fisheries manager in the NSW Department of Primary Industries (DPI) Fisheries Aquatic Habitat Rehabilitation Unit. He says it suggests some of the Murray–Darling Basin's 30,000 wetlands could be used to help the recovery of native fish stocks.

Nursery value

Wetlands provide important feeding, spawning and nursery sites for native fish. Most of the 40 or so native species of fish in the Murray–Darling Basin use wetlands at some point in their life cycle. Wetland habitats can be particularly important for 'flow-pulse specialists' such as Golden Perch and Silver Perch.

"The concept revolves around the idea of floodplain recruitment," Iain Ellis says. "That's a phenomenon where high flows or floods induce migration and spawning of Golden and Silver Perch.

"River flows then transport drifting young – eggs and larvae – downstream, often into floodplain billabongs and lakes. By virtue of their ephemeral nature these wetlands are very productive, and can offer a warm, sheltered and food-rich habitat for young fish."

Many of the wetlands in the Murray–Darling Basin historically underwent natural wetting and drying cycles linked to the boom-and-bust flow patterns in our rivers. When dry, sediments compact and crack, locking nutrients into what Iain Ellis calls "ecological stock cubes".

Importantly, carp are eradicated when a wetland dries out completely. When river flows later refill these wetlands, a burst of nutrients is released. Millions of tiny plankton and aquatic plants can emerge from dormant seedbanks or drift in as the wetland refills.

These provide abundant food and habitat for the hungry mouths of tiny developing fish, which may also drift in or are laid in situ by adult fish that move in to take advantage of the productivity boom.

Iain Ellis suggests breeding by many species, in addition to flow-pulse specialists, would have regularly been promoted by floodplain recruitment in nursery habitats throughout the Murray–Darling Basin. The regulation of rivers has disrupted the natural flow patterns and prevents many wetlands from drying out. It also reduces the availability

of faster-flowing habitat in river channels, which adult fish may require to proliferate.

Murky water

Unfortunately, adult carp are early colonisers of refilling wetlands. In addition to preying on and competing with native fish, their feeding habits also disturb sediment.

"Emerging plants and plankton get disturbed or eaten, and the value of the nursery habitat is substantially reduced," Iain Ellis says. "The turbidity levels get higher, so you don't get appropriate light penetration either, which further compromises aquatic food webs.

"So just by preventing larger carp from entering during refilling, you give the wetland a better chance of establishing good water quality, and you increase the potential for plankton, waterbugs and aquatic plants to proliferate. This equates to a good nursery habitat for young native fish."

The pilot study was funded by Western Local Land Services and led by NSW DPI Fisheries, which worked with local Indigenous natural resource management stakeholder, the Tar-Ru Lands Board of Management.

The site of the study, Wetland 780 on land managed by the Tar-Ru Board, has been artificially maintained full in recent decades by the operation of Lock 8 on the Murray River. However, it was drained during a deliberate drawdown of the lock and river level in 2015.

When the wetland was dry, 20 metres of 40-millimetre square mesh screen was installed across the creek that feeds the wetland. The screen allowed small-bodied and larval native fish to pass through when the wetland was later refilled, but prevented access by mature carp.

Mesh success

As the wetland began refilling in late April 2016, the screen successfully kept out larger carp. In their absence, the water in Wetland 780 was substantially clearer than it was prior to its drying (see photos). It was also clearer than other nearby wetlands that had undergone the same dry–wet cycle, but without the addition of a carp-exclusion screen. Within weeks aquatic vegetation in Wetland 780 had started to germinate, and waterbugs and plankton were abundant.

The project then tested the viability of using screened carp-free wetlands for the 'grow-out' of hatchery-bred native fish. Approximately 700 hatchery-bred Golden Perch fingerlings were released into Wetland 780 in late May of 2016.

Opposite page Tar-Ru Wetland after the installation of the screens. **Below** Tar-Ru Wetland before screens.

Below Tar-Ru Wetland mesh screen.
Photos: Iain Ellis

Each fish was marked with a chemical dye to differentiate them from wild-bred Golden Perch.

An assessment of the wetland's fish community was conducted in October 2016, detecting abundant native Australian Smelt, Bony Herring, Carp Gudgeon and plenty of yabbies. The survey also recorded juvenile Golden Perch, which were later found to be a mix of the marked hatchery-bred fish and naturally spawned juveniles that had passed through the exclusion screen as the wetland was filled. Only two small carp were collected in the survey, but had little impact due to their size.

New options

Iain Ellis says the results present at least three opportunities. "One, it's a potential grow-out option for hatchery-bred native fish. A hatchery can produce millions of eggs and larvae of large-bodied, recreationally valued species. Instead of growing them out in small rearing ponds, they could potentially be released to natural wetlands with managed hydrology and temporary screens. This could in turn increase production capabilities and may even improve stocking success."

The second option involves using these wetlands to rebuild stocks of threatened species in strategic locations within their historic range.

"There is a suite of native species that are gone from vast areas throughout the Basin where we know they were formerly abundant," Iain Ellis says. These include small ones such as Southern Purplespotted Gudgeon and Southern Pygmy Perch, but also larger-bodied Silver Perch, Trout Cod, Catfish and Macquarie Perch.

"We could potentially reintroduce threatened species to managed and screened wetlands in cases where appropriate habitat can be created in the absence of carp." This could be particularly valuable should larger-scale carp control measures be implemented in the near future – opening the door for threatened fish to return to their former habitat.

Finally, managed and screened wetlands provide an opportunity for engagement with local stakeholders and communities.

"Fish are a great engagement tool – they bring all types of people into the conversation," Iain Ellis says. "In the case of Tar-Ru Wetland, the Indigenous land managers quickly recognised they could contribute to water management in addition to their land-management practices.

"It's the same with groups of school kids or local fishing communities. They love getting involved in boosting native fish stocks in their region. The more people we can get involved in helping native fish recover the better."

The key is finding wetlands with the right properties, including the ability to be drained and refilled and connections to the water source that are narrow enough to be practically screened.

"At this stage it's not a large-scale option for carp control, but it can certainly give native fish a helping hand. There could be hundreds of wetlands that might be suitable for one species or another, under the right management program," Iain Ellis says. F

MORE INFORMATION
Australian Fisheries Management Authority, www.afma.gov.au
South East Trawl Fishing Industry Association, www.setfia.org.au
www.youtube.com/watch?v=uDgtO4wn0lA

It's curtains for seabird conflict

By **Catherine Norwood**

Commercial fishers have taken the lead to reduce interactions with seabirds, using cost-effective technology that also improves crew safety

Curtains of brightly coloured plastic ribbons hung from doorways to keep out the flies are an iconic part of summer in Australia. And now a similar concept has been adapted to fishing vessels – to keep seabirds away from the fishing gear at the back of boats.

Known as 'bird bafflers', this world-leading innovation deters seabirds from foraging between the stern of the fishing trawlers and the area where net warp wires enter the water – where unwanted bycatch and offal are discarded overboard.

In the past, the Australian Fisheries Management Authority (AFMA) has required demersal trawlers in Commonwealth fisheries to use pinkies to deter seabirds – bright red, pink or orange inflatable buoys attached to the warp wires at the back of the boat.

However, after rigorous testing and at the request of the fishing industry, AFMA has now added the bird bafflers and also a bird sprayer to its list of approved bird-deterrent devices.

The bird sprayer is a comparatively complex technology, costing about $45,000, while bafflers cost $4000 to $5000. Pinkies cost about $1000 per vessel, allowing for two in use and several onboard spares.

Industry-led research

Both the baffler and sprayer were developed and trialled in Australia following a government-funded study tour to New Zealand in 2014

Left The *FV Imlay* in port, sporting a new bird baffler designed to deter seabirds from the trawl net warp wires.
Photos: Australian Fisheries Management Authority

to identify and adapt seabird deterrents that might be more effective than pinkies.

The executive officer of the South East Trawl Fishing Industry Association (SETFIA), Simon Boag, says fishers supported AFMA's mandatory use of pinkies to reduce seabird interactions when this regulation was introduced in 2010. Pinkies reduce seabird warp strikes by about 75 per cent compared with unprotected warps with no mitigation device.

"However, pinkies can become tangled in fishing gear," Simon Boag says. "And we believed we could do better to further reduce interactions with seabirds."

From the eight devices initially proposed, the baffler and the sprayer were short-listed for further trials. The project team included representatives from the Australian Antarctic Division, CSIRO, AFMA, OceanWatch and the fishing industry. The project was led by Fishwell Consulting and trials were conducted over 12 months.

The results showed that the bird sprayer reduced heavy interactions with seabirds by 92 per cent and the baffler reduced interactions by 96 per cent compared with bare warp wires. A heavy interaction is any contact between a cable and a seabird that caused the seabird to vary its course. The vast majority of incidents do not injure the seabird but some may.

> "Australia is leading the world in minimising risks between seabirds and trawl vessels."
> Christian Pyke

"Australia is leading the world in minimising risks between seabirds and trawl vessels," says Christian Pyke, executive officer at the Great Australian Bight Fishing Industry Association. The southern Australian trawl fleet is the first small-vessel fleet in the world to mandate the use of proven devices on all vessels to minimise risks associated with trawling and seabirds.

At the opening of the 2017-18 fishing season in the Southern and Eastern Scalefish and Shark Fishery all but two active demersal board trawlers in the fishery have installed the new bafflers. These include vessels in the South East Trawl and the Great Australian Bight Fisheries.

One vessel is using the bird sprayer, and one part-time vessel is continuing to use pinkies. Where pinkies are used, fishers must not dispose of any offal while fishing.

Onboard experience

Bird bafflers contain two booms, one on the port and one on the starboard stern quarters, which extend perpendicular to the sides of the vessel, past where the trawl wire enters the water. The booms have brightly coloured droppers hanging down to the waterline, which act as a curtain, and tori lines extending from the booms.

During the past few months, Chris Andrew and his crew have been tweaking the new bird bafflers onboard their trawler, the *Tullaberga*, to ensure they are working as effectively as possible.

He says the bafflers are more effective than pinkies in keeping birds away from the warp wires, which is the main aim. But they are also proving much safer, simpler and faster for the crew to use.

"We don't have to hang out over the boat to bring them in, like we have to with pinkies," he says. "In a 30 to 40-knot wind, that's dangerous for the crew.

"I have a hand winch to pull in the bafflers and then we use a gaff to pull them into the side of the boat when we need to. Particularly in difficult weather, I don't have to wait until the pinkies are pulled in and we don't get pushed off the shot," he says.

While Lakes Entrance is home for the *Tullaberga*, the 150-tonne trawler fishes along the south-east coast to Eden in NSW and around King Island and Tasmania, spending four to six months working from Hobart over summer.

Chris Andrew says seabirds are an issue all year round, particularly albatrosses. Mutton birds are also common in summer, but begin their migration, moving away as winter approaches.

He says when the weather is deteriorating the birds can become ferocious in their battle for food, and it can be difficult to keep them away from the vessel. They can gather behind boats, up to 1000 birds at a time, all in competition with each other. But the bafflers have been successful in keeping them out of the danger zone. F

Why are bird bafflers so bright?

Bird bafflers use brightly coloured droppers – ribbons of orange or red pipe hose or sometimes even rope – that hang off the metal boom arms and backbone of rope. Recent science has confirmed earlier research that seabirds can see these bright colours.

In the 1970s, researchers found that albatrosses and giant petrels were attracted to orange and red-coloured rubbish on the ocean surface, anything from orange peel to red paper packaging. A test using paper balls in 10 different colours with equivalent light-reflecting qualities showed that some birds preferred the orange and red-coloured paper balls, followed by pink, yellow, blue, white and green respectively.

At the time researchers theorised this was because albatrosses and petrels were targeting items that were a similar colour to their food, such as krill and the shrimp-like mysids.

When it comes to fishing vessels, it seems birds are attracted by the smell of fish and offal and also use visual cues such as bright colour to locate food, and then touch to determine whether or not it can be eaten.

In 2011, a US study found that birds can see colours that are invisible to humans because they have additional colour cones in their retina that are sensitive to the ultraviolet range. So using bright red and orange colours for bafflers and buoys means birds can see them clearly and can avoid collisions. Source: SETFIA

MORE INFORMATION
Australian Marine Safety Authority, www.amsa.gov.au
FRDC RESEARCH CODE: 2015-401

Working solo on the water is risky

Safety planning and practices can help fishers identify and address risks

Putting safety first: FRDC staff wear safety vests when working on the water. (From left) Crispian Ashby, Patrick Hone and John Wilson. Photo: FRDC

By **Australian Maritime Safety Authority**

In June 2013, a 39-year-old fisher was found floating facedown in the water near his overturned dory off the north Queensland coast. The man was a skilled dory operator with more than 10 years' experience.

He was one of four dory operators fishing for coral trout about nine kilometres from their mothership, a 13-metre vessel, and a fellow operator raised the alarm after coming across the man's capsized dory on a journey back to the mothership.

The master of the mothership immediately directed the other dory operators to return to the area to conduct a search for the missing man. Tragically, when they arrived back to the location of the capsized dory, they found the missing man floating facedown and motionless in the water.

As part of the coronial investigation, several potential safety issues were identified as contributing to the accident.

One finding identified that the capsized dory had been modified, with the fitting of a fish tank and associated equipment, which may have changed the stability characteristics and contributed to the vessel capsizing. And although the dory had adequate safety equipment, the man who fell in the water was not wearing a life jacket when he was found.

Head of operational safety at the Australian Maritime Safety Authority Michelle Grech says there are several lessons to be learnt from the accident.

"Any operation in which there is a solo operator should be considered high risk," she says. "This is especially the case when working at sea because there is no-one there to watch your back, rescue is far away and environmental conditions can change quickly."

Michelle Grech says it is important that fishers identify and address the unique risks of their operation and include these in their safety management system. For a sole operator, this might include mandating the wearing of life jackets at all times and having additional communications equipment and procedures.

"For an operation involving multiple vessels, a regular communications schedule can improve safety by potentially raising the alarm sooner should a sole operator be unable to call for help.

"The use of safety and rescue equipment in general increases the likelihood of surviving a fall-overboard accident, especially when you're alone," she says.

Risks for solo operations

Every operation has unique risks. For those operating in an environment where fishers or other staff may be working on their own, it is important to identify and address possible risks to safety including things such as:

- adequate safety communication such as between a mothership and a dory vessel;
- fatigue management (people do not perform at their best at night or when they are tired);
- vessel design (is your vessel suitable for the operations and have there been any modifications that may affect its stability?); and
- personal protective equipment (if you are alone and you fall overboard, how will you stay afloat and alive until help arrives?).

Safety management systems

National laws require all vessels to have a safety management system – a systematic approach to managing safety.

The process of creating a safety management system specific to an operation involves identifying the hazards, assessing the risks associated with each hazard, selecting appropriate control measures to reduce or eliminate those risks, then implementing and reviewing the effectiveness of these control measures. The goal is to prevent accidents from happening. F

- The safety management system requirements for commercial vessels are contained in Part E of the National Standard for Commercial Vessels (www.amsa.gov.au/domestic/standards/national-standards).
- The Australian Maritime Safety Authority (AMSA) has a sample of safety management systems at its website (www.amsa.gov.au/domestic/vessels-operations-surveys/certificates-of-operation).
- Read the fact sheets and guidance notices about the general safety duties and safety management systems (www.amsa.gov.au)
- Speak to your local AMSA liaison officer. Call AMSA Connect 02 6279 5000 to be forwarded to your local officer.

Supply chain strengthens sustainability solutions

Pike Place Market, Seattle.

Long-term business models are helping to drive change in the global fisheries sector

Story and photos by Catherine Norwood

Traceability emerged as a leading criterion for the seafood industry during the 2017 SeaWeb Seafood Summit held in the US, as discussions in the sector evolve beyond the environment sustainability and certification issues that have previously dominated discussions.

The summit, held in Seattle, Washington, attracted 560 attendees from 36 countries to discuss the future of seafood production and markets. Business interests representing all parts of the global supply chain were represented by delegates and speakers, who mixed with representatives from environmental and philanthropy non-government organisations (NGOs), governments and research agencies.

The summit was a great opportunity to discover what is happening in the seafood industry around the world and the large number of Australian attendees showed the strong engagement of Australia's seafood sector.

Far from the adversarial and conflict-driven approaches that have typified discussions between fishery stakeholders in the past, the 2017 SeaWeb Summit demonstrated the evolution of a more international collaborative approach.

The opening keynote speaker was Kathleen McLaughlin, senior vice-president and chief sustainability officer for the world's largest grocer, Walmart.

Her role with the company, she said, was to work on initiatives that enhanced the sustainability of the business for the categories they sold and to strengthen communities where the business operates, and from where it sourced products. "And seafood is a big part of that," she said.

Seafood was one of 20 commodities Walmart had pledged to buy from certified sustainable sources by 2025, she said. However, it had realised it needed to provide "a ladder to sustainability" for fisheries that could not yet meet certification criteria.

To achieve this, Walmart has participated in six formally agreed upon and audited Fishery Improvement Projects (FIPs), which provide systematic improvement in fishery and aquaculture operations.

Looking ahead, Kathleen McLaughlin nominated overfishing, illegal, unregulated and unreported (IUU) fishing, the interdependency of social and environmental systems and food security as major threats to the future of sustainable seafood.

It was incumbent on Walmart to address these threats, she said, which would in turn help its efforts to responsibly source seafood, verifying the origin of seafood from the source through to finished product, and conditions under which it was harvested or produced. This included both environmental and human conditions.

Ocean workplace

The need to ensure safe workplaces and unforced labour has come to the fore with


Whole Mackerel at Pike Place Market, Seattle.

recent media reports of human trafficking and slavery on fishing vessels.

NGOs and philanthropic organisations were strongly represented at the conference in sessions about possible action on better labour practices, particularly on board vessels in developing nations, and identifying illegal practices.

These included a presentation from NGO Oceana on its investigations into trans-shipping – the exchange of supplies, crew and cargo at sea. The practice has the potential to disguise illegally caught fish with legal catch, and to prevent crew members from disembarking.

Data systems

Supply chain speakers included Thomas Kraft of Norpac Fisheries Export. For more than a decade his focus has been on developing electronic traceability to track product from the vessels of the company's fishing partners to the consumer, tracking pathways across the globe. He also spoke of improving the speed and efficiency of the company's buying, processing and distribution systems. He said these efficiencies often paid for themselves.

Thomas Kraft's presentation echoed the broader conference discussions around data tracking and digital systems, with multiple perspectives provided about data collection and use, including collaborations with "fishers as researchers" to help monitor and determine the sustainability of fish stocks.

Sessions on marketing and seafood sales identified the lack, even in the US, of a united platform for seafood promotion. New marketing research presented found that consumer confidence in labelling that demonstrated traceability fed into higher consumer confidence for other claims such as sustainability. F

The 2018 SeaWeb Seafood Summit will be held in Barcelona, Spain, from 19 to 21 June (www.seafoodsummit.org).

Implications for Australia

The Australian contingent at the SeaWeb Seafood Summit held in Seattle in June was relatively small, but provided representation for a broad cross-section of the Australian seafood sector. Here's how some of Australia's participants saw the event.

GOVERNMENT

Nick Rayns
Executive manager, fisheries, Australian Fisheries Management Authority (AFMA)

Why did you attend?

I am always curious to know what is happening in the world that may impact on future fisheries regulation and the Australian fishing industry. 'Regulation' comes in many forms and governments are not the only ones who apply them – the private sector has an increasing role.

What were the top issues for you?

- The strategy of environmental NGOs to use pre-agreed United Nations/Food and Agriculture Organization/International Labour Organization codes as a means of operationalising fishery certification schemes and related standards such as the Global Sustainable Seafood Index. This in turn will control market access in many, but not all, cases.
- The changing definition of a sustainable fishery – broadening from fish stocks, to ecosystem to socioeconomic issues including human and animal welfare.

What are the implications for your organisation?

AFMA is in a pretty good position, especially because of our fishery independent monitoring through fishery independent surveys, the observer program, vessel monitoring system and electronic monitoring with cameras and other sensors.

The major issue ahead is government coordination across AFMA, the Australian Department of Agriculture and Water Resources, Australian Maritime Safety Authority, the Fair Work Commision and the states/NT who have collective responsibility for fisheries, marine safety, human welfare and animal welfare. Industry and the private sector will demand this coordination within the next three years to meet market requirements.

WILD FISHERIES HARVESTING AND SEAFOOD SUPPLIER

Martin Exel
General manager environment and policy, Austral Fisheries

Why did you attend?

To evaluate the priority issues for seafood in the conservation community and broader global seafood businesses, and how we can adapt our approach at Austral to meet those future needs.

What were the top issues for you?

- Environmental sustainability is becoming an absolute bottom line for seafood sales, in the same way as food safety and quality standards did. If our seafood doesn't meet the requirements of sustainable seafood, it will not get sold.
- The increasing societal pressure in the US market to demonstrate that our seafood is harvested acceptably in relation to crewing and labour-market issues.
- Climate change remains the number one identified issue of concern with seafood production, both in aquaculture and wild-capture fisheries.

What are the implications for your organisation?

- Austral will continue to promote Australian seafood as sustainable and healthy, and work with other industries, scientists, managers and conservation groups to ensure our products are genuinely sustainably sourced and recognised as such.
- We have been working on mechanisms to demonstrate our crewing arrangements meet any reasonable standards that may be imposed, and will stay in close touch with the joint working group from the UK's Seafish authority, and the National Fisheries Institute in the US (among others) who are testing an international 'baseline standard' for labour practices.
- We are continuing to work and highlight the need to do better globally at reducing our carbon emissions.

Pike Place Market, Seattle.

WILD FISHERIES HARVESTING AND SEAFOOD SUPPLIER

Malcolm McNeill
Managing director, Australian Longline

Why did you attend?

To better understand the environmental and social issues at a global scale, that we (Australian Longline and the fishing industry in general) need to be mindful of when paving our way forward both strategically and in our day-to-day operations. We can then transfer this into voluntary improvement of environmental and socially responsible fishing practices.

What were the top issues for you?

- An increasing focus on ensuring that seafood is sustainable and takes into account the social aspects of delivering seafood to the consumer's plate. The use of slave and child labour in the global seafood industry is being increasingly highlighted and consumers are in turn demanding increased transparency.
- 'Stuff' in the ocean that's not meant to be there, such as lost fishing gear that has the potential to ghost fish, but also the increase of plastics, specifically microfibres and micro plastics that have made it into the waterways in the world.

What are the implications for your organisation?

Steps to be taken from an Australian Longline perspective to address these issues include:

- Working with organisations such as the UK's Seafish to ensure we are using responsible employment practices that also monitor the wellbeing of our crew.
- Continuing to investigate ways to minimise gear loss through working with innovative fishing gear suppliers and improving our own means of recovering lost gear.
- In conjunction with other Australian seafood companies, promoting 'Product of Australia' seafood as being clean, green, sustainable and delicious.

RESEARCH

Crispian Ashby
Programs manager, FRDC

Why did you attend?

Following the 2012 SeaWeb Seafood Summit, I was interested to see how things have changed and moved forward. The Australian industry and managers are interested in sustainability reporting and what has been occurring in this space to help progress efforts here in Australia regarding reporting standards for fisheries.

What were the top issues for you?

The major take-home message was the shift from environmental to social/societal sustainability such as labour conditions etc. The pendulum appears to be shifting. It was refreshing to see that retailers and wholesalers were on the front foot a little more with regard to sustainability. There was also a change in language, more to do with meeting protein and food needs for future generations.

What are the implications for your organisation?

Given the shift and apparent changing focus to social elements it would be good to get on the front foot with regard how these can be measured and reported. Another message is to get ahead of the game and own the space rather than have others create the space (and several versions of it) that the industry both harvest and post-harvest may have to conform to.

Above right SeaWeb Seafood Summit speakers, (from left) chefs Tom Douglas, Ned Bell and Barton Seaver. Photo: Azzura Photography

EAT SEAFOOD, SAVE LIVES

As a chef, author and activist, Barton Seaver provided a passionate presentation as the final speaker of the SeaWeb Seafood Summit.

Sustainability, he said, was not an outcome in and of itself, but a tool to achieve the goal of thriving, healthy communities, including fisheries.

While many people viewed fisheries as "something we set out from a safe dock to find", he said it was better to stand on that same dock and turn around to see the infrastructure and the heritage, the weaknesses and opportunities of the adjacent towns.

"A fishery is the sum of the aspirations and labours of the community, and when we understand a fishery to be that, that's powerful," he said. "All of a sudden we have assigned the civic, social and moral value that we have long assigned to agrarian heroes, and we begin to hang that same halo over the head of our handsome fishers."

He outlined the moral values of fisheries as including the promotion of good health, and acting on the "legacy impact" of dietary choices.

"When we talk about seafood, we have to start off by saying 'EAT SEAFOOD'," he said.

"The number one cause of death in [the US] is heart disease. Eating a diet rich in sustainable omega-3 fatty acid seafoods can reduce mortality incidence by 36 per cent. This is not a health issue; this is a moral issue.

"We literally have the cure in our hands and we're not using it. We as a community are not espousing this as a fundamental principle to start conversations.
Eat seafood, save lives. It's that simple."

Barton Seaver said people who were not eating seafood were consuming other proteins such as beef, pork, chicken and lamb instead.

"And if you look at the legacy impacts of that, from land-use alterations, feed conversion ratios, freshwater use, antibiotic use and greenhouse gas emissions ... seafood comes out on top, all the time.

"And when we scare people, inadvertently, away from the seafood counter we are driving them off into lesser environmental choices, and certainly to the lesser health choice."

Barton Seaver is leader of the Sustainable Seafood and Health Initiative at the Centre for Health and the Global Environment at the Harvard T.H. Chan School of Public Health.

MORE INFORMATION
www.taylorshellfishfarms.com

Sound move to diversify production

A tour hosted by Taylor Shellfish Farms as part of the SeaWeb Sustainable Seafood Summit provides insight into bivalve aquaculture, Washington-style

Story and photos by **Catherine Norwood**

Young oysters are initially laid out in mesh bags, but once big enough will be left in the open in the beach tidal zone to grow to a harvestable size.

When you walk across the tidal flats at Totten Inlet on Washington's Puget Sound, tread carefully: you are walking on next year's crop of clams and oysters.

While the clams may be safely hidden beneath the mud, sand and gravel, various species of oysters sit openly on the beach where they have been deliberately seeded to grow in the ebb and flow of the tide. This includes Olympia Oysters and Pacific Oysters in sucessive seasons.

When it is time for harvest, the oysters are simply shovelled off the surface into baskets and taken to the company's processing plant for cleaning, grading and sometimes shucking.

This style of tidal production is one of four techniques Taylor Shellfish Farms uses for oysters at its five farm locations – four in Washington and one in the Canadian state of British Columbia. The other techniques include seeded ropes, a bag and buoy system and vertically hanging column baskets.

When the Taylor family first began farming in 1890, the small native Olympia Oyster (*Ostrea lurida*) was the focus of production. The California gold rush had created an insatiable appetite for oysters in San Francisco.

As luck would have it, however, Washington was too far north to regularly supply this market, which effectively prevented the overfishing of oyster stocks, as was the case further down the coast.

The Taylors are now in their fifth generation as shellfish farmers and Bill Taylor heads the operation with his brother and sister. Collectively they have eight children also involved. They have 732 employees, including those in Canada. This includes oyster bars in Seattle, Olympia and Shelton, two shellfish markets and hatcheries in Washington and California, in addition to their farming operations and two processing sites.

They still harvest Olympia Oysters, generally at three to four years old, but these now constitute less than two per cent of the 60 to 70 million oysters produced each year.

Pacific Oysters (*Crassostrea gigas*) make up 90 per cent of production. Seed was first introduced from Japan in the 1920s, but has been locally produced since the 1970s. The Taylors use different production systems depending on the location and desired results – mostly triploid oysters, with some diploid, all produced in their own hatcheries.

Seeding onto ropes often results in clumps of oysters that are prised apart and harvested for their meat. The bag and buoy system is particularly favoured for the highest-quality half-shell oysters supplied to restaurants. This wave-and-wind-tumbled technique results in harder and deeper cupped shells, which the Taylors market as Shigoku Oysters (shigoku means 'ultimate' in Japanese). Pacific Oysters are harvested between 18 months and four years old.

The past 30 years have seen a transformation of the market for oysters. Bill Taylor says in the 1980s all oysters were sold shucked. Today 80 per cent are sold alive in shells or frozen in half shells.

Diversification

Over the years, the Taylors have diversified their production. Kumamoto Oysters (*Crassostrea sikamea*), originally grown from seed imported from Japan, are a premium line and account for about eight per cent of oyster production. These are harvested after three years.

Manila Clams (*Venerupis philippinarum*) established themselves as an accidental import – possibly with Pacific Oysters although that is unconfirmed, Bill Taylor says. However, they have adapted successfully to the US and have proven popular with Asian immigrants who are familiar with the species and who account for most of the 2.6 million kilograms the Taylors produce.

Blue Mussels (*Mytilus edulis*) and Pacific Geoduck (*Panopea generosa*), which is a large saltwater clam known as mirugai in Japan, were added to the farm in the 1990s. Both are native to the US.

New Zealander Gordon King overseas the mussel farming, which uses ropes hung from rafts. Longline ropes commonly used in other countries are vulnerable to ducks, who enjoy the mussels, he says.

Each rope is one to two metres long, and each raft is 10 metres square, capable of producing 10,000 kilograms of mussels per raft. In Totten Inlet there are 21 rafts, but the total area committed to mussel farming is almost one hectare, including a recently approved farm nearby. Annual production potential is now 1.5 million kilograms, up from 544,300 kilograms, with mussels harvested at 18 months.

1 About 20 per cent of oysters are shucked and sold as meat. **2** Locally grown Blue Mussels prepared as part of a seafood lunch for the tour group. **3** Farming geoduck (pronounced gooey duck) has been a new venture for the Taylors and for the US aquaculture industry. **4** Gordon King explains mussel production to visitors at the Taylor Shellfish Farms. Totten Inlet site.

Unlike mussel farming, Bill Taylor says geoduck (pronounced gooey-duck) farming was virtually unknown when they started doing it in the 1990s: "There was a lot of trial and error, and not a lot of research on the species."

Geoducks live in the sand and bury themselves more than a metre below the surface. The clam's distinctive siphon is extended from beneath the sand into the water to both extract nutrients from the water and to eliminate waste.

In the wild they can grow to more than six kilograms and can potentially live for more than 100 years. In commercial production, the Taylors harvest them at six years of age, when they reach 900 grams to 1 kilogram. They harvest about 272,000 kilograms of geoduck a year, which are sold live.

Environmental issues

Water quality is a crucial issue for the Taylors; their geoduck and oysters in particular are often sold live and eaten raw. As such, the Taylors and other shellfish farmers have been on the frontline of water pollution issues for almost a century.

Shellfish farmers are often "at the edge of the drain," Bill Taylor says, and as such have been on the frontline of water pollution issues for more than a century.

Bill Taylor says when a pulp mill was set up at Shelton on the shores of the Puget Sound in 1929 there was no regulation of its sulfide discharges. The mill was eventually closed in the 1950s after an extended campaign from shellfish farmers.

While the *US Clean Water Act 1972* helped control these kinds of discharges, non-point source pollution then become a growing issue, including agricultural run-off, contamination from animals, untreated sewage leaks and stormwater.

"We're at the bottom of the drain, so we've been involved with agriculture for a long time to prevent pollution," Bill Taylor says.

And just when they thought the water-quality issues were generally under control they found a large proportion of the oyster larvae at their Shelton hatchery was dying.

They treated the water for what they initially thought was a marine bacteria, but the larvae kept dying. They soon realised there was upwelling of high-acidity water in the Sound, and the Pacific Oysters were particularly susceptible during the first three to four days of their life. Buffering the water at the hatchery by injecting sodium carbonate has helped to increase the pH and improve survival.

But the business continues to employ a full-time research supervisor at the hatchery to oversee a range of trials including water quality and shellfish survival, breeding for improved disease and pH resilience and increasing the production of algae used to feed the larvae and spat. There are always new challenges. "And we're always trying to improve the product," Bill Taylor says. F

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FRDC RESEARCH CODES: 2010-534, 2012-061

Seaweed dreams

From snorkelling with seaweed to high-tech algal aquaculture for better health, Pia Winberg's focus is on production for a sustainable future

By **Anne Crawford**

For almost 20 years Australian scientist Pia Winberg has been investigating and advocating for the wide-ranging benefits of seaweed.

Her message is now reaching national and international audiences. The business she founded four years ago as a leap of faith is on the cusp of a major expansion of seaweed production and its own food and pharmaceutical product range. Today, she says, the field of seaweed aquaculture is "ready to explode".

Based at Shoalhaven on the New South Wales south coast, Pia Winberg has long advocated for more widespread use of these diverse marine plants in Australia and has established herself as an international expert in phycology – the study of algae and seaweeds.

Her efforts include leading the Australian Seaweed Network, which operated for four years from 2010–13, and coordinating an international applied phycology conference in Australia in 2014. She also published the cookbook *Coastal Chef* in conjunction with the event, featuring recipes from 18 chefs using 27 seaweed species from around the world.

Her own early encounters with seaweed were as a child, snorkelling in Sydney Harbour. She admits that when Japan's 'sushi wave' first hit the world the 1990s, eating seaweed initially seemed "a stretch" from her westernised perspective, despite its popularity in Asia. But tastes, including her own, have evolved considerably since then.

In the late 1990s she was studying a master's in marine science at Stockholm University, investigating seaweed potential to remediate tiger prawn farms in Sri Lanka. This included analysing water nutrient dynamics – how nitrogen, for example, can be taken up from prawn waste into seaweed.

While being paid to grow seaweed to "clean up" seemed an unlikely future, she has remained committed to the principles of balanced environmental systems and recycling of nutrients. This underpins the seaweed production business she set up in 2013, Venus Shell Systems, where she is CEO and chief scientist. The seaweed is grown in land-based ponds using a combination of wastewater taken from the nearby Shoalhaven Starches wheat-processing plant and water from the Shoalhaven River estuary. While the processing plant is able reclaim 80 per cent of its wastewater for potable uses, the remaining 20 per cent contains nitrogen and other nutrients that make it ideal for seaweed. Extracts from her seaweed are used in aquaculture feeds, foods, cosmetics, dermatological products and pharmaceuticals; the range of products is continually expanding.

Venus Shell Systems has been a long time in gestation, as Pia Winberg's belief in the potential of seaweeds continued to grow in parallel with increasing concerns about the future of the Shoalhaven community where she lives with her husband and two daughters.

She says during the 2000s the local fishing industry was affected by lower fish yields, restructuring of fisheries management, the creation of marine protected areas and competing interests; people were losing jobs.

"I was incredibly frustrated just writing papers about the opportunity of aquaculture and seaweed, living in a community where it could be part of the solution to real socioeconomic problems." She began pushing the idea of a sustainable seaweed industry with the Shoalhaven City Council and other agencies on the south coast.

Good eating

In 2008, Pia Winberg reviewed the nutritional value and market potential of seaweed for the Rural Industries Research and Development Corporation. The review identified seaweed as an excellent source of trace elements, vitamins and minerals, omega-3, protein and dietary fibre that benefits gut microbiome.

Concurrently, in mid-2008, she became the director of the new Shoalhaven Marine and Freshwater Centre at the University of Wollongong. The focus of the centre is sustainable marine food production and it works on a range of marine projects important to the local industry.

As the director she helped foster opportunities for sustainable aquaculture in the region, including projects funded by the FRDC for the environmental monitoring of estuaries, aquaculture opportunities for Jervis Bay and support for the oyster industry.

The role was also a chance to promote research into seaweed as a key element in sustainable aquaculture. Australia has thousands of species of seaweeds, hundreds of which are unique to this country. From an evolutionary perspective, they are more diverse than plants on land, Pia Winberg says. Her research has evaluated the nutritional differences across species, as well as strategies to convince consumers to eat seaweed.

New ventures

In 2014 she left the Shoalhaven Marine and Freshwater Centre to establish Venus Shell Systems. With the potential for future employment she was supported by the local community.

The gathering momentum also led Shoalhaven City Council to establish Blue BioTech Shoalhaven in 2014 as an industry hub and collaborative venture with local industries, researchers and government to promote aquatic biotechnology growth in the region – including seaweed. Since then, it has been a 'big ride', she says.

It took some time to find the right equipment to build an efficient system that supported the ecological process, and to scale it up from the laboratory to a farm. In 2016, the farm produced three tonnes of a single species of seaweed a year, with plans to expand the area under production and to include other species.

"We have done a lot of research looking at the genetic barcoding to identify the species around Australia's coastline. The great opportunity in Australia is that our seaweeds are unique and clean in most parts of the continent. It is currently used for food and health products to fortify what food lacks in most Western diets," she says.

The company's food arm, PhycoFood Co.,

Pia Winberg
Photo: Blue BioTech Shoalhaven

took seaweed food concepts from the lab to the market last year, showcasing its seaweed pasta, protein bars, falafels and snacks in market stalls to gauge reaction. Its products won three medals in the 2016 Australian Food Awards.

PhycoFood is now on the verge of scaling to larger commercial production and Pia Winberg is approaching supermarket chains about its food products.

"At the moment demand has suddenly exploded, right in the middle of getting new investment and scaling up our production to commercial scale to achieve that demand – it's challenging," she says.

Scientific approach

She appeared at a BBC event on the future of food last year with the popular British television presenter Michael Mosley, who happened to be writing a book on gut health, which has been the subject of clinical research trials for another of Venus Shell Systems' subsidiaries, PhycoHealth.

"Now everyone wants to try our capsules for gut health," Pia Winberg says.

PhycoHealth has partnered with a supplements and pharmaceutical manufacturing company in the region and will launch its gut health and skincare products this year. Its e-commerce platform is expected to take advantage of international interest in these products.

> "There's a $6 billion global crop for food production alone. Australia may not become the biggest seaweed producer in the world but we can embrace our high levels of food regulations and excel by being the most quality-controlled and sustainability-focused producer in the world."
>
> Pia Winberg

Below Seaweed pasta.
Photo: Pia Winberg

Other clinical studies include the health benefits of seaweed in reversing inflammation and pre-diabetes symptoms, purifying molecules as a potential treatment for a range of health disorders and investigating wound-healing properties.

Given her scientific background, which includes a PhD in Marine Ecology at the University of Wollongong, an evidence-based approach is crucial for Pia Winberg in approaching investors and in countering naysayers critical of seaweed as just another fad.

She believes the prospects for the industry, and for Australia's role in the industry, are bright.

"There's a $6 billion global crop for food production alone. Australia may not become the biggest seaweed producer in the world but we can embrace our high levels of food regulations and excel by being the most quality-controlled and sustainability-focused producer in the world," she says. F

Final reports

Evaluation of fisheries data 2014-200

The problems of managing data-poor fisheries have been the subject of much research in recent years. The project aimed to critique data collection methods by evaluating data robustness, identifying data gaps and exploring areas for improvement in two of Queensland's fisheries: reef line fishery for coral reef species and Spanish Mackerel; and Mud Crab and Blue Swimmer Crab fishery. It also sought to explore data collection methods and provide an analysis of the costs and benefits of those methods and changes to existing processes and protocols.

The project found that misunderstandings about data are widespread across all sectors. A lack of communication and relationship building, particularly between fishers (data collectors) and managers (data custodians and users) has fishers and industry at odds with the current data collection processes. The project identified the urgent need to rebuild communication channels and develop resources in order to improve data collection and validation and to educate fishers about the need for data collection.

More information: Andrew Tobin, admin@tobinfishtales.com

White spot disease response assessment 2016-064

This report provides independent documentation and analysis of events related to a white spot disease (WSD) outbreak in Black Tiger Prawns (*Penaeus monodon*) cultured on the Logan River from late November 2016 until February 2017.

More information: Ben Diggles, ben@digsfish.com

Brownlip Abalone potential 2012-016

The report provides a comprehensive evaluation of Brownlip Abalone biology and an assessment of Brownlip Abalone fisheries. For wild populations, it has provided reliable estimates of natural and fishing mortality size composition. This study is the first to model all life stages of Brownlip Abalone. The project also successfully demonstrated the viability of Brownlip Abalone as an aquaculture species.

More information: Lachlan Strain, lachlan.strain@fish.wa.gov.au

Reef fish build capability 2013-017

The project examined the stock structure of three key tropical reef fish species – Black Jewfish, Grass Emperor and Golden Snapper. It used this research as a basis to develop a certified training course to develop skills in fisheries data collection and assessment. Both of these outputs addressed key needs of filling a knowledge gap in the biology of important fish species to assist with their sustainable management as well as providing increased research capacity within Indigenous communities. The project successfully improved the understanding of stock structures of all three species – allowing for effective reform of fisheries management. A cohort of graduates successfully graduated from the training course with the newly developed certification.

More information: Thor Saunders, thor.saunders@nt.gov.au

Shellfish quality program review 2013-056

This updated Australian Shellfish Quality Assurance Program (ASQAP) manual forms the basis for the review of state programs to ensure Australian shellfish are being grown using approaches that are risk-based, world-best practice with food safety management systems. The formal nature of the ASQAP structure and of the state program's steering committee structures will ensure that the output of this project is implemented quickly and effectively by the relevant bivalve shellfish growing jurisdictions. The manual can be found at the SafeFish website (http://safefish.com.au/technical-program).

More information: Clinton Wilkinson, clinton.wilkinson@sa.gov.au

Evaluating fisheries performance 2014-235

This evaluation of fisheries and aquaculture followed an earlier study in 2009. Issues and priorities driving fisheries and aquaculture resources are complex and dynamic – accordingly assessments of performance and use must also change over time. Using a consistent Delphi research methodology across environmental, economic and social issues, 58 experts assessed 41 separate fisheries and aquaculture ventures.

The Delphi methodology builds our understanding via a cost-effective and systematic process to interrogate national and local issues across all fisheries and aquaculture. This report summarises the Delphi approach, the refinements adopted to improve the scope and scale of assessments to include economic activity from all sectors, the headline outcomes, as well as the early trends in performance and use over the five years since 2009.

More information: Ewan Colquhoun, ewan@ridgepartners.com.au

Ciguatera toxin screening 2014-035

Ciguatera fish poisoning (CFP) is the most frequently reported fish-borne illness in tropical regions brought about by ciguatoxins (CTXs) developed by benthic dinoflagellates of the genus *Gambierdiscus*. In Australia, cases of CFP have occurred in fish caught in Queensland, the Northern Territory and New South Wales.

CTXs are odourless and tasteless, making it difficult to distinguish toxic fish from non-toxic fish. The objective of this study was to set up a facility with the ability to determine P-CTX-1B presence in fish to test Spanish Mackerel from NSW for the presence of CTXs. If found, the study aimed to determine if there was a relationship between the size and weight of fish detected with the toxin. However, no apparent relationship was observed between the length or weight of Spanish Mackerel and toxins detected.

More information: Shauna Murray, shauna.murray@uts.edu.au

Assessing import controls 2016-066

Before the outbreak of white spot disease (WSD) on Australian prawn farms in November–December 2016, this project aimed to generate data on some of the potential entry pathways for WSD into Australia via the retail purchase of uncooked prawns and crabs. The project also sought to compare the import procedures across different commodity types including chicken meat, pork, salmon and stockfeeds to those applied to prawns.

The results identified WSSV-positive human-grade commodities in every retail outlet tested. Many different brands of product returned positive WSSV results with product origins from a variety of countries including Malaysia, China, Vietnam, Thailand and Indonesia.

The identification of positive commodities in Queensland, New South Wales and Western Australian retail suggests a national issue, rather than an individual port issue. The project looked at the import controls and identified gaps that could be addressed in future.

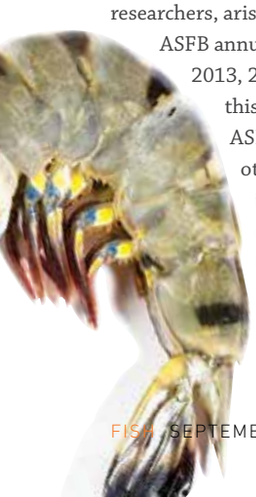
More information: Matt Landos, matty.landos@gmail.com

Fish Biology Conference 2013-404

The Australian Society for Fish Biology (ASFB) was founded in 1971 to promote research, education and management of fish and fisheries and to provide a forum for the exchange of information.

The primary outcomes of this project have been knowledge transfer, building research partnerships and recognition and promotion of research achievements, particularly among early-career researchers, arising from very successful ASFB annual science conferences held in 2013, 2014 and 2015. Each year during this three -year period saw the ASFB partner with at least one other science-based society or interest group for the annual conference.

More information: Bronwyn Gillanders, bronwyn.gillanders@adelaide.edu.au



Virus tests on re-imported prawns 2016-172

White spot disease (WSD) was officially diagnosed for the first time on an Australian prawn farm on 1 December 2016. During December and January, the disease spread through several prawn farms along the Logan River, Queensland. This detection had a wide range of implications affecting aquaculture, wild harvest and recreational sectors, importation of raw prawns, and the bait trade, and includes a loss of confidence of consumers of Australian seafood.

Advanced Analytical Australia undertook routine testing for the largest re-importers of wild caught prawns in Australia. This data was examined for indications of white spot syndrome virus (WSSV) recorded prior to the detection of WSD in Queensland. Results of yellow head virus (YHV) testing were also provided, and are presented in this report. An examination of the data did not find any positive indications for the presence of WSSV or YHV on re-imported prawns.

More information: Matt Koopman, koops@netspace.net.au

National maritime safety standards 2015-401

The Australian Government's funds to assist commercial and recreational organisations to adapt to National Maritime Safety Standards were managed by the FRDC.

In July 2015, the FRDC invited expressions of interest from organisations that were well positioned to support industry to develop safety management systems (SMS). Eligible applicants included industry associations on behalf of members, fishing enterprises where planned activities benefit a group of operators and enterprises, and training and service providers delivering SMS training to the target group.

The target groups were at the operational level of industry, with a particular emphasis on small vessel operators. The project delivered 10 projects in six states. They included the delivery of workshops and one-on-one training to fishers and other members of associations and networks across the country to help participants to develop a SMS.

More information: Australian Maritime Safety Authority, www.amsa.gov.au

Data methods for undefined species 2016-063

A target under National Priority 1 of the FRDC *Research, Development and Extension Plan 2015–20* is that, by 2020, community attitudes to fishing and aquaculture are more positive as a result of an increased awareness of Australian seafood's sustainability performance and the value it provides to local communities. The Status of Australian Fish Stocks (SAFS) reports are a key component to the achievement of this objective by increasing the number of species assessed in SAFS and reducing the percentage of species classified as 'undefined.'

This requires the use of methods specifically developed for data-limited stocks. The objective of this project was to progress the development of assessment methods for undefined species in the SAFS reports and for other data-limited species/fisheries. A workshop discussed assessment methods and tools for 'undefined' species in the SAFS reports. It sought to identify the next steps to reduce the percentage of species classified as 'undefined'. The workshop resulted in several recommendations, which included that a risk-assessment process be undertaken to identify which undefined species be assessed, the development of a toolkit of data-limited assessment methods and the trial of different data-limited assessment methods to assess particular undefined species.

More information: Sevaly Sen, sevaly.sen@gmail.com

Ornamental fish virus testing 2014-001

Despite the biosecurity measures in place since 2000, there have been several incidents of exotic pathogens from ornamental fish affecting wild and farmed fish populations in Australia. There is a need to acquire new knowledge to support policy reform as the ornamental fish industry advances and new pathogens emerge.

During 2015, a cross-sectional survey was completed for the nationally and internationally significant pathogens carried by ornamental fish entering Australia.

The report contains the first comprehensive survey of the parasite assemblages affecting imported ornamental fish under quarantine. This report provides new knowledge to support improved regulation of imported commodities. This knowledge will facilitate the safe trade and enhanced biosecurity for Australia's aquatic animal industries, the developing domestic ornamental fish breeding industry and Australia's natural resources.

More information: Joy Becker, joy.becker@sydney.edu.au

Aquatic training scholarship 2009-315.27

An aquatic training scholarship awarded to Christine Huynh supported the completion of the online course 'Diseases of warm water fishes' covered by the University of Florida. The objectives of the scholarship are to expand the knowledge of warm-water finfish diseases and treatments, learn about different health management techniques and expand knowledge on nutritional support for fish, nutritional diseases in finfish and on substitution research for sustainable fish feeds.

More information: Christine Huynh, christine.huynh@tassal.com.au

Fisheries Network training framework 2012-403

A team from Charles Darwin University worked with Indigenous people involved in the fishing industry and the Northern Territory Department of Primary Industry and Resources to develop the East Arnhem Indigenous Fisheries Network training framework. This framework provides a set of exemplary policy, training and practice initiatives. The framework uses a suite of e-learning tools, skills and processesto create high-impact, integrated, flexible and engaging teaching, learning and assessment experiences.

The outputs are:

- the development of a training framework for sustainable seafood-based enterprises for Indigenous people;
- accreditation of a vocational training program for Indigenous seafood-based enterprises at Charles Darwin University using nationally endorsed units of competency; and
- exemplars of contextualised training and assessment plans and materials in English, Maung and Yolngu Matha.

More information: Ruth Wallace, ruth.wallace@cdu.edu.au

Blue-eye Trevalla stocks 2013-015

The first spatial mapping of Blue-eye Trevalla stocks in Australian waters was completed between 2013 and 2016 using a variety of techniques: leading-edge technology, a synthesis of historical data and input from knowledgeable commercial fishers. Each of the three primary analyses provided evidence for stock structure within the broad southern Australian distribution of Blue-eye Trevalla. Spatial differences in age and growth and otolith chemistry of the adult life stage implied there was local and regional residency by adult Blue-eye Trevalla. Dispersal potential indicated a broader scale connectivity among regional populations is likely during early life.

By overlaying these spatial patterns, four broad Blue-eye Trevalla 'stock areas' were identified (west, south, east and Seamounts–Lord Howe. Each of these stock areas represents an interconnected 'meta-population', that is, a group of discrete adult sub-populations resident on the continental slope and seamounts without extensive migration between them. Stock areas do not reflect truly separated biological stocks. These findings will help identify spatial management options for fishery managers (other than further spatial closures).

More information: Alan Williams, alan.williams@csiro.au

SBT release survival 2013-025

The primary objective of this study was to assess the post-release survival rate of Southern Bluefin Tuna (SBT) caught by the recreational fishery in Australia. An analysis was also conducted to determine whether the fate of fish after release could be related to factors occurring during capture. Finally, a code of practice for the recreational SBT fishery was compiled.

The results showed that recreationally caught SBT have a low incidence of mortality (three per cent) occurring during the capture event related directly to the hooking and retrieval of the fish. The fate of fish that were landed in a non-responsive state was generally attributed to deep-hooking.

An exception to the low pre-landing mortality was attributed to seal predation of SBT caught in Tasmanian waters. The research indicates that current management strategies using catch limits, including personal bag or possession limits, are reasonably effective.

These findings will complement future research to investigate the recreational harvest of SBT in Australia (Moore et al. 2015). The combined results of these projects will provide greater transparency around the recreational fishery for SBT, an objective that is an obligation of Australia to the Commission for the Conservation of Southern Bluefin Tuna.

More information: Sean Tracey, sean.tracey@utas.edu.au

Crab pot theft solutions 2015-039

The theft of crabs from estuarine pots is a serious issue facing both the New South Wales commercial and recreational fishing communities. The high price of mud crabs drives a thriving black market in their trade.

A workshop attended by affected fishers and researchers from the Designing Out Crime Research Centre examined the ways that exist to mitigate theft. The workshop identified 17 recommendations that focused on justice, community awareness, stewardship, trust and innovation. Participants agreed that no one pathway would mitigate the impact of estuarine pot theft. The recommendations are still conceptual and require further development, but give a clear sense of the priority areas and issues identified.

More information: Tricia Beatty, eo@pfai.com.au

Movers and ...

Gail Owens is the chair of the inaugural board of the Victorian Fisheries, Authority established on 1 July 2017 as an independent statutory authority to manage Victoria's fisheries resources. She is joined by **Bernadette Northeast** (deputy chair), **Christine Cussen, Christopher Rose, David Shirer, Graeme Dear, Rebecca Edwards** and **Yorick Piper**.

Scott Hayward from Sealords Barramundi has been appointed as the president of the Australian Barramundi Farmers Association.

Former federal senator for Victoria **Helen Kroger** has taken up the position of chair of the Australian Fisheries Management Authority.

The Western Rock Lobster Council has appointed **Matt Taylor** as its new CEO.

Helen Jenkins has departed as executive officer of the Australian Prawn Farmers Association (APFA) to take up a role as aquatic industry liaison officer for northern Australia with Animal Health Australia. **Kim Hooper** has taken on her role at APFA.

John Gunn has left the Australian Institute of Marine Science and his replacement as CEO is **Paul Hardisty**, who was previously with CSIRO.

Tony Worby, previously director of the Antarctic Climate Change and Ecosystems Cooperative Research Centre, is the new director of CSIRO Oceans and Atmosphere.

Pauline Mooney has moved to Primary Industries and Regions SA and **Peter Appleford** has been appointed as her replacement as CEO of the South Australian Research and Development Institute.

Luke Twomey has taken over as general manager of the Western Australian Marine Science Institution (WAMSI) from **Patrick Seares**.

CEO of the Western Australian Fisheries Industry Council **John Harrison** has been appointed to the WAMSI board.

Pranab Acharya has joined the FRDC in the role of accountant.

Ruben Alvarez, outgoing COO of New Zealand King Salmon is taking up the role of CEO at Tamanian Salmon producer Petuna, replacing **Mark Porter** who stepped down last year.

FEEDBACK

FRDC WELCOMES YOUR COMMENTS

frdc@frdc.com.au

MOVERS WE'VE MISSED?

INFO PLEASE TO

Annabel Boyer, 02 6285 0415,

annabel.boyer@frdc.com.au

Calendar of events

DATE	EVENT	MORE INFORMATION
2017		
19 to 21 September	**Nuffield Australia National Conference, Darwin**	http://nuffield.com.au
23 to 25 September	**10th Trans Tasman Rock Lobster Congress, Hobart**	www. rocklobstercongress2017.com
27 to 29 September	**Seafood Directions, Sydney**	www.seafooddirectionsconference.com
4 October	**Global Aquaculture Alliance GOAL, Dublin, Ireland**	www.aquaculturealliance.org/goal
5 to 6 October	**Our Ocean 2017, Malta**	http://ourocean2017.org
17 to 20 October	**Aquaculture Europe 2017, Dubrovnik, Croatia**	www.easonline.org
23 to 24 October	**9th World Aqua Congress, Dubai, UAE**	http://aqua.conferenceseries.com
21 to 22 November	**FRDC Board Meeting, Canberra**	02 6285 0400
25 November	**National Recreational Fishing Conference, Darwin**	www.recreationalfishing.com.au
4 to 6 December	**Australian Shellfish Reef Restoration Network Meeting & 19th International Conference on Shellfish Restoration, University of Adelaide**	www.shellfishrestoration.org.au

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- with the authority to make decisions

CONFIRMED SPEAKERS ARE:

Craig Rispin, *Business Futurist and Innovation Expert ;* ***Tim Pankhurst,*** *Chief Executive at Seafood New Zealand;* ***Robert Terry,*** *CTO and Founder of SmartCatch Inc.;* ***The Hon. Anne Ruston,*** *Assistant Minister for Agriculture and Water Resources;* ***Craig James,*** *Chief Economist for CommSec;* ***Jono Gregory,*** *Director – Internet of Things, KPMG*

Preliminary program information available at: www.seafooddirectionsconference.com