FISH

FISHERIES RESEARCH & DEVELOPMENT CORPORATION **NEWS**

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MARCH 2022

NEW OPPORTUNITIES FOR THE BLUE ECONOMY

AQUATIC ANIMAL WELFARE

READY-TO-EAT CHALLENGES

Women in seafood

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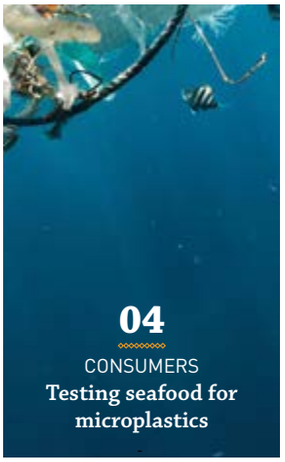

REGULAR

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The FRDC acknowledges the traditional custodians of the lands on which *FISH* magazine is produced, and pay our respects to their Elders past and present. We acknowledge the special relationship that Indigenous Australians have with their traditional lands and waters.

Australian seafood scores well on microplastic scale

An initial investigation into the presence of microplastics in seafood has found much smaller quantities in the guts of Australian marine species compared to those in many other countries

Words
Annabel Boyer,
Illustrations
Nina Wootton

Plastic in the oceans and the impact it is having on marine wildlife and ecosystems has been sounding alarms around the world for some time. However, the potential impact that microplastics consumed via food may have on human health is poorly understood. Although international research has tackled the issue, a recent FRDC-funded study is the first to investigate the potential impact on human health in an Australian context. In doing so, the study has provided Australia's seafood sector and Australian consumers with the first verified data on the issue. Principal investigator on the project, Bronwyn Gillanders from the University of Adelaide, says as the first study of its kind in Australia, the project is significant. "It is the first lot of information that focuses on seafood sampling and highlights information around microplastics in seafood in Australia," she says.

Identifying the issues

Gillanders says, "There has been a lot in the media around microplastics but, at the end of the day, if you don't have that information, it's really hard to make informed, evidence-based decisions."

Previous work in Australia has confirmed the presence of microplastics in sea floor sediments, so this recent project set out to establish whether or not those microplastics were being consumed by marine organisms.

The study examined the frequency with which microplastics occur among finfish, crustaceans and molluscs collected from Australia's commercial seafood markets, as well as the amount or load of microplastics present in each organism. It also conducted a literature review of similar studies around the world to compare where Australia sits in relation to other countries.

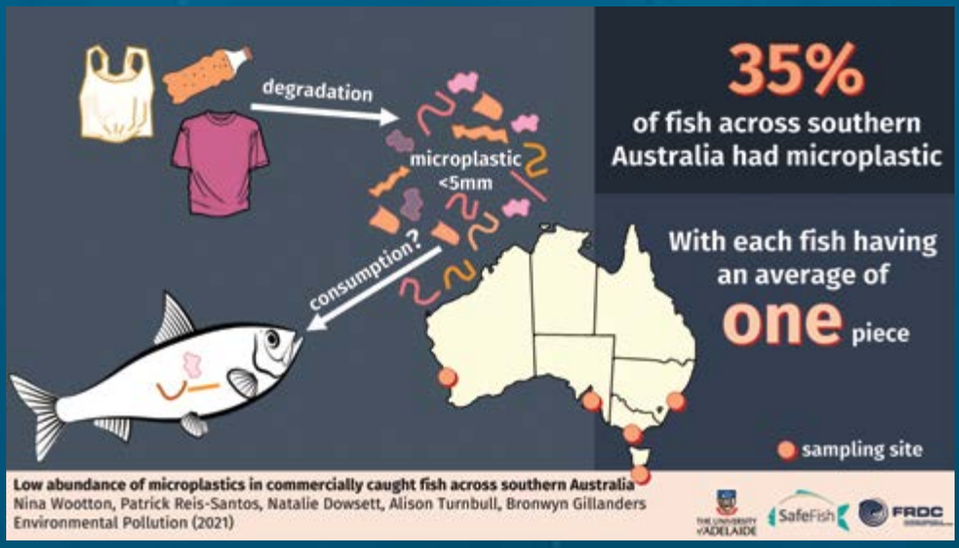
"We found that fish in Australia do consume microplastics, but it is at relatively low levels," says Gillanders, "and slightly less than what you find everywhere else in the world, which is a positive."

The project found that 44 per cent of about 1800 examined marine organisms contained microplastics, with no clear trends for the frequency of occurrence either by species or geographic region. The microplastic load (the number of pieces of microplastic) found in each organism varied widely.

In terms of the occurrence of microplastics found in seafood, when compared with other studies around the world, the occurrence in Australian seafood roughly equalled the median. However, with an average of 1.02 pieces per organism, the quantity of microplastics found in Australian finfish, shellfish, prawns, crabs and squid was low compared to many international studies.

Alison Turnbull from SafeFish, the FRDC-funded body that provides information on the safety of seafood for consumption, says the research goes a long way to allaying concerns about the issue for Australian consumers.

"At the moment, there is no indication that this



is a human-health risk, but it is an area for future research," she says. "The United Nations Food and Agriculture Organization has advised that microplastics from food are not a risk to human health. At the moment, you would be consuming much higher levels of microplastics through your drinking water than through any seafood you may consume."

"It's also important to note that in this project we were looking for microplastics in the fish guts, where we anticipated them to be most prevalent, and mostly people don't eat fish guts. Where microplastics are more commonly consumed is where you eat the whole animal.

"We did find some microplastics in oysters. But even if you ate bucket loads of oysters, you still wouldn't be consuming as much as what you do through your drinking water.

"The questions that follow on from this pertain to all food and drink, they are not specific to seafood," Turnbull says.

Australian methods

Gillanders says that, prior to about 2010, there were very few studies that looked at microplastics in fish and seafood. But growing awareness and concern has seen a boom in the number of studies.

"There are large numbers of studies focused on North America and Europe and fewer in the Australasian region, but their methodology and quality are varied.

"We looked at what we thought was best practice and what methods were used in other studies and came up with an approach that worked for us," she says.

As an initial study, the FRDC project examined the digestive systems of 25 species of finfish, six species of crustacea, three bivalves and a single squid species for the presence of microplastics. The examination of the digestive system places the focus on whether these marine organisms do consume microplastics.

"All of the samples are species that are widely consumed. We got the vast majority of our samples through markets and they were all commercially caught. The species we used were determined by what we could get hold of for a reasonable price," Gillanders explains.

Where appropriate, the gastrointestinal tract was removed from sample organisms. It was then digested or dissolved and the resultant material was sorted under a dissecting microscope. Plastic particles were counted for each organism.

Gillanders says this process is a departure from some previous studies, which have identified plastics using only the naked eye.

Plastic validation

These results have also been verified with Fourier Transform Infrared Spectroscopy (FTIR), a method used to identify chemical compounds. Gillanders says this component of the project was vital, but has only been a recent development in this area of research.

Through further analysis of global studies, Gillanders's team identified the need for consistent guidelines in methods used to evaluate microplastics in seafood. This could help to ensure data collected around the world is unambiguous, comparable and can be widely used to inform decision-making to manage and prevent any issues related to human consumption of microplastics through seafood.

Establishing the source of microplastics found in seafood can provide compelling information for decision-makers to manage the issue, such as when the Australian Government banned the use of plastic microbeads in cosmetics.

Gillanders says, "We used FTIR to confirm the presence of microplastics and then to further investigate what type of microplastic it might be. Is it likely to be coming from clothing or is it likely to be coming from plastic bags or something else?

"If you look at the Australian samples, a lot more of them had plastics from fibres whereas other work we've done in Fiji had film-like microplastics, from things like plastic bags." →

Microplastics are small particles and fibres of plastic. There is no recognised standard for the maximum particle size but they are generally considered to be particles measuring less than five millimetres in diameter. This includes nano-sized plastics that are fragments measuring less than 100 nanometres.

Source: FAO

Photo: Unsplash

Future investigations

However, Gillanders points out that it is still unclear where and how fish may be consuming microplastics. "These are plastics that the fish have consumed, but whether or not the fish have consumed them within the environment or as part of the fishing process, we can't be sure.

"We are now looking at whether microplastics are more likely to be retained in certain habitat types, such as seagrass and mangroves, rather than the adjacent soft sediment," she says.

Although the project has provided some valuable information about the presence of microplastics within Australian seafood, both Turnbull and Gillanders highlight the need for further investigation about microplastics and human health.

Chief among these potential future investigations is to establish whether microplastics make their way from the gut of marine animals into tissues that are consumed. In Gillanders's project, tissue samples from the research were frozen, which will allow them to be analysed for the presence of chemicals associated with microplastics sometime in the future. Work is underway to establish a satisfactory method to do this.

Turnbull says there are questions about whether microplastics are able to cross through the human gut, if they are consumed, and whether that may be cause for concern. There are also questions around whether microplastics are a source of harmful chemicals that may leach into the flesh of seafood used for human consumption.

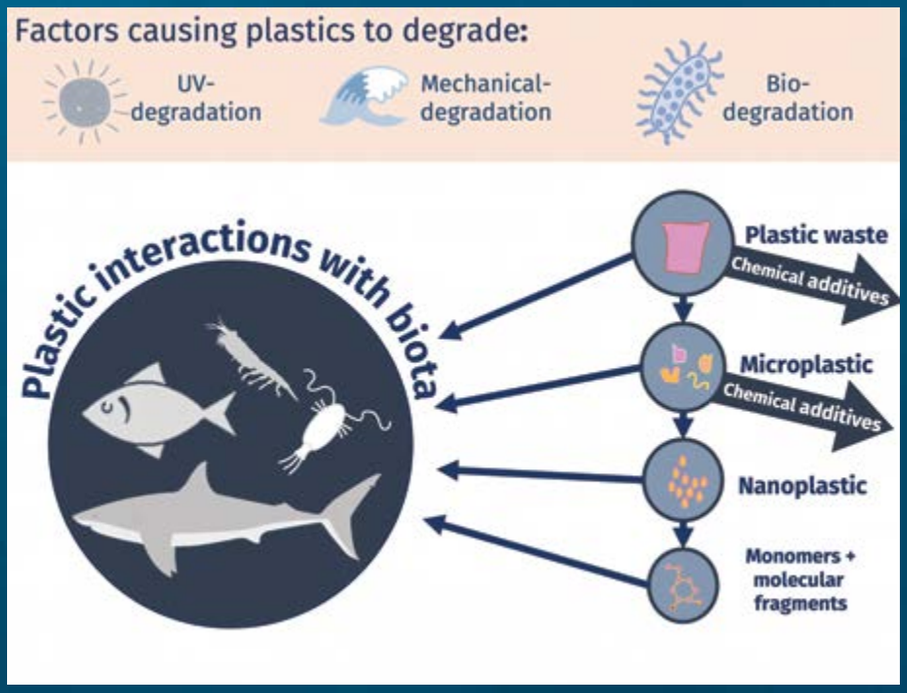
"The future questions should include looking at nanoplastics, looking at what chemical contaminants are adsorbing onto plastic surfaces, and how they might desorb in the gut and across gut membranes," Turnbull says. "If you think of it from a human health perspective, is this going to survive through our digestive tract?"

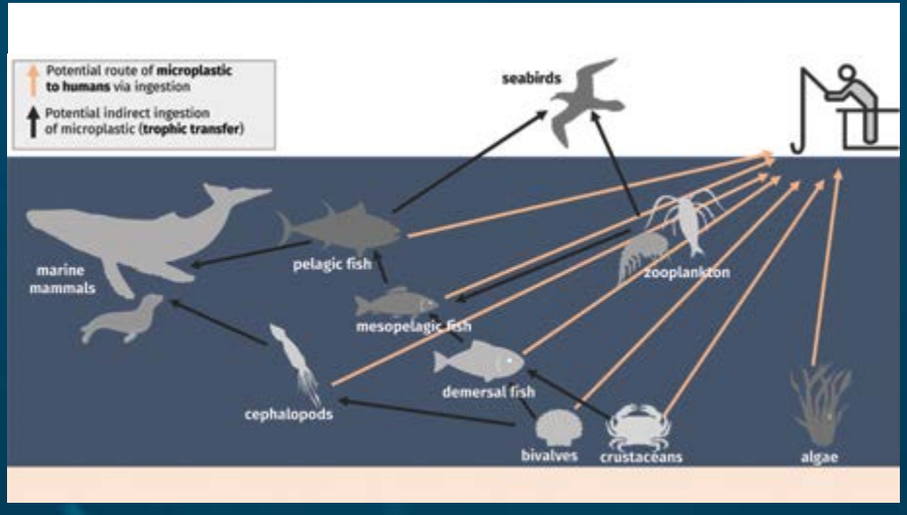
One of Gillanders's students is already investigating how microplastics may change in the environment, to see what chemicals may be taken up by them and how that may change through time.

For Turnbull, an expert in the safe consumption of seafood, the more urgent issue continues to be the broader issue of plastic pollution, its impact on marine organisms and the environments in which they live.

"A bigger concern by far for me is the impact of microplastics and other plastics on the animal itself. That has a much bigger ecological impact and the potential to disrupt food chains than it has for human health risk," Turnbull says.

Although Australian seafood consumers can enjoy their local catch without worrying about their health, the urgency to reduce plastic usage and prevent plastics from entering marine environments remains. F





"A bigger concern by far for me is the impact of microplastics and other plastics on the animal itself. That has a much bigger ecological impact and the potential to disrupt food chains than it has for human health risk."

Alison Turnbull, SafeFish

MORE INFORMATION

www.frdc.com.au/marine-plastics-impacts-and-policy-responses
www.safefish.com.au/reports
food-safety-fact-sheets/microplastics-in-seafood
www.safefish.com.au/reports/food-safety-fact-sheets/microplastics-research-australia-new-zealand
www.fao.org/documents/card/en/c/CA3540EN
www.gillanderslab.org/plastics

FRDC RESEARCH CODE

2017-199

In brief

Welcome to FRDC News

In January, the FRDC launched its monthly **FRDC News**, with the latest news and information about fisheries research outcomes, innovation and engagement. You can read the first issue and watch FRDC Managing Director Patrick Hone's welcome video on our website. **FRDC News** is a digital newsletter that replaces our previous fortnightly newsletter, *Message in a Bottle*, and it will soon replace *FISH* magazine. We have moved to a digital format so that we can get news to you more quickly and more regularly, and we can also tailor stories to your interests. The June edition of *FISH* magazine will be our last print issue so, if you wish to keep reading great stories and understanding what's happening in fisheries research, development and innovation, please subscribe to **FRDC News** at **frdc.com.au/subscribe** or update your details using the **QR code**. F

SEAFOOD DIRECTIONS 2022 ONE VOICE, ONE FUTURE

The 2022 Seafood Directions Conference will be held in Brisbane from 13–16 September. It is time to submit your papers and purchase early bird tickets for the premier seafood sector conference in Australia where the wildcatch, aquaculture and post-harvest sectors come together to share ideas and plan for the future.

The FRDC is a key sponsor of Seafood Directions, which is hosted by Seafood Industry Australia (SIA).

"We are delighted to support Seafood Directions and help industry leaders, innovators and disruptors from all parts of the seafood industry come together to plan a prosperous and sustainable future," says FRDC Managing Director Patrick Hone.

"As we look towards a new chapter of growth for the industry, it is important that we reinforce the unity of the Australian seafood industry and the ties that bind us," SIA Chief Executive Officer Veronica Papacosta says.

For more information, including the call for papers and the sponsorship and exhibitor prospectus, contact Rosie Love at **rosie@seafoodindustryaustralia.com.au** or visit **www.seafooddirections.com.au** F

OAM RECOGNISES RECREATIONAL FISHING EFFORTS

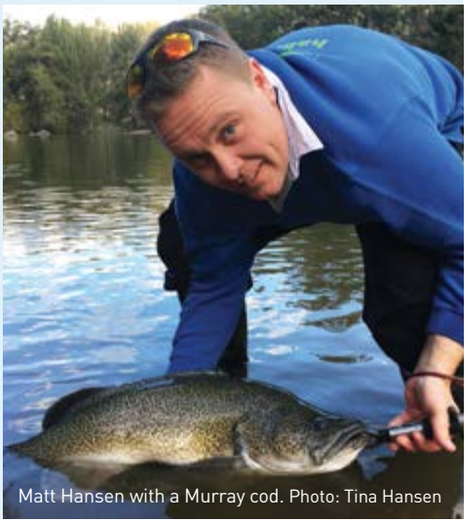
Congratulations to Matthew (Matt) Hansen from Dubbo who received a Medal of the Order of Australia (OAM) in the 2022 Australia Day Honours for his services to recreational fishing and conservation.

Hansen has been an OzFish Unlimited member since the organisation began in 2015 and has led one of the most active chapters in the organisation. During his time as an OzFish board member, he helped drive the decisions that direct much of what the organisation does today.

OzFish Unlimited is a not-for-profit organisation dedicated to helping the millions of Australian recreational fishers take control of the health of their rivers, lakes and estuaries and support the future of the sport they love.

Hansen led an inland recreational fishing group in the Dubbo region that was the first to carry out large-scale public fundraising to support river health restoration actions. The group was also the first non-government organisation to undertake large-scale river restoration work and it established the first – and now highly successful – River Repair Bus. Hansen's recreational fishing group was also able to overcome decades of litter problems in Dubbo and realise a multimillion-dollar gross pollutant trap initiative by Dubbo Regional Council.

Hansen has been at the forefront of efforts by the recreational fishing sector to see irrigation pumps screened to stop millions of fish deaths each year. "Matt is a passionate recreational fisher and conservationist and it's wonderful to see his years of dedication and achievement recognised with this OAM," says FRDC Managing Director Patrick Hone. F

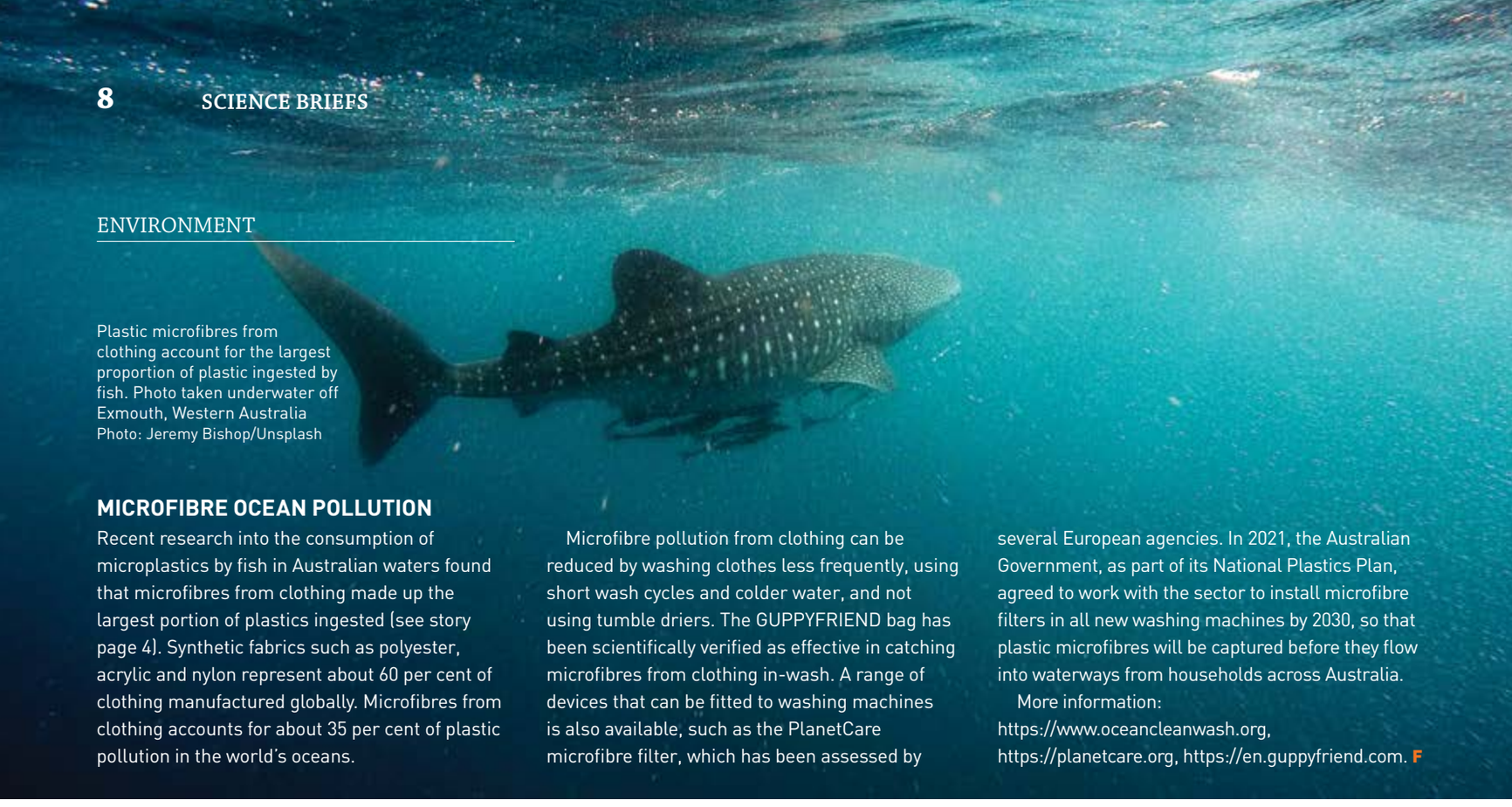


Matt Hansen with a Murray cod. Photo: Tina Hansen

NEW TECHNOLOGIES AND TOOLS TO IMPROVE CREW SAFETY AT SEA

Tuna Australia is helping tuna fishers modernise their safety management systems (SMSs) by providing all interested members with a one-year subscription to the Offshore SMS app and a tablet to use the app. The app provides a fully compliant and up-to-date SMS and real-time digital logs for vessels. The SMS is a suite of operating procedures, protocols and policies that identifies onboard hazards and risks, assesses the likelihood and consequence of each risk, and identifies steps to protect against those risks. The SMS also documents crew training, safety drills and maintenance schedules. FRDC's Managing Director Patrick Hone says this proactive initiative from Tuna Australia will help to improve crew safety at sea. "Making the SMS available digitally will help tuna operators modernise their systems and help everyone come home safely," Hone says. F

ENVIRONMENT



Plastic microfibres from clothing account for the largest proportion of plastic ingested by fish. Photo taken underwater off Exmouth, Western Australia
Photo: Jeremy Bishop/Unsplash

MICROFIBRE OCEAN POLLUTION

Recent research into the consumption of microplastics by fish in Australian waters found that microfibres from clothing made up the largest portion of plastics ingested (see story page 4). Synthetic fabrics such as polyester, acrylic and nylon represent about 60 per cent of clothing manufactured globally. Microfibres from clothing accounts for about 35 per cent of plastic pollution in the world's oceans.

Microfibre pollution from clothing can be reduced by washing clothes less frequently, using short wash cycles and colder water, and not using tumble driers. The GUPPYFRIEND bag has been scientifically verified as effective in catching microfibres from clothing in-wash. A range of devices that can be fitted to washing machines is also available, such as the PlanetCare microfibre filter, which has been assessed by several European agencies. In 2021, the Australian Government, as part of its National Plastics Plan, agreed to work with the sector to install microfibre filters in all new washing machines by 2030, so that plastic microfibres will be captured before they flow into waterways from households across Australia.

More information: https://www.oceancleanwash.org, https://planetcare.org, https://en.guppyfriend.com. F

TECHNOLOGY

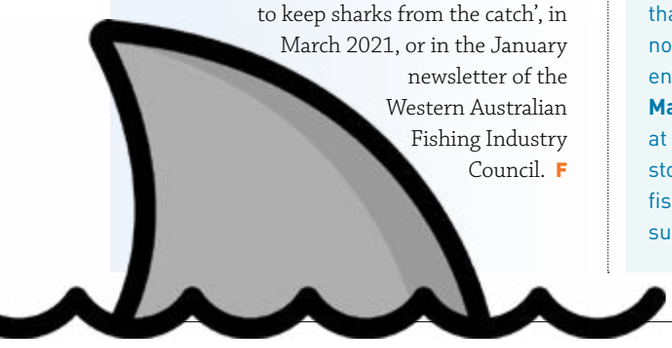
Reducing shark bite-off

Western Australian researchers have tested the effectiveness of three shark-deterrent devices, finding that all three devices reduced shark depredation of fish on lines by 65 per cent overall.

Each device used a different operating system – an electrical field, magnetic field or acoustics. Researchers tested the devices for hundreds of hours at locations between the Abrolhos and the Montebello Islands in WA to assess their effectiveness.

The research was funded by the WA Recreational Fishing Initiatives Fund. It has also provided insight into shark behaviour, shark biology and information about other species that may be contributing to the depredation of caught fish before they are landed.

Read more details about the research in *FISH* magazine 'Device trials underway to keep sharks from the catch', in March 2021, or in the January newsletter of the Western Australian Fishing Industry Council. F



AUSTRALIAN STANDARD

PROPOSED NAME CHANGES

Feedback is being sought on five proposed additions to the Australian Fish Names Standard and two fish name changes.

Proposed additions to the Standard include:

- Western Rock Octopus for *Octopus Djinda*;
- Abalone for *Haliotis* spp.;
- Orange-footed Sea Cucumber for *Cucumaria frondose*;
- Whelks for *Muricoidea* and *Buccinoidea*; and
- King Crabs for *Lithodidae*.

Applications have also been made to change the common name of *Lutjanus bitaeniatus* from Indonesian Snapper to Whitetip Snapper and *Wattsia mossambica* from Mozambique Seabream to Large-eye Seabream.

Public consultation on the proposed names will close on 23 April 2022. The Fish Names Committee has an online survey to allow for quick feedback.

For more details, or to receive the Fish Names newsletter and survey notifications, email **fnc@frdc.com.au**, or visit **www.frdc.com.au/subscribe**. F

WORD-WISE

Common terms used in assessing the sustainable management of fisheries stocks include the following:

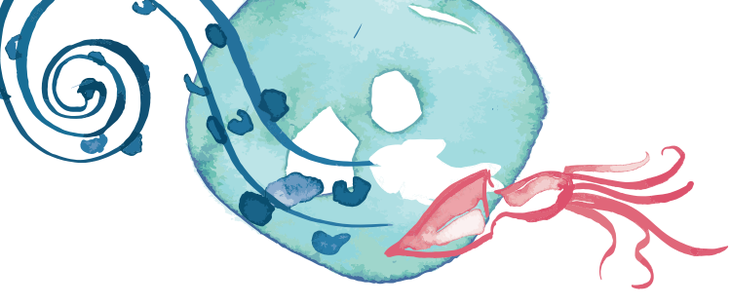
Maximum Sustainable Yield (MSY): The maximum average annual catch that can be removed from a fisheries stock on an ongoing basis under constant environmental conditions. MSY defined in this way assumes that fish stocks reach equilibrium and makes no allowance for productivity changes and environmental variability.

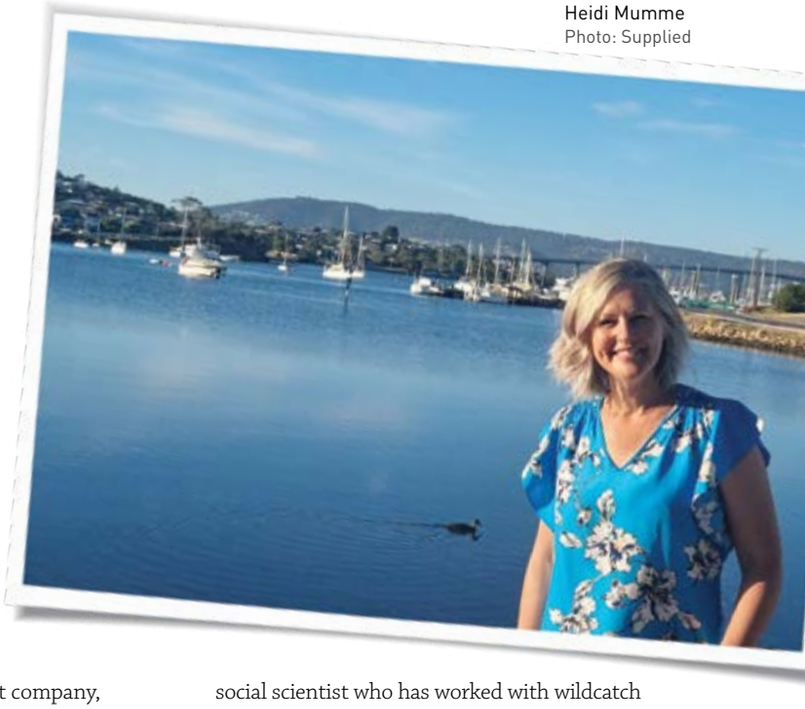
Maximum Economic Yield (MEY): The level at which consistent extraction of a fisheries stock maximises the economic returns from a fishery. This is often lower than the maximum sustainable yield.

Biomass Maximum Sustainable Yield (BMSY): Average biomass corresponding to maximum sustainable yield. A target reference point estimated using a stock assessment model.

Fishing Mortality Maximum Sustainable Yield (FMSY): The fishing mortality rate that, at equilibrium, is expected to produce the maximum sustainable yield.

Unfished biomass: Biomass that existed, or that would exist, for a stock that has not yet been fished, or if it had not been fished (also called the 'unfished' or 'unexploited' biomass or unfished level). This may refer to an estimated historical biomass level before fishing began, or the current biomass that would have existed had no fishing occurred. F





Heidi Mumme
Photo: Supplied

Expanding roles, new leaders for women in seafood

To mark International Women's Day 2022 on Tuesday 8 March, *FISH* magazine highlights some of the organisations and women helping to shape the future of Australia's fishing and seafood sector

Women in Australia's seafood sector will have new opportunities in the year ahead to develop their skills and strengthen their voice through Women in Seafood Australasia (WISA).

For more than 20 years, volunteers have worked hard to make WISA the national voice for women in the Australian seafood sector. In November 2021, WISA started on the path to being a company limited by guarantee after its new constitution was passed at its annual general meeting.

Kirstin Abernethy Photo: Supplied

As a registered not-for-profit company, WISA will be better able to respond to members and their needs, be a stronger voice for women and be able to run a charity arm of the organisation.

New leadership at WISA

WISA has also had a change in leadership. After three years of steering WISA through instrumental changes and the renewal process, president Karen Holder has passed the role to Heidi Mumme, who was vice president.

Mumme has been a member of the WISA board since 2017 as a director for both the Northern Territory and Tasmania.

"Karen's passion, commitment and dedication to WISA and the industry has seen the organisation go from strength to strength, leaving us with an amazing legacy to build upon," says Mumme.

"I've been involved in fisheries and aquaculture for over 20 years and I'm passionate about women in the seafood industry having a voice and empowering them to reach their full potential.

"WISA is in a fantastic position to enhance the skills of seafood women and develop effective partnerships with stakeholders to raise the profile of women in the seafood industry. As WISA moves to its new structure, we are looking to expand our membership and create opportunities for new board members to help guide WISA through its next phase," she says.

WISA has also recruited its inaugural executive officer, Kirsten Abernethy. She is a social scientist who has worked with wildcatch fisheries and fishing communities for more than 10 years as a researcher, teacher and advocate.

"I've worked internationally and in Australia with my own consultancy business, while at the same time working in my family's fishing business," Abernethy says.

"I'm passionate about industry stories and seafood communities. I've focused my work on health and wellbeing, particularly mental health, and building community knowledge, trust and support for the industry. But first and foremost, I'm an optimistic advocate for women in the Australian seafood industry.

"One of my first tasks is to finalise an exciting webinar series focusing on leadership and women in the seafood industry, so keep an eye out for that," says Abernethy.

WISA has several other exciting events and learning opportunities in the pipeline for 2022, including its popular Power Up Breakfast at Seafood Directions, which will be held in Brisbane from 13–15 September 2022.

To find out more about WISA, to become a member or attend a WISA event, please visit the WISA website www.womeninseafood.org.au, connect on social media, or email eo@womeninseafood.org.au or president@womeninseafood.org.au.

MORE INFORMATION
Kirstin Abernethy eo@womeninseafood.org.au;
Heidi Mumme president@womeninseafood.org.au,
www.womeninseafood.org.au.

Suzie McEnallay
Photo: Supplied

Suzie McEnallay
Honouring family tradition

By **Gio Braidotti**

Established in 1947, the Wallis Lake Fishermen's Co-operative in Tuncurry, New South Wales, is today headed by general manager Suzie McEnallay. The co-op is the voice of the local commercial fishers and forms the central receiving depot for daily catches of fresh fish, lobster, crabs, prawns and a variety of shellfish.

McEnallay says that a career in the seafood sector came naturally to her as fishing and the seafood sector are in her blood.

She grew up as a fourth-generation member of a fishing family. Her grandfather was one of the first shareholders when the co-op formed and her father, brother and husband are all fishers and co-op shareholders. In fact, many of the local fishers are the children, grandchildren and great-grandchildren of co-op founders.

"I grew up in the co-op and have a passion for the industry due to my family's involvement," she says. "This isn't a job but something that is part of my heritage and my family's future."

Her role sees her take care of all aspects of the facility, including liaising with staff, fishers, suppliers and markets. It's an operation that sells seafood locally and also distributes to markets in Sydney, where the brand is well known to buyers on the auction floor. The Wallis Lake operation runs seven days a week.

McEnallay worked her way up to the role of general manager, starting out as a shop assistant and learning the ropes as she progressed to shop manager, wholesale manager and then operations manager.

Included in the co-op's operations are two trawling boats, three lobster fishing vessels, eight ocean trap and line boats, and about 35 estuary fishers.

"I have been lucky over the years to receive many opportunities for development, including participating in the National Seafood Industry Leadership Program," she says. McEnallay has also travelled to the US to visit fishing ports and attend a seafood summit in Virginia.

She says she values these practical learning experiences as they allow her to better navigate a course forward, especially given the many changes she has seen take place within the sector over recent years.

"The biggest challenge was the NSW commercial fisheries reform in 2017 that saw many fishers leave the industry and it changed the way fishers fished," she says. "That's made us very proactive in ensuring the co-op's success into the future and we have plans for growth and redevelopment."

Her vision is strongly focused on helping fishers stay in the sector and making their job easier with better facilities and more efficient weigh-in processes. It is a duty of care that comes from the heart.

> "This isn't a job but something that is part of my heritage and my family's future."

MORE INFORMATION
Suzie McEnallay
admin@wallislakefish.com.au
Website https://wallislakefishco-op.com.au
Video www.youtube.com/watch?v=TwXo1tKWq_A

Tarun Richards
Photo by Jenni Collier

Tarun Richards
Values that matter

By **Gio Braidotti**

Between Darwin and Kakadu National Park in the Northern Territory lies a family-owned enterprise, Humpty Doo Barramundi, that achieves something truly special in the field of food security. It realises the dream of producing high-quality protein for a growing population without harm to the environment.

Humpty Doo Barramundi is an aquaculture facility that farms saltwater Barramundi (*Lates calcarifer*) alongside the Adelaide River using advanced, award-winning and highly sustainable farming practices and, by necessity, a very sturdy crocodile-exclusion fence.

The facility is Australia's largest Barramundi producer, with an annual output of more than 3500 tonnes of premium Barramundi, nearly half of the national production.

Humpty Doo Barramundi's Brand Manager and Head of Business Services is business graduate Tarun Richards. She ensures the logistically complex facility has the supporting resources it needs to operate optimally, while developing a brand that captures the family farm's core values.

"At Humpty Doo Barramundi, there is an authentic desire to produce healthy food while being gentle on the environment," she says. "To achieve that, we use a pond system that mimics a natural saltwater wetland,

"At Humpty Doo Barramundi, there is an authentic desire to produce healthy food while being gentle on the environment."

which includes using wetland grasses to clean the water for recirculation through the farm."

The benefits of the enterprise, however, run deeper into the social sphere, something that matters greatly to the Richards family.

"We are a remote regional enterprise and the opportunities we provide for employment, upskilling, innovation and community development are often overlooked," Richards explains. "These are values that I am passionate about and that I'd like to see acknowledged more broadly, including by regulators."

Women, she adds, are increasingly joining the business's team of 150 people. They are expanding from more traditional roles in the nursery and office to technically demanding roles in the hatchery and more physically challenging fieldwork.

She strongly encourages women who are interested in the sector to have a go.

"There are so many on-farm job opportunities at the moment and it's a great time for women," she says. There is a growing awareness of the need for flexibility and for zero tolerance regarding harassment. That is certainly the case at Humpty Doo Barramundi."

Richards says innovation will play an important part in the future sustainability of aquaculture, and she is knows the seafood sector needs to bring the public along on this journey.

"The quality and sustainability of Australian seafood and the social goods the sector provides – they are achievements worth celebrating and a story that I am keen to tell."

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Humpty Doo Barramundi
www.humptydoobarramundi.com.au
Corporate community action
www.humptydoobarramundi.com.au/our-community
Video www.youtube.com/watch?v=EvlSJRVEUpg

Veronica Papacosta
A promise to better the seafood sector

By **Jessica McInerney**

Seafood Industry Australia (SIA) CEO Veronica Papacosta has stepped forward in a traditionally male-led sector to help develop a sustainable national seafood sector peak body.

"For me, my role is less about fish and more about people," she says. "Seafood means family, connection and community. I was born and raised in a fish shop, my mother was born and raised in a fish shop, and my grandfather, Costas Costi, opened his first fish shop in Sydney in the 1950s.

She and her brother Paul have now taken over the reins of the family business and have a number of retail stores along the east coast of Australia, with a few more in the pipeline.

"When my brother and I decided to take over the family business, my grandmother cried for a week. She'd always hoped I would be the one to 'get out'. When she finally came round, she made me promise I would 'do it better'."

Today, that promise to "do better" is what motivates Papacosta and has led her to become one of the driving forces behind the establishment of SIA.

In 2015, concerned by the closure of fishing grounds, she quickly discovered there was no peak body for the sector to lobby against the closures and build community support for commercial fishing.

From here, Papacosta undertook the National Seafood Industry Leadership course. And when government funding was provided to investigate the support for a representative national sector peak body, Papacosta joined the push that led to the formal launch of SIA on 9 June 2017. She was appointed inaugural chair.

In August 2020, Papacosta was formally appointed as CEO.

Veronica Papacosta Photo: Supplied

"I've been fortunate to watch the industry grow, evolve and 'do better' right before my eyes," she says. "I've seen the hard times, the impacts of COVID, trade volatility, droughts and reforms that have seen people leave the industry. But I've also seen the industry advance and do better in many areas like mental health, sustainability, aquaculture, traceability, provenance and labelling.

"For me, this role is all about helping industry to 'do better'. While we might operate as separate sectors, fisheries or states, what's important is that we come together and work together. A rising tide lifts all boats."

Papacosta's advice for women in the sector looking to advance in leadership is to actively seek opportunities. "You need to have confidence in your skills and put yourself forward," she says. "One of the most important things you can do is look for opportunities, not wait for them to come knocking.

"Women need to put themselves into situations where they get noticed. Attend networking events, conferences and meetings and make sure you speak to people while you're there."

MORE INFORMATION
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"Seafood means family, connection and community. I was born and raised in a fish shop, my mother was born and raised in a fish shop, and my grandfather, Costas Costi, opened his first fish shop in Sydney in the 1950s."

Jane Gallichan
Duty of care drives innovation

By **Gio Braidotti**

Jane Gallichan Photo: Supplied

Jane Gallichan lives in Tasmania and she is acutely aware that her state's prosperity relies heavily on natural resources, especially the oceans.

She has proven adept at pioneering ways for the aquaculture sector to reframe its identity around acknowledging and deepening a sense of stewardship of public resources, and now she is bringing that focus to recreational fishing.

For eight years she worked as Huon Aquaculture's corporate affairs manager, where a key role was to ensure that the Tasmanian community knew about and could help shape what the company was planning.

She created trusted relationships and harnessed new technology, including the launch of a sustainability dashboard that allowed Huon Aquaculture to report on the company's performance to the public in real time. Gallichan worked closely with stakeholders throughout Tasmania on this, about the kind of information they were interested in seeing and why that information was important to them.

This approach to providing real-time relevant information has since been adopted by aquaculture companies around the world. For Gallichan, this work brought home the importance of communities developing a voice about the issues that matter to them. That insight saw her join the Tasmanian Association of Recreational Fishing (TARFish) in 2020 as CEO to empower the voices of recreational fishers.

"I believe that good decisions to support sustainable resource use come from all parties having a voice and representation that is informed by science and works to find win–win solutions wherever possible. Even if that means changing the way things are done."

Her approach is built on an understanding that a duty of care implicitly drives innovation and continual improvement. But it also requires communication between parties and relationship building.

Gallicahan has developed her career around these values, combining passion, purpose and skills. But she says women still face residual biases in the sector and she sees a role for seafood's senior leadership to champion and encourage talented women.

"There is nothing lost in listening to other people, their concerns and ideas, including the experiences of women," she says. "Being open as an organisation means that your own perspective will continue to improve. The flip side of that is that you have to be prepared to change."

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Huon Aquaculture's sustainability dashboard https://dashboard.huonaqua.com.au
Tasmanian Association of Recreational Fishing (TARFish) www.tarfish.org

Cassie Price The habitat restorer

Cassie Price Photo by Bob and Carol Burns

By **Gio Braidotti**

Born into a recreational fishing family in South Australia, Cassie Price developed a strong affinity for the wonders of natural aquatic environments when she was very young. The desire to better understand these intriguing ecologies saw her study environmental science and then pursue a career in habitat management.

Now based near Richmond River in northern New South Wales, Price serves as director of habitat programs at the not-for-profit organisation OzFish Unlimited, where she coordinates aquatic habitat restoration projects across Australia.

"Our aim at OzFish is to provide technical expertise that enables fishers to take action for the health of aquatic systems – rivers, lakes, estuaries and reefs," she says. "By working together, we help shore up the future of these beautiful habitats."

Price oversees more than 70 projects in partnership with thousands of volunteer fishers and local communities across Australia.

These projects range from local efforts to clean up waterways through to complex multi-state initiatives. Examples of such projects are the Fish Emergency Recovery projects that deploy recreational fishers to help fish populations recover from the impact of bushfires, droughts and floods.

Price's role is multifaceted and requires extensive multitasking, broad-ranging scientific expertise and exceptional communication skills. Additionally, she makes time to cultivate a rich family life, which includes introducing her young children to a fishing line and the local marine habitats.

Despite the challenges, she says getting the balance right between her professional and private life allows her to thrive.

"It's important that women understand they don't have to pursue careers in a traditional way," she says. "It's okay to 'operate like a woman'. That may mean a different approach to your work, or taking time out of work to start a family and creating a unique work life that suits you. That is possible, especially so if you are mindful about building networks of support in your life," says Price.

Ultimately, her career and family life help to supercharge an innate drive to build a better future. This drive will see her stay on at OzFish, helping the organisation that first launched actionable projects in 2017 to grow and develop.

"Despite the many challenges associated with ensuring continuity of resources for OzFish projects, I want to see OzFish continue to build our movement of active recreational fishers and tap the growing national sentiments towards more sustainable management of our natural habitats," she says. F

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R&D PLAN OUTCOME 2
Best practices and production systems

Changing perceptions drive fish welfare practices

Changing community perceptions has prompted a review of aquatic animal welfare laws across Australia; the aquaculture and fishing sectors are confident their practices will measure up

By **Catherine Norwood**

Animal welfare is an issue of rising importance to Australia's fishing and aquaculture sectors, and good aquatic animal welfare practices are reflected in best-practice handling procedures and improved food quality.

The fishing and aquaculture sectors have identified animal welfare as essential to their stewardship of the resource, reflected in the commercial sector's pledge to the community (by Seafood Industry Australia), and the *National Recreational Fishing Code of Practice*.

Two FRDC-funded research projects are analysing the current state of play, in law and in practice, to identify any steps needed to address community expectations and improve aquatic animal welfare.

The 2005 Australian Animal Welfare Strategy provided the initial impetus for a flurry of work by both governments and relevant sectors to assess and improve animal welfare practices, including aquatics.

In 2006, the Aquatic Animal Welfare Working Group was one of six groups formed to respond to the national strategy. It represented the ornamental, commercial and recreational fishing and aquaculture sectors, as well as animal welfare NGOs.

The FRDC has also responded to this issue with a suite of research to assess the welfare impact of existing fishing and handling practices and the use of these practices to develop specific animal welfare guidelines for fishers and seafood producers. This includes an initial audit of animal welfare legislation in 2006, which was repeated in 2021 to assess any changes and the implications for the sectors.

The latest audit includes animal welfare provisions for commercial wildcatch fishing and aquaculture, the ornamental fish trade and recreational fishing. It considers aquatic animals in the broader context of the seafood supply chain, and in educational and research settings.

The Australian Animal Welfare Strategy was an initiative of the Australian Government that covered animal welfare in the context of trade and international agreements, working with exporters to maintain international export standards.

However, animal welfare standards and laws to prevent animal cruelty are the responsibility of individual states and territories.

Aquatic animals are those that live fully or partially in fresh or saltwater habitats. They include fresh and saltwater fish and sharks. There is general acceptance by both the commercial and recreational sectors that procedures for careful and controlled capture, holding and processing should be welfare-oriented. Generic guidelines developed for the commercial wildcatch sector through the Australian Animal Welfare Strategy note that the overall aim is to minimise suffering within the constraint of practices inherent to a sector.

Diverse definitions

However, the principal investigator for the 2021 audit, Paul Hardy-Smith from Panaquatic, says variations in state legislation reflect diverse views about the issue of animal welfare and whether or not it applies to fish and other aquatic animals.

The aim of the audit is to provide advice to fisheries stakeholders about new scientific knowledge and changes in legislation, to allow them to assess current practices and identify potential risks for their sectors.

The 2021 audit updates the 2006 audit and includes a review of international scientific literature on the subject.

The aim of the audit was to provide advice to fisheries stakeholders about new scientific knowledge and changes in legislation, to allow them to assess current practices and identify potential risks for their sectors.

Hardy-Smith says the first indication of the changes over the past decade is in the scope of the two audits. The 2006 audit, completed as part of the Australian Animal Welfare Strategy, focused only on finfish. The FRDC's 2021 audit includes crustaceans (for example, lobsters, crabs and prawns) and cephalopods (such as octopus and squid).

Hardy-Smith notes that even the definition of an 'animal' in legislation varies widely across jurisdictions. "South Australian and Western Australian animal welfare legislation specifically exclude fish under their definition of an animal," he says. "But in the Northern Territory, fish, crustaceans and cephalopods are all included as animals under new legislation. In New South Wales, there is welfare legislation related to how fish and crustaceans are treated within the context of a building – in live tanks at a restaurant, for instance. But there are no provisions relating to their welfare in other places, including at sea."

Responding to change

Hardy-Smith says the 2021 audit will help the sectors get ahead of potential changes and help fishers and seafood producers understand what the changes may be and what they may need to do differently.

"It is good to be able to talk openly with our fishing and aquaculture sectors about it so that we can identify and address any issues and where we may have gaps. We don't want to be caught by sudden changes in community attitudes, as has happened in some of the terrestrial animal industries with respect to welfare."

He says possible fishing and aquaculture responses may include codes of conduct for different sectors outlining best practices to specifically address animal welfare. The development of these codes is underway in the NT, in conjunction with the *Animal Protection Act 2018*.

The 2021 legislative audit and scientific literature review is complete, and findings will be presented to stakeholders at a series of workshops where current practices and gaps can also be discussed. Arrangements for three planned workshops are being adapted to cater for the evolving COVID-19 conditions. Planned in-person events may instead be held via video conferencing. Contact Paul Hardy-Smith if you are interested in attending (email paul@panaquatic.com).

Best practice uptake

The 2021 audit has been the impetus for a related research project into the factors that may help or hinder the adoption of aquatic animal welfare best practices in Australia's commercial wildcatch and finfish aquaculture sectors.

Nicki Mazur from ENVision Environmental Consulting has been working on a project to assess how the commercial wildcatch and aquaculture sectors have responded to the issue of animal welfare over the past 15 years.

During that time, work by the Department of Agriculture, Water and the Environment and the FRDC has:

- refined the definition of 'aquatic animals';
- identified key challenges for improving aquatic animal welfare;
- established overarching principles for aquatic animal welfare;
- benchmarked harvest methods for reducing stress in fish;
- identified welfare practices for killing fish;
- developed fish welfare guidelines for seven commercial fish capture methods; and
- road-tested these fish welfare guidelines in the commercial and recreational sectors.

More recently, Seafood Industry Australia has formally pledged ('Our Pledge') to actively care for the marine environment and aquatic animals. And, while the Aquatic Animal Welfare Working Group is no longer funded by the Federal Government, members have continued to meet to progress issues on a voluntary basis. Chair Brett McCallum has called for more coordinated and informed approaches to help the seafood sectors better appreciate the importance of adopting best practices and the need to credibly demonstrate that their practices are both based in science and socially acceptable.

Between December 2019 and September 2021, Mazur's team conducted a desktop review of sector practices and guidelines, 23 stakeholder consultations and 16 in-depth interviews. These provided only a sample of industry responses, says Mazur, rather than a comprehensive, sector-wide assessment of practice uptake.

The researchers examined practices for rock lobsters, mud crabs, target shark and shark bycatch fisheries, trawl, seine and hook and line fishing, as well as two aquaculture operations.

> "It is good to be able to talk openly with our fishing and aquaculture sectors about it so that we can identify and address any issues and where we may have gaps. We don't want to be caught by sudden changes in community attitudes, as has happened in some of the terrestrial animal industries with respect to welfare."
>
> Paul Hardy-Smith

TABLE 1: ANIMAL WELFARE BEST PRACTICE IN SELECTED AUSTRALIAN FISHERIES

SECTOR DIVISION	BEST PRACTICE
Rock lobster (Southern, Eastern zones)	Careful handling to avoid stress, and broken limbs; holding procedures that avoid crowding and use optimal water quality
Mud crab (NT Fishery, some Blue Swimmer Crab NSW)	Tying claws to prevent cannibalism, fighting and damage
Target shark fishery and shark bycatch (NT Offshore Net and Line, Pilbara Ocean Trawl)	Quick removal of target and non-target catch from net, humane slaughter of target catch
Trawl (Northern, Southern, Western Prawn)	Bycatch reduction, maximising survivability of non-target catch
Seine (Purse, Beach, Danish) (NSW General Estuary, others)	Ice slurry for slaughter*, careful and minimal handling of catch generally
Hook and line (NSW Trap and Line)	Iki jime/spiking or percussion stunning for slaughter

*Although ice slurries are considered best-practice slaughter in seine fishing, there is considerable international debate about this.

Source: ENVision Environmental Consulting

Overcoming barriers

In line with other research, Mazur's team found that more appropriately designed and consistently funded extension programs could help improve the uptake and adoption of animal welfare practices. However, a range of other factors influence the extent to which seafood producers will implement recommended welfare practices. For individual producers, other mechanisms, such as market premiums and regulations, may also be needed.

From a sector-wide perspective, Mazur says it will be important that poor practices are called out and addressed. Regardless of an individual's personal philosophical views on aquatic animals and their welfare, when they do not meet broader community expectations, the behaviour of a few could jeopardise the continued operations of whole parts within the seafood sector.

Mazur highlights the importance of understanding how the existing recommended practices fit in with the day-to-day work for fishers, seafood producers and the welfare of aquatic animals. Then, if needed, and in close consultation with those stakeholders, existing practices can be adjusted or new ones developed. Previous research has already established wide-ranging guidelines for many parts of the sector. Based on those sectors sampled for the project, best practices mentioned by seafood producers are outlined in Table 1.

Encouraging action

Mazur recommends that those already undertaking best practices should be recognised and encouraged to act as champions for change within their industries, either formally or informally. Training and skill-building programs, along with peer support programs, can help build momentum within a sector towards improved practices.

Ensuring that there are advantages for seafood producers undertaking improved practices will also help encourage the sector. Practices should be easy, inexpensive, easily trialled and result in measurable benefits, for example, earning a price premium for improved quality.

Safety was raised by interviewees as an issue in relation to shark catch and bycatch, where the quick release or dispatch of large animals can be difficult. This also points to other factors that affect fishers' ability to undertake recommended practices, including vessel design, financial resources and the crew needed.

Mazur recommends proactively addressing animal welfare-related issues by tapping into existing sector engagement strategies and networks to build trust within the sector and with influential decision-makers and interest groups. This may include assessing the risk of negative public sentiment by incorporating animal welfare into existing public surveys conducted by and for the seafood sector, and efforts to increase buyers' awareness of the link between product quality and best-practice animal welfare.

"There is also the question of shared responsibility," Mazur says. "Society is calling for the seafood industry to clearly demonstrate its duty of care to aquatic animals using (more) welfare-focused methods. Where that duty of care requires step changes in fishing practices, considerable costs may be imposed on some fishers. This may be a barrier for some businesses, particularly those operating on slim profit margins. The fisheries policy community could investigate ways to ensure the procedural fairness of current and future decision-making when wider societal expectations impose large financial costs on the industry."

Mazur's report, *Practicing Aquatic Animal Welfare: Identifying and Mitigating Obstacles to Uptake and Adoption by the Australian Seafood Industry* will be available from the FRDC's website, www.frdc.com.au. F

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FRDC RESEARCH CODES
2012-507, 2013-049, 2017-221, 2019-023, 2020-040

R&D PLAN OUTCOME 1
Growth for enduring prosperity

Securing a $100 billion blue economy by 2025

The Midway Point report on the 10-year National Marine Science Plan measures progress and defines the next steps required to achieve our blue economy potential

By **Kate Harvey**

It is easy to forget that the Earth is a blue, water-dominated planet; continents and islands make up only 29 per cent of the Earth's surface and water covers the rest.

As an island continent, Australia has a vast marine estate (see breakout box) with enormous economic and environmental wealth. Projections suggest that Australia's marine estate could support a prosperous and healthy blue economy worth $100 billion each year by 2025 if we focus investment on the biggest development and sustainability challenges facing our oceans.

In 2015, the National Marine Science Committee (NMSC) mapped out the way to help Australia realise this potential in the *National Marine Science Plan 2015–2025*. The NMSC is an advisory body that promotes the essential role of high-quality marine science in developing Australia's blue economy. It has 39 member organisations, including the FRDC, that conduct and use marine research across Australia.

The plan was a call to action outlining the marine science needed to provide the knowledge, technology and innovation to address seven critical challenges that Australia needs to overcome if we are to achieve the potential of our blue economy. Those challenges are:

- maintaining maritime sovereignty, safety and security;
- achieving energy security;
- ensuring food security;
- understanding and adapting to climate variability and change;
- conserving our biodiversity and ecosystem health;
- creating sustainable urban costal development; and
- developing equitable and balanced resource allocation.

The midway point

So, six years on, how are we tracking against the plan?

Late last year, the NMSC released the *National Marine Science Plan 2015–2025: The Midway Point*, which assesses how far we have come and what is still required to achieve the long-term health and wealth of Australia's marine environment, economy and people.

The report is a detailed look at the marine science sector's progress in achieving the plan's eight recommendations and it builds on the original plan by identifying three new recommendations (see Table 1 right). Of the original recommendations, two are at an early stage, four are underway and two are at maturity.

Some of the achievements include:

- the establishment of the Blue Economy Cooperative Research Centre (CRC) and the Marine Bioproducts CRC (see story page 18);
- increased research vessel capacity with the replacement of *RSV Aurora Australis* with a new national icebreaker *RSV Nuyina*, the operation of *RV Investigator* for a full 300 days a year and the operation of coastal research vessels such as *RV Cape Ferguson* and *RV Solander*; and
- secure funding for the Integrated Marine Observing System (IMOS) to 2023 and extension of its focus into marine ecological monitoring.

The Midway Point covers the progress and highlights the next steps required to achieve our blue economy potential. And this strong focus on marine science is perfectly timed. There is increased international attention on collaboration with the commencement in 2021 of the UN Decade of Ocean Science for Sustainable Development and the Australian Government's commitments through the High Level Panel for a Sustainable Ocean Economy. F

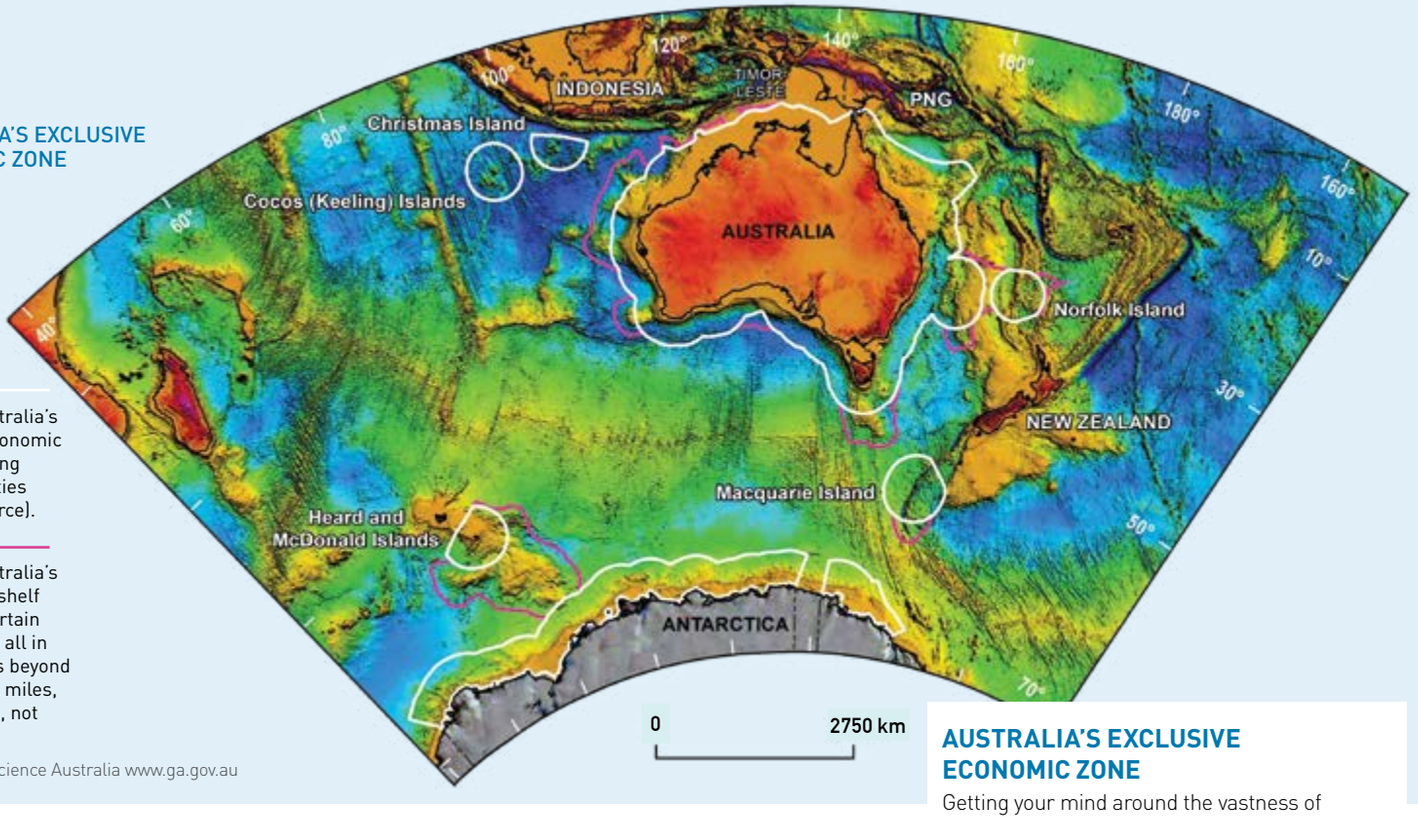


FIGURE 1: AUSTRALIA'S EXCLUSIVE ECONOMIC ZONE

Limit of Australia's exclusive economic zone including certain treaties (not all in force).

Limit of Australia's continental shelf including certain treaties (not all in force). Areas beyond 200 nautical miles, not resolved, not shown.

Source: Geoscience Australia www.ga.gov.au

AUSTRALIA'S EXCLUSIVE ECONOMIC ZONE

Getting your mind around the vastness of Australia's ocean resource is not an easy task.

Thanks to our 35,821 kilometres of coastline, we have the world's third-largest Exclusive Economic Zone (EEZ) (Figure 1). This is the area of Australian sovereign rights to the natural resources (living and non-living) of the water column, seabed and subsoil. Australia has a confirmed outer limit to its continental shelf extending beyond 200 nautical miles (370 kilometres) from the territorial sea baseline.

With a total marine area of about 10 million square kilometres, our EEZ is considerably larger than the 7.69 million square kilometres of land that makes up Australia's states and territories. More than 70 per cent of Australia's territory lies beneath the ocean.

Australia's oceans and seas include those off the mainland and our offshore territories in the Pacific, Southern and Indian oceans as well as the Timor, Tasman and Coral seas. Our EEZ area is made up of 8.2 million square kilometres off the coast of Australia and our remote offshore territories, and 2 million square kilometres off the Australian Antarctic Territory. **F**

TABLE 1: NATIONAL MARINE SCIENCE COUNCIL RECOMMENDATIONS AND PROGRESS

	RECOMMENDATION	PROGRESS
1	Create an explicit focus on the blue economy throughout the marine science system.	Underway
2	Establish and support a national marine baseline and long-term monitoring program to develop a comprehensive assessment of our estate and help inform management of Commonwealth and state marine parks.	Underway
3	Facilitate coordinated national studies on marine system processes and resilience to enable understanding of the impacts of development and climate change on our marine estate.	Underway
4	Create a national oceanographic modelling system to provide the accurate, detailed data and predictions of ocean state that are required by defence, industry and government.	Early stage
5	Develop a dedicated and coordinated science program to support decision-making by policymakers and industry.	Early stage
6	Sustain and expand IMOS to support critical climate change and coastal systems research that includes coverage of key estuarine systems.	Mature
7	Develop marine science research training that is more quantitative, cross-disciplinary and congruent with the needs of industry and government.	Underway
8	Fund national research vessels for full use.	Mature
9	Develop a nationally coordinated approach to integrate the knowledge, rights, capability and aspirations of traditional owners into conventional marine science.	New recommendations published in *The Midway Point*
10	Establish national policy guidelines for open access to government-funded or regulatory data, provide historical dataset access, and expand the Australian Ocean Data Network (AODN).	
11	Develop a coastal resilience-building approach firmly based in the proactive use of our natural environment.	

MORE INFORMATION
National Marine Science Committee,
www.marinescience.net.au

Marine Bioproducts CRC to kickstart new industries

Below Seaweed is one of several products that will be the focus of the MBCRC. Photo: Lou O'Brien, USC Seaweed Research Group

Technological advances are helping with the discovery and development of many novel ingredients that our marine ecosystems offer beyond seafood, to create new industries, employment and economic opportunities

By **Catherine Norwood**

Over the next 10 years, the Marine Bioproducts Cooperative Research Centre (MBCRC) plans to establish products and processes that will underpin whole new industries for Australia's marine estate.

Farming ocean plants and animals will provide the basis for the initial ingredients. However, it is the potential of the unique biochemistry of Australian marine life, combined with advanced manufacturing technologies, that will drive the next generation of marine-based products.

The global marine biotechnology industry is rapidly expanding, with an estimated value of more than $176 billion by 2035. High-value products already include omega-3 oils, cosmetics, plant-based proteins, agrochemicals, bioplastics and nutraceuticals (products derived from food sources that provide nutrition and medicinal benefits).

Partners in research

In June 2021, the Australian Government announced funding of $59 million over 10 years, officially launching the MBCRC. When this funding is combined with contributions from industry partners, the MBCRC is a $270 million initiative. It has about 70 partners who represent a broad cross-section of industry, including some of Australia's major agribusinesses, small and medium enterprises and two global chemical industry giants, along with some of the country's leading scientists and researchers.

The FRDC is among the latest organisations to sign on as a partner, bringing three seaweed-related research projects it has underway into the MBCRC program. Two projects are investigating the use of seaweeds in water treatment processes, with the third project investigating year-round seaweed propagation.

The move will consolidate and coordinate Australian seaweed-related research under the auspices of the MBCRC to make the best use of available resources and share knowledge. But FRDC Managing Director Patrick Hone is quick to point out the possibilities beyond algae and food. "It's phenomenal what the products we already know about can do, and exciting to think how much more there is to discover," he says.

Marine biochemicals, such as algae-based cellulose, can replace petrochemicals as the base ingredient in many products, particularly plastics, he says. There are uses in electronic systems, where biocells are being developed, and in renewable energy, where marine products could provide an alternative option to the balsa wood used for the blades on wind turbines.

Research directions

Although seaweed is garnering substantial international attention, the MBCRC's scope includes investigating bioactive ingredients from other marine plants including microalgae, as well as marine microbes and animals such as oysters.

The MBCRC has three research programs:

- **Program 1**: Sustainable marine resources, achieved through developing cultivation skills, technologies and management practices to grow high-quality marine bioproducts sustainably and cost-effectively;
- **Program 2**: Innovative bioprocessing technologies designed specifically for the Australian marine bioproducts industry and critical for its growth; and
- **Program 3**: Australian marine bioproducts – selection, development, validation and delivery of a range of certified, evidence-based, high-value Australian marine bioproducts into global markets.

Based at the University of Tasmania, Catriona MacLeod is leading Program 1, which will include the initial projects from the FRDC. The program aims to develop:

- a decision-support framework to optimise success by aligning product, location and production models;

Right Qponics will work with the MBCRC to refine microalgae production, processing and products. Photo: Qponics

- a breeding and hatchery program that will provide partners with access to species strains that are best suited to their physical and economic environment; and
- reliable, efficient and commercially viable production, harvesting and stabilisation systems built around validated cost-effective, state-of-the-art technologies and the necessary operational skills.

MacLeod says she particularly likes the way the MBCRC's three programs are integrated, rather than competing with each other. Colin Barrow from Deakin University is leading Program 2 and Rob Capon at the University of Queensland is leading Program 3.

"Many of the participants have a vested interest in all three programs. If you are producing a biomass, you're either producing it for a product, which requires processing, or you want to know what the product is. So, the programs are absolutely linked," she says.

MacLeod says the greatest proportion of partners are interested in seaweed and macroalgae, but there are fish and oyster producers looking to add value to their existing production strategies or products. Several companies are also looking at end-product diversification.

Industry needs

Among those companies looking to diversify is PhycoHealth, led by director and chief scientist Pia Winberg. The business grows a type of green seaweed for food and nutraceutical products. During her product development research, Winberg identified that the species she grows has potential in wound dressings with active biochemistry that promotes healing.

She says the MBCRC provides a great opportunity to start extending that research and development to the next stage, to bring in additional partners and expand the scope of the work. Surgical-grade products, such as a wound dressing, require a long trajectory of research and development before becoming commercially viable. This is one of the projects the MBCRC will bring on board.

Winberg sees the MBCRC as an important opportunity to bring together researchers from different fields, with different skill sets, to work across the entire value chain.

Another partner is the Tasmanian business Marinova, which extracts fucoidan, a bioactive ingredient in brown seaweeds, for dietary supplements, cosmetics and human health products. Operations Manager Damien Stringer says the business is aligned with the MBCRC's Program 3, looking at bioproduct development and advancing the market of Australian marine biproducts.

"The MBCRC will provide a step change in the level of investment investigating the activity of these extracts, which differ from species to species. It will confirm their biological potential and uses, with evidence to substantiate health claims," Stringer explains. Although Marinova works with two non-native species, Stringer says the company is interested in ingredients that may be derived from native species.

Stringer highlights the networks between industry partners and researchers as an important part of what the MBCRC will offer. "There is a lot of entrepreneurial activity in the sector, but a lot of it is also quite disparate. The MBCRC is really bringing that together, with some great opportunities to create a critical mass of industry," he says.

Over the past five years, Qponics Limited in Queensland has developed a commercial farming system for marine microalgae, initially a species of *Nannochloropsis*. Managing Director Graeme Barnett says it is partnering with the MBCRC to refine microalgae cultivation, harvesting and processing

Above Damien Stringer from Marinova says the MBCRC will help to evaluate bioactive ingredients in marine products. Photo: Qponics

Above Microalgae in production in Queensland. Photo: Qponics

technologies to extract omega-3 oils and high-quality proteins from the microalgae for the human food market. This will help the company to capture a greater share of the value chain within Australia. Working with the MBCRC, which includes 11 leading Australian research organisations, Barnett also hopes to examine the potential of other microalgae held in their research collections. "That's a valuable opportunity that might otherwise never be available to a small business like Qponics or even a much larger one," he says.

Justin Coombs is the newly appointed CEO for the MBCRC and he says that sustainable economic development is very much the intended outcome of MBCRC. "We're looking to catalyse the development of a whole new industry. One of the challenges ahead is to find the people the industry will need to do that, and that is the focus of our overarching Connect, Educate and Train Program," he says.

There will be opportunities for people interested in translational roles, bridging science and industry. There will also be opportunities for jobs and businesses in regional areas, which Coombs expects will be major beneficiaries of a new industry focused on creating new processing techniques and the highest quality value-added products from diverse marine feedstocks. **F**

For more information on the MBCRC, or to become involved in its programs, visit https://mbcrc.com

MORE INFORMATION
https://mbcrc.com, email info@mbcrc.com

FRDC RESEARCH CODES
2019-032, 2020-070, 2021-082

Australia's blue diamond

Blue Carbon Lab members overlooking the Stony Creek Backwash, Port Phillip Bay, Victoria. Photo: Blue Carbon Lab, Deakin University

By **Melody Horrill** and **Catherine Norwood**

As the true value of estuaries and coastal wetlands is realised, Australia's fishing sectors are in a prime position to benefit from the burgeoning blue carbon economy

European settlers once considered mangrove forests and salt marshes nothing more than pungent repositories for diseases such as malaria. But as nature-based carbon sequestration is recognised as a way to offset greenhouse gas emissions generated by human activities, new mechanisms have calculated the potential of these ecosystems as carbon sinks. And the news is good, according to Peter Macreadie, director of Deakin University's Blue Carbon Lab.

What is blue carbon?

Blue carbon is a name used for carbon sequestered by marine vegetation. Mangroves, saltmarshes, macroalgae (such as kelps) and seagrasses are highly efficient at capturing carbon in the atmosphere and converting it,

R&D PLAN OUTCOME 1
Growth for enduring prosperity

Blue Carbon Lab members at work at the Stony Backwash site, Port Philip Bay. Photo: Blue Carbon Lab, Deakin University

via photosynthesis, into organic matter, which is then stored in sediment. These ecosystems also trap and store carbon from land run-off and from the tides. In this sense, they act as a carbon sink for particulate carbon that they did not produce. They provide long-term carbon sinks, sequestering carbon over thousands of years, and they sequester carbon in the ground at rates 10 times faster than most of their green carbon counterparts, such as trees.

The fishing and aquaculture sectors will be in the box seat as beneficiaries of blue carbon. Opportunities to earn carbon credits will drive investment in marine habitat protection and restoration, which will improve fisheries ecosystems and increase their productivity. For those in fishing and aquaculture sectors wanting to offset carbon emissions from their own activities, it will offer a way to invest that also improves the foundations of their own businesses.

Agreed accounting

Although there's increasing enthusiasm for blue carbon, historically, Australia has been unable to trade homegrown blue carbon offsets on the carbon market.

However, that has started to change. Following consultation with technical experts, scientists and the broader public, the Australian Government announced in early 2022 that it has established an agreed blue carbon accounting method under the Emissions Reduction Fund. This will allow Australian blue carbon credits to be awarded for the first time.

In conjunction with this decision, the Australian Government has called for four demonstration trial projects to be funded through its Blue Carbon Ecosystem Restoration Grants. These grants are a core component of the broader Blue Carbon Conservation, Restoration and Accounting Program and will help establish an Australian standard for blue carbon credits, in line with other standards created under the United Nations Framework Convention on Climate Change.

The creation of blue carbon trial sites will provide a real-world demonstration of the opportunities. It will also help the Government develop environmental economic accounting of blue carbon restoration projects and help measure the ecosystem service benefits more broadly.

For investors, it will identify which of Australia's various coastal ecosystems and processes offer the most effective, repeatable and secure long-term sequestration of carbon. Among the likely contenders are tidal saltmarshes, seagrasses and mangroves.

Macreadie says the agreed accounting method will form the basis for evaluating and comparing different trial sites and is "a big step forward" towards creating a blue carbon market in Australia. Projects that restore coastal wetlands by reintroducing tidal flows to drained ecosystems or modifying existing restrictions on tidal flows caused by sea walls or bunds could be eligible for credits.

"Or it might be restoring seagrasses," Macreadie explains. "We know seagrasses are important nursery grounds for fish and crustaceans, so there may be some other things to consider as add-ons to the current accounting

method." He says the demonstration projects are likely to evaluate the potential to upscale both the projects and the impacts, so that they can be rolled out right across the nation.

"Australia is uniquely positioned to make a decisive contribution to blue carbon solutions. Our scientists are world leaders in the field. We have vast coastal landscapes and seascapes amenable to blue carbon projects. We have growing stakeholder support for nature-based solutions for climate change mitigation and adaptation.

"Despite this, Australia hasn't yet issued a single blue carbon credit. Now is the opportunity to do so, and through high-profile demonstration projects we have to boost investor confidence and seed the market."

A business investment

Macreadie says that the fisheries sector is in a prime position to capitalise on benefits and opportunities. Blue carbon credits, like any other commodity, can be banked, traded or used to reduce a business's own carbon footprint. In 2016, Austral Fisheries in Western Australia became the world's first fisheries business to go carbon neutral, initially investing in tree plantations to generate the carbon credits that offset its operational emissions. At the time, CEO David Carter said he would have preferred a blue carbon option, but the method for measuring carbon in coastal or estuarine systems was not adequately developed.

"As a business committed to climate leadership, we have been eagerly awaiting an approved blue carbon method," Carter says. "It will both increase the overall supply of credits to the voluntary carbon market and allow us to invest in offsets to directly benefit the marine systems upon which our business relies. The caveat, of course, is that these credits need to be broadly price-competitive with other sources of offsets available."

The creation of an Australian Blue Carbon Standard is expected to guide the development of what Carter calls "gold standard carbon credits", which is a requirement for investment by companies such as Austral. Although the Australian standard could still take up to five years to develop, work on the trial sites is expected to begin this year.

Below Blue Carbon Lab members processing soil samples in the labs at Deakin University's Burwood campus. Photo: Blue Carbon Lab, Deakin University

An underwater shot from the Maldives (Laamu Atoll), where BCL Director Peter Macreadie is teaching local community members how to collect seagrass soil cores to monitor the soil carbon stocks around the resort. Photo: Six Senses Laamu resort.

Decarbonising

Fisheries Research and Development Corporation Managing Director Patrick Hone says the development of blue carbon credits will help the seafood sector decarbonise in a way that makes sense and aligns with its values. He points to the commercial sector's pledge ('Our Pledge') led by Seafood Industry Australia that has committed to doing the right thing by the Australian community.

This will mean doing things differently, he says, to address climate change, for example. "If we are going to get to zero nett carbon at any time in the future, we are going to have to come up with mechanisms to do that in Australia," Hone says. "Until viable alternative fuels are available for use in aquatic industries, such as ammonia or hydrogen, trade-offs will be needed for the emissions created by petroleum fuels. It makes sense for us, in terms of 'Our Pledge', to sequester carbon in the ocean and have the health of the ocean improve its carbon sequestration."

Restoring productivity

Hone says there has been a significant loss of seagrass beds along Australia's southern coastline. Recovering seagrasses would immediately create a massive carbon bank. "We would get blue carbon, and we would begin to get healthier habitats. If we rebuild kelp forests, it is good for fish populations, and we get our blue carbon.

"If we can reclaim the samphire across the NSW tidal estuaries and wetlands, it will provide amazing carbon sequestration and great breeding grounds for fish, prawns and other creatures. There are so many win–wins in blue carbon. You get environmental services, you get sequestration, doing the right thing to get to nett zero, we start to rebuild our fish populations, we recover from the impacts of existing climate change, such as the loss of kelp forests, which is happening right now. And it isn't just about the commercial sector; it's recreational fishers and Indigenous fishers, as well. We can all do the lifting," Hone says.

To do this at the scale needed to make an impact in terms of effective carbon sequestration will require an economic benefit to

FAST FACTS

- Mangroves cover 0.1 per cent of the earth's surface, yet are among the most effective carbon sinks in the world. Seagrasses, which account for 1 per cent of the sea floor area, store 11 per cent of organic carbon buried in the ocean.
- Research has found that carbon in sediments in coastal soils is often thousands of years old.
- Blue carbon can also be stored deep in the ocean by phytoplankton and algae.
- Countries around the world are evaluating the potential of blue carbon to find climate solutions. Blue carbon credits are likely to be a premium product.
- FRDC has been investing in blue carbon research since 2011.

drive investment. Blue carbon credits will create the incentive to help attract the billions of dollars needed to make it work.

State initiatives

Australia is home to more blue carbon than any other country and was one of the first countries to include blue carbon in its Greenhouse Gas Inventory. The global carbon market grew by 20 per cent last year and is expected to continue to soar.

State governments have already dipped their toes into the blue carbon pond. The Victorian Coastal Wetland Restoration Program is a multi-sector approach that brings together academia, government, traditional owners and the sector to undertake wetland restoration on private and public land.

In Queensland, the Government's $500 million Land Restoration Fund aims to expand on farming carbon in a way that also delivers environmental and economic benefits. The South Australian Government released its Blue Carbon Strategy in 2019, which outlines ways for state-based projects to progress. This may include blue bonds, payment for ecosystem services and public–private partnerships.

SA Environment Minister David Speirs agrees that blue carbon is a win–win–win when it comes to climate action.

"The SA Carbon Strategy aims to develop a range of blue carbon projects along South Australia's coastline, particularly those near metropolitan Adelaide. We are working with universities, not-for-profits and councils to advance initiatives that have practical benefits. The opportunities are endless with blue carbon. We believe we can get significant income streams through carbon credits that can then be directed back into environmental restoration projects."

International efforts

Australia is part of an international research effort involved in establishing blue carbon projects and credits. It is a member of the International Partnership for Blue Carbon, which supports knowledge exchange and collaborations between researchers, project managers and policymakers by establishing a blue carbon restoration and accounting community of practice.

The Australian Government operates the Blue Carbon Accelerator Fund, supporting blue carbon restoration and conservation projects in overseas countries. These projects will demonstrate and enable measurement of climate, biodiversity and livelihood benefits, enhancing the business case for private sector investment in coastal blue carbon ecosystems.

The Government also supports the Global Ocean Accounts Partnership to build ocean accounting capability internationally and deliver environmental economic accounting for projects under the Blue Carbon Accelerator Fund.

Macreadie believes that, once established, blue carbon credits will attract a premium. "A colleague of mine talks about them as the Tiffany diamond of the carbon world. You're investing in a system that will bury the carbon for thousands of years.

"The science clearly supports investment in blue carbon conservation and restoration as a pathway for mitigating climate change. But blue carbon projects are not being implemented on the ground, despite enthusiasm for them in carbon accounting systems," says Macreadie. Barriers lie in misunderstanding and confusion around governance, social dimensions, finance and law. More specifically: a lack of understanding and acceptability of blue carbon by stakeholders and users; uncertainty in legal rights to blue carbon, particularly with complex land tenures; immaturity in market-based mechanisms to finance blue carbon and a lack of decision support to guide or prioritise on-ground actions.

However, Macreadie remains confident about future developments. He says, "This is an exciting time for blue carbon in Australia. Operationalising blue carbon will not only achieve measurable changes to atmospheric greenhouse gas concentrations, it will also provide multiple co-benefits for the natural environment and society." F

MORE INFORMATION
Deakin Carbon Lab, www.bluecarbonlab.org
Coastal Blue Carbon Ecosystem, www.awe.gov.au/science-research/climate-change/ocean-sustainability/coastal-blue-carbon-ecosystems
FRDC RESEARCH CODES
2018-060, 2011-084

Above Blue Carbon Lab members collecting and checking the soil in an intertidal creek in Port Phillip Bay, Victoria. Photo: Blue Carbon Lab, Deakin University

R&D PLAN OUTCOME 1
Growth for enduring prosperity

Ready-to-eat seafood: challenge accepted

The cold-chain practice remains key in maintaining seafood safety, but a new study identifies other steps in the supply chain to protect consumers and ensure their seafood meal choices have no unexpected health consequences

By **Cristina Lesseur** (CL Advisory Pty Ltd) on behalf of SafeFish

The seafood sector has taken advantage of the growing trend of ready-to-eat foods, along with convenience and alternative delivery options for consumers in recent years. The impact of COVID-19 has accelerated the demand for these services, with direct-to-consumer models, more takeaway options and in-house and third-party deliveries continuing to increase.

Changing consumer preferences have also seen an increase in demand for healthier options, adding raw and lightly processed food into the mix. Seafood provides a high-quality protein, and added functional benefits from some species include healthy fats, iodine, zinc and omega fatty acids.

Short-shelf-life ready-to-eat (SSL-RTE) seafood is consumed in the same state in which it is sold, with a potential shelf life of one to eight days. Figure 1 illustrates the most commonly used ready-to-eat species and the most common preparation methods. SSL-RTE seafood includes fresh raw products such as oysters and sashimi-grade fish and minimally processed seafood such as hot or cold smoked salmon, precooked but sold fresh cocktail prawns, and preparations with a light curing step such as sushi, poke bowls, ceviche and fish carpaccio.

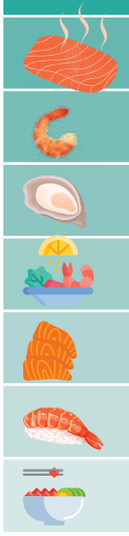
Safety practices

This increasing diversity is expanding the ways people can buy and enjoy eating seafood. But it also creates new food safety challenges associated with the way seafood ingredients are handled, stored, prepared and consumed. The mixing of ingredients from different sources, with varied supply chain histories and confusion around safe handling and shelf life, is a particular challenge in the ready-to-eat market.

FIGURE 1: SPECIES USED IN SHORT-SHELF-LIFE READY-TO-EAT SEAFOOD PRODUCTS
(from most common to least common)

Source: SafeFish

SHORT-SHELF-LIFE READY-TO-EAT SEAFOOD PRODUCTS
(from most common to least common)



Source: SafeFish

SafeFish is the seafood sector's food safety technical advisory body, funded largely by the FRDC, and in 2021 it analysed the current supply chain practices in the SSL-RTE market. It did this through a situational analysis that surveyed 56 seafood businesses and conducted 21 in-depth interviews. The research targeted seafood producers, distributors, processors, food service providers, retailers and delivery services, as well as regulators, food safety auditors and risk experts.

The study found that many operators in the seafood sector were well aware of food risks and adopted effective safety practices and standards to control them, such as the crucial understanding of maintaining cold temperatures throughout the chain. However, seafood suppliers are not confident in consumers' understanding of these risks.

Most packaged SSL-RTE seafood has precautionary labelling and alerts to inform consumers of food safety risks if the food is not stored or prepared appropriately – often with more detail than is required by regulations. But the survey findings suggest that, based on a lack of consumer awareness of the risks, advice on labels may not always be followed correctly.

Risk factors

Although there have been no widespread instances of illnesses associated with SSL-RTE seafood in Australia, there remains an ongoing low level of seafood-related illnesses reported each year. The main causes of these illnesses are *Listeria monocytogenes*, *Salmonella spp.*, *Vibrio spp.*, histamine poisoning, ciguatera toxin, *Escherichia coli* and biotoxins (substances that are both toxic and have a biological origin, for example toxic algal blooms).

Some of these risks are inherent in the marine environment from which seafood comes,

particularly *Vibrio* bacteria, ciguatera toxins and marine biotoxins. FRDC-funded research has identified increasing instances of the above three as potential food safety risks in Australia, with researchers suggesting a link to warming oceans.

One particular concern is the need to protect vulnerable groups in the population: young children, pregnant women, people with a compromised immune system and the elderly. Food safety guidelines in most states provide specific guidance for these groups. One survey participant did note that targeted information promoting the safe consumption of seafood for pregnant women had greatly improved in recent years, which suggests more could be done to target other population groups from both a food safety and nutritional perspective.

Challenges

The survey identified the following key challenges for SSL-RTE product development:

- inconsistent cold temperature controls throughout the supply chain;
- inconsistent product handling, quality or shelf life parameters that could affect intended use;
- lack of standard definitions for terms such as 'sashimi grade';
- confusing landscape of food safety standards, definitions and guidelines to follow because of the variety of product types and preparations; and
- expectations from some retailers and consumers that seafood SSL-RTE products should have a longer shelf life than they do.

Opportunities

The SafeFish research identified a number of areas that could be further developed to help mitigate food safety risks:

- improving cold-chain controls and monitoring throughout supply chains using information, technology and awareness;
- developing e-training and online navigation tools to help product providers understand the processing, handling, cleaning, storing and labelling of seafood as a high-risk product;
- supporting vulnerable populations with clear guidance about the foods they consume and the potential risks;
- harmonising or simplifying existing standards for ready-to-eat foods;
- improving instructions for consumers about ready-to-eat products, their intended use, appropriate handling and shelf life timeframes; and
- developing education tools for providers and consumers about how to reduce food safety risks.

The Australian seafood sector has taken up the challenge to provide healthy, safe and innovative ready-to-eat products to consumers. To continue to do this successfully and sustainably, operators, consumers and vulnerable populations need support with better tools, awareness and education measures. SafeFish and the seafood sector are working together to make this happen.

See the *Food Safety of Short Shelf Life Ready to Eat* (SSL-RTE) seafood report at the SafeFish website www.safefish.com.au **F**

MORE INFORMATION
SafeFish,
www.safefish.com.au
FRDC RESEARCH CODE 2021-018

SAFE SEAFOOD HANDLING BEST PRACTICE

The following are three examples of best practice in safe seafood handling and communication identified during the SafeFish assessment of ready-to-eat products.

SYDNEY FISH MARKET

As Australia's largest seafood wholesale market, the Sydney Fish Market has developed extensive Seafood Handling Guidelines that are audited every six months. These guidelines include sections on sashimi fish, cooked crustacea and processed and overseas products, including ready-to-eat products. The guidelines can be downloaded and provide a starting point for others in the industry in evaluating and implementing their own practices.

www.sydneyfishmarket.com.au/Seafood-Trading/Quality/Food-Safety

HUON AQUACULTURE

Huon Online Shop FAQs explain how products are kept cold during shipment, and also provides clear details about how customers should handle their Atlantic Salmon (*Salmo salar*) products, and the expected shelf life of those products.
For example:
What is the product shelf life on dispatch?
Cold smoked, hot smoked – 25 minimum fresh days
Pâté – 25 minimum fresh days
Reserve hot smoked – 21 minimum fresh days
Reserve cold smoked – 21 minimum fresh days
Premium caviar – 17 minimum fresh days
Reserve caviar – 17 minimum fresh days
Premium portions – 12 minimum fresh days
Premium/sashimi-grade fillet – 9 minimum fresh days
www.huonaqua.com.au/huon-online-shop-faqs

DINKO SEAFOODS

The home page of the Dinko Seafoods website includes a visual guide with detailed instructions about the use of its premium Southern Bluefin Tuna (*Thunnus maccoyii*) products. These instructions also come on cards supplied with each portion of tuna sold (Figure 2).
https://dinkoseafoods.com.au

FIGURE 2: HOW TO HANDLE YOUR TUNA

Step 1
Remove loins from carton and place on 0-4° C refrigeration, still in cryovac bags for 12-15 hours.

Step 2
Remove from cryovac bags, pat dery, and wrap in Japanese wasabi paper.

Step 3
Place wrapped loins in airtight container and store in coldest part of fridge.

Step 4
Consume within four days of defrosting and opening vacuum bag.

Step 5
Loins should not be refrozen after defrosting.

ARLP drives leadership vision into action

Kylie Dunstan reflects on the value of her participation in the highly regarded Australian Rural Leadership Program

By **Jo Fulwood**

Queensland fisher Kylie Dunstan (front, right) with her three children (back, from left) Lachlan, William and Chloe and her brother (front, left) Shane Paulsen, co-owner of Paulsen Fisheries Pty Ltd and skipper of the *FV Angelina S.* Photo: Supplied

Having recently graduated from the Australian Rural Leadership Program (ARLP), run by the Australian Rural Leadership Foundation, Kylie Dunstan believes strong and conciliatory leaders with a capacity for both conflict resolution and innovation will be critical for the long-term survival of Australia's seafood sector.

Dunstan, who received sponsorship from the FRDC, was one of 35 graduates of the 26th ARLP. She is a co-owner and partner of the Queensland-based Paulsen Fisheries with her brother Shane Paulsen. She is also head of government business with media intelligence company Isentia.

Dunstan began her professional career in the seafood sector spearheading a campaign to ensure the retention and legality of selling trawled bycatch products. She says decisions affecting the ability of the sector to operate both profitably and with community support must be based on science-backed research, made by leaders who have the support of the sector.

"There are policy decisions being made for political reasons, not because they are in the best interests of industry. Bad decisions are being made because of political expediency, which, in turn, are having a profound impact on those fishers involved," she says.

"Our industry is full of hugely knowledgeable, passionate people, so we need to get these people into decision-making roles."

The running of the 26th ARLP was not smooth sailing. The program began in 2019 and was disrupted by bushfires in Victoria and New South Wales in the summer of 2019–20, followed by COVID-19 travel restrictions.

Despite this, the program managed to deliver high-level personal and professional development, taking participants across Australia to experience once-in-a-lifetime leadership opportunities.

Dealing with difficult issues

"This course has had a tangible impact on me, my view of myself and how I turn up for others," Dunstan says. "This was one of the most profound experiences of my life."

The program forced all participants to step out of their comfort zones, encouraging learning and growth away from the noise of everyday life. It also highlighted the importance of communication, quality networks and honest conversations, particularly about issues that may not be very palatable, she says.

Her experiences from the ARLP have given her the confidence to take on more leadership roles within the seafood sector. Since her graduation from the program, she has become a safety champion for the sector.

She believes the future of Australia's commercial seafood sector requires continued long-term investment in the capacity of sector leaders.

Community support

Dunstan highlights the sector's reliance on social approval to operate efficiently and profitably, emphasising the importance of community support for commercial operations, no matter what they are.

She says maintaining access and fisheries rights for commercial fishers is paramount. Poor decisions by a small minority should not be tolerated, particularly if these decisions affect the ability to operate commercially in those fisheries in the future.

"We have to be having really authentic, honest conversations with industry about the need for community support. For example, there is an incredible amount of scrutiny on inshore commercial operators, such as beam trawlers in estuaries. They have to operate respectfully within their environment and in a way that is consistent with community expectations, or their ability to operate in those fisheries will not be able to continue."

A fourth-generation sector participant, Dunstan has worked in both professional and volunteer roles in seafood organisations, including the FRDC and the Queensland Commercial Fishermen's Organisation (now the Queensland Seafood Industry Association). She also spent 13 years in a senior management position at the Grains Research and Development Corporation.

Expressions of interest in the ARLP are now being taken. Visit rural-leaders.org.au for more information. **F**

MORE INFORMATION
Australian Rural Leadership Foundation, https://rural-leaders.org.au
Kylie Dunstan kyliepaulsen@gmail.com

FRDC RESEARCH CODE
2016-408

R&D PLAN OUTCOME 3
A culture that is inclusive and forward thinking

PORT LINCOLN GROUP 2020
Pictured above from left, Daniel Chen, Claire Webber (guest NSILP graduate), Cassie Pert, Jaime McAllister, Sal Bolton, Sean Larby, Meaghan Dood, Hika Rountree (withdrew), Rattana Wiriyakiat, Ash Lukin (guest NSILP graduate), Anthony Tennant, Darci Wallis, Adam Radford (withdrew), Patrick Cavalli, Ciara Farrell (withdrew), Dene Rodd, Basia Lamb (withdrew), Bianca Dubber (withdrew), Natalie Manahan and Luke Cordwell.

Photo: Supplied, Jill Briggs

Leadership program creates new online opportunities

The value of networks came to the fore as the National Seafood Industry Leadership Program adapted to uncertain times, developing new opportunities for current and future participants

By **Anne Crawford**

The FRDC's National Seafood Industry Leadership Program (NSILP) faced an uphill challenge when COVID-19 disrupted its face-to-face format. However, its participants rallied to support each other and a promising new model of operating emerged.

Jill Briggs, managing director of Affectus, which runs the NSILP for the FRDC, says three cohorts of participants are undertaking the program but they have been unable to complete it due to the COVID-19 pandemic. Two groups started in 2020 and one in 2021.

The NSILP, the seafood sector's premier leadership development program, spans six months with three blocks of three-day workshops. These are usually held in a regional area, then at the Sydney Fish Market and finally in Canberra, where participants meet decision-makers and attend Parliament.

Working together

The program exposes participants to guest speakers and networking events, and breaks them up into small groups to work on a sector-related project.

NSILP 2021
Pictured above from left: James Baker, Wayne McManus (guest, Gold Coast Fishermen's Co-op), Sarah Gorst, Phillip Ravanello, Rebecca Sellers, Rachel Ong, Claire Denamur, Richard Hamilton (guest NSILP graduate), Steven Rust, Jock Muir, Delahay Miller, Fred Bailleul, Rhys Barton, Mark Thompson (guest, Gold Coast Fishermen's Co-op treasurer), Ryan Lowrey, Gerard (Doody) Dennis, Jessica McInerney and Lou Cathro.

Photo: Supplied, Jill Briggs

At the end of the six months, the groups present their projects to sector and government dignitaries in Canberra and seek assistance to complete them.

"There are some great projects this year, including one about educational resources for pre-primary schools, getting kids to know about the industry really early, and another on how to communicate the success stories of the industry to people," Briggs says.

Other projects underway include investigating how the industry can best assist people in the digital learning space, and where seafood as a topic could be placed in the curriculum to encourage school-leavers to enter the sector.

The FRDC has run the NSILP since 2000 and there have been more than 300 graduates to date. Participants come from all parts of the seafood sector – from recreational fishers to traditional owners living in the Torres Strait, small business owners to Australian Government employees. Graduates are of all ages and come from all sectors of the industry, including people working as processors, exporters, importers, marketers and deckhands.

Most people take part in the NSILP primarily because they want to see change in the seafood sector, either at a micro or macro level. "Our philosophy is that we want to grow skills, knowledge and industry networks and to initiate leadership experience," Briggs says.

COVID-19, though, put a dampener on the usual in-person events.

Real support, virtually

"With COVID, we put the participants on pause and spent additional time with them in Zoom meetings, supporting and encouraging them, making sure they were okay and still working on their projects and connecting as a group," Briggs says.

Participants were reluctant to have the program moved online and some felt anxious about it. However, the first three-day block of virtual meetings went well and participants reported that they felt it had been a great experience. Nonetheless, one group opted to wait until February 2022 and meet in person after the tragic death of one of its members. The participants have been "incredibly supportive of each other", Briggs says.

"Even though they've been through unsettled times, the program has given the participants a new perspective on how the industry could work. It let them see that, while it is sometimes necessary to meet face-to-face in the industry, there is also power in doing it virtually."

One cohort, called the Port Lincoln Group (because that is where they had started their program), opted to continue the program online and was taken on virtual tours of three seafood businesses in Townsville, Sydney and Melbourne. "Had we been tied to meeting in one place geographically, there's no way we would have seen those three amazing industry businesses," Briggs says. See article on page 30 about how members of this cohort investigated the benefits of mobile apps for the seafood sector.

CAIRNS GROUP 2020

Pictured above from left, Geo Gomez Rios, Amrik Signh Aulakh, Luke Dutney, Lewis Christensen, James Thomas, Max Bayley (withdrew), Siobhan Threlfall, Wil Conn, Anita Lee, Sam Bock, the late Rebecca Marks, Brandon Panebianco, Amie Steele, Tom Hartley, Kirsten Rough, Cindy Manu, Rhett Bartz, Ben Stobart, and Bryan Van Wyk (guest).

Photo: Supplied, Jill Briggs

The FRDC has run the NSILP since 2000 and there have been more than 300 graduates to date. Participants come from all parts of the seafood sector – from recreational fishers to traditional owners living in the Torres Strait, small business owners to Australian Government employees.

A virtual drinks night also allowed the participants to meet people from all over Australia rather than just the people who would normally attend in person. "It was a fantastic networking activity," Briggs says.

The FRDC is considering funding a pilot version of the NSILP that is fully online. "If this funding is provided, it will allow for comparison of online and face-to-face outcomes. The data will tell us what works for people and what doesn't. We might come out with a shiny new product at the end of it," Briggs says. One downside has been that about 20 per cent of participants withdrew from the program.

Alumni network

Those who undertake the NSILP bring new skills and perspectives to the hundreds of seafood sector organisations that exist across Australia.

"To have people moving out into the industry who understand teamwork and the concept of working across sectors, who understand the challenges of different life experiences and who have an appreciation of all levels of the seafood industry is gold to the industry," Briggs notes.

"Feedback from alumni indicates that they appreciate how important, rich, valuable and strategic it is to have a strong network that they can bring into whatever room they walk into."

One graduate writes: "The NSILP gave me confidence in my own ability to be able to engage with stakeholders and share my ideas. It has helped me in numerous roles since the program." This graduate has since taken on roles in the National Seafood Industry Alliance and the Aquaculture and Wild Catch Industry Reference Committee.

The three groups from the 2020 and 2021 programs are scheduled to graduate from the NSILP by the end of May 2022.

Applications for the NSILP 2022 will open in March 2022. Contact admin@affectusaus.com.au for further information.

MORE INFORMATION
Affectus, https://affectusaus.com.au
FRDC RESEARCH CODE
2017-003

An *app*-etite for smartphone technology

A team of emerging leaders in Australia's fishing and seafood sectors set out to identify how smartphone apps and digital technologies are benefiting users

By **Luke Cordwell, Jaime McAllister** and **Cassandra Pert**

Al McGlashan (right) uses smartphone apps to make his fishing trips safer and more successful. Photo: Supplied

From enhanced user experiences to digital catch reporting, the creation and adoption of mobile applications (apps) presents a significant opportunity across the seafood sector.

Recreational fishers can check the day's forecast on the RipCharts app before heading out on the boat. Commercial fishers can log their catch on the New South Wales Fisheries' FishOnline app. Seafood consumers can consult the FRDC's Status of Australian Fish Stocks Reports app before choosing what type of fish to buy.

The functionality and diversity of apps related to fisheries and seafood continues to evolve. However, this boom in mobile technology has created an overwhelming amount of choice and information. Apps that have the potential to greatly benefit seafood communities risk being lost in the mass of information available.

As members of the 2020 National Seafood Industry Leadership Program's Port Lincoln cohort, we set out to investigate this issue. We wanted to shine a light on the range of apps out there and how they can be integrated into everyday activities. We also wanted to uncover what makes a good seafood app and why many apps, despite developers' best intentions, remain underutilised.

Our initial research involved a comprehensive search of various web and app store databases, which revealed more than 100 products directly related to or tailored for the fishing and seafood communities. Most of these apps are targeted at the recreational sector, with rapid uptake of digital technology among these users. There has also been a strong uptake of generic apps geared towards increasing productivity in the commercial and post-harvest sectors, such as accounting or word processing apps.

Our research revealed the large scale of the app landscape and how difficult some apps were to find, so we created a database of apps directly related to the seafood sectors across Australia – accessible using the QR code.

Scan the code below to access the database of apps directly related to the seafood sectors across Australia – accessible using this QR code, or visit https://airtable.com/shrJnFoU3AwdSI3cD

We also spoke with a range of fishers and individuals within seafood supply chains to help understand which apps they use and how these apps help them in their day-to-day lives. The team reached out for additional user experiences through a survey, first advertised in the December 2021 edition of the FRDC'S *FISH* magazine, to gain an even broader perspective on app use across seafood sectors.

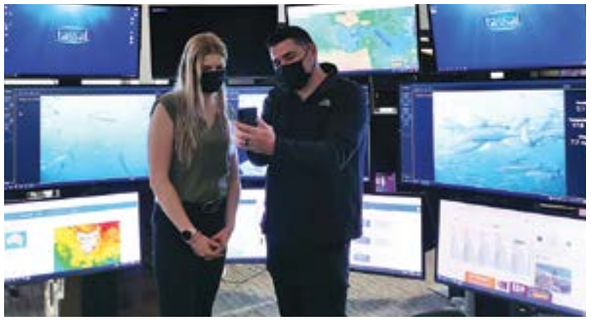
Recreational fishers

Social media apps were the most used among the recreational fishers interviewed. Facebook, Instagram and Messenger all allow recreational fishers to share fishing stories and images of their latest catch. For some people, such as advocates of Tuna Champions, social media helps promote advocacy work and educate the public and other recreational fishers about best-practice methods.

Apps are also helping to improve safety on the water. As recreational fishers move further offshore, a mobile device linked to a SatSleeve Hotspot through the SatSleeve app turns a regular phone into a satellite device to improve communication on the water.

A key message from the interviewed recreational fishers was that apps help them make more informed decisions. By allowing users to review multiple sources of information in a simplified form, apps can greatly enhance the fishing experience.

Fishbrain is an app that tries to do just this. Used by 1.6 million recreational fishers worldwide, Fishbrain integrates weather forecast data, catch information from other users, recommended catch times and bait for target species in an area,



combined with a social media news feed and the ability to stay up to date with the latest fishing efforts of others in your area.

Apps are also making participation in citizen science projects easier for recreational fishers. The Tackle Box app, developed by the Australian Recreational Fishing Foundation, provides fishers with a range of resources to improve their fishing experience, and allows them to submit catch information to inform citizen science projects.

Commercial fishing and aquaculture

For Tasmanian commercial fisher Ben Allen, the Tasmanian Government app FishPort has become a key part of his fishing activities. FishPort allows Allen to track his commercial catches in real time, ensuring that his catch is compliant with quota limits. In recent years, Allen has also become a big supporter of communication apps, such as Zoom, which allow him to stay connected with family while he is out at sea.

In the commercial sectors, apps are changing how some operations do business. With the creation of Microsoft Power Apps, businesses can build their own apps tailored to their specific activities. For example, aquaculture company Tassal has built multiple in-house apps to digitise operational activities and build its 'smart farm' vision. This has given managers greater visibility over operations, with all data recorded and available in real time.

Fisheries regulators are also increasingly moving towards the use of digital tools. Most Australian jurisdictions use apps for reporting certain commercial fishing activities. This trend is likely to continue as catch reporting apps provide regulators and fishers with real-time information, helping decision-making and business planning.

What makes a good app?

Functionality and ease of use were overwhelmingly reported as key characteristics of a good app from the people interviewed. For most users, an app must make their activities more efficient, allowing them to spend more time fishing – whether as a sport, leisure activity or a job.

Many users indicated that they are much more likely to engage with an app where information is shared both ways. Some users noted that they are hesitant to use apps that require lots of information from the user. They are more likely to continue using an app when they can see an outcome from the information they provide.

A good app should also provide information at a fine enough scale to make it relevant to an individual user (and their specific fishing spot). This is particularly relevant to apps that provide weather forecasts and information on local environmental conditions.

But beyond the characteristics of the app itself, a good seafood app is one that people actually use. With so many apps available, the potential value of a seafood app is often tied to its marketing and engagement strategy. Whether through the use of sector champions, an advertising campaign, links to existing products or businesses, or direct extension activities with the core market, a successful app must break through the noise of digital technologies to engage the user.

We hope our work will assist in these efforts to spread the word about some great apps that could benefit the seafood community.

Apps and connected digital technologies have the potential to revolutionise how we fish: to make our operations safer and more efficient, enable more informed decision-making, improve the fishing experience and increase the traceability of fish. This makes app awareness and digital literacy more important than ever before. F

AL MCGLASHAN: For recreational fisher Al McGlashan (pictured left), apps are a great tool to enhance his experience out on the water. Before he heads out, he consults **RipCharts**, **Windy** and **Buoyweather** for the latest forecast, as well as checking any new fisheries regulations or zoning information on the **NSW Fisheries** app. He can also keep track of who is out on the water with the **MarineTraffic** app for real-time information.

RipCharts

Windy

MarineTraffic

Above left Luke Cordwell (right) shares information with a colleague using an app he has developed for use at Tassal, where he works.
Photo: Supplied

MORE INFORMATION
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FRDC RESEARCH CODE
2017-003

R&D PLAN OUTCOME 5
Community trust, respect and value

Of fish, chips, community, culture and batter

By **Anne Crawford**

Communities have united behind their favourite fish and chip shops, with close competition in the voting for the state winners of the 2021 Great Australian Fish & Chip Awards

Photo: 123rf

Fish and chip shops are ubiquitous in Australia and a familiar sight in country towns and suburbs nationwide. It is little surprise then that, when a call went out last year for Australians to vote for their favourite fish and chippery, there were about 300,000 votes.

The 2021 Great Australian Fish & Chip Awards state winners were announced in December by Seafood Industry Australia (SIA). The awards, an initiative of the FRDC, are now run by SIA, the national peak body representing the seafood sector, with funding provided by the FRDC and others, including MasterFoods.

"Buying Australian seafood supports Australian fishing families and the regional communities where they operate," says SIA CEO Veronica Papacosta.

"Australian seafood is one of the most sustainable protein sources in the world and our fisheries management is world-class. However, close to 70 per cent of seafood eaten in Australia is imported," she says.

Fish and chips are an important route to market for Australian seafood and the awards celebrate those businesses that excel in delivering delicious fish and chips.

Bringing communities together

The small town of Ceduna, South Australia got right behind its local seafood shop, the Ceduna Oyster Barn, in the awards. Ceduna, known as the oyster capital of South Australia, sits on the west coast of Eyre Peninsula.

An online post about the competition brought the local community together.
Photo: Ceduna Oyster Barn

Photo: SIA

Ceduna local Karen Kavanagh says an online post about the competition "set in motion a month of fun and community unity and brought out the passion for seafood that is Ceduna".

"Our community consists of a high proportion of Aboriginal people as well as a smaller proportion of Greek people," Kavanagh says. "This competition brought all nationalities together and our community page was awash daily with people encouraging others, tagging people to vote, acknowledging they had voted and so on," she says.

"The competition created a situation where people were talking about it in the street and asking each other had they voted, what the numbers were, what we needed to move from fourth to third – it was a real topic around town. It was positively awesome. It's a great community-orientated competition," she says.

The Ceduna Oyster Barn, a converted portable hut with dining space on the roof, came third in the SA awards behind two larger businesses.

"We've got our sights set firmly on second – if not first – place for SA in 2022!" says Kavanagh.

A long tradition

The tradition of buying and sharing paper-wrapped bundles of battered fish and fried chips is deep-rooted in Australian culture. For many, it is a part of growing up, picnics on the beach and, for some families, a Friday night institution.

According to the FRDC's *Short History of Fish and Chips*, the English first combined the two key ingredients – potatoes and fish – as fast fare for the common people in a London shop opened in 1860 by Jewish migrant Joseph Malin. Greek migrant Athanasias Comino is often credited with introducing the takeaway meal here, opening the first Australian fish and chip shop in 1879 on Sydney's Oxford Street (though family records say Comino copied the idea from a Welshman's shop nearby). Successive waves of migrants invested in similar businesses and played a crucial role in popularising the meal across the country. Recently, there were an estimated 4000 fish and chip shops in Australia.

Papacosta, a third-generation seafood retailer and fish and chip shop co-owner, explains the surprising origin and use of batter in a podcast by Myf Warhurst devoted to the fish and chip shop in the series *Our Place*. "Batter is meant to be more of a vehicle for cooking fish," Papacosta says on the podcast. "So fish is best cooked quickly. We know the English would put a batter around the fish so that it was protected and wouldn't dry out because they were obviously deep frying. The batter was something that you're actually meant to peel off and eat the fish inside and some people I know still do that. We've become very used to eating the batter," she says.

Batter in Australia evolved to become much thinner, Papacosta says, with Japanese techniques introduced to the process here.

Today, fish and chips are an essential part of the menu for many pubs, restaurants and upmarket eateries as well as takeaway shops, and they are the culinary subject of many celebrity and Michelin-starred chefs. F

STATE WINNERS

Congratulations to the state winners of the MasterFoods People's Choice Award – Great Australian Fish & Chip Awards 2021 for showcasing outstanding seafood. State winners are:

Australian Capital Territory
The Fish Shack, Civic
New South Wales
Something Seafood, Callala Bay
Northern Territory
Frying Nemo Fish and Chippery, Stuart Park
Queensland
Costa's Seafood Cafe, Capalaba
South Australia
Fish Out of Water, Hyde Park
Tasmania
Fraggle's Fish and Chips, Invermay
Victoria
Trident Fish Bar, Queenscliff
Western Australia
Pinjarra Fish & Chips, Pinjarra

MORE INFORMATION
www.fishandchipawards.com.au;
https://shows.acast.com/our-place/episodes/thefish-chipshop

FRDC RESEARCH CODE
2020-110

Diving into sustainability

Good science is the basis of credible assessment initiatives to help consumers choose sustainable seafood

By **Ilaria Catizone**

Consumers are increasingly demanding proof of their seafood's sustainability and they are turning to a range of seafood certifications, rating programs and indices to inform their purchases.

Globally, there is a growing number of initiatives to guide consumers. But they do not all measure and report on the same parameters.

Reporting on stock sustainability is often cooperatively implemented by governments, either internationally (for example, Food and Agriculture Organization of the United Nations's [FAO's] Fishery Status Reporting Process), or nationally (for example, the Status of Australian Fish Stocks [SAFS] Reports). These programs typically focus on stock sustainability – the capacity of the fished stock to maintain itself at a given level of abundance – rather than on sustainability in a broader sense that may include considerations such as bycatch, carbon footprint or plastic use.

Some schemes provide endorsement for specific fisheries and species, such as the Marine Stewardship Council (MSC) certification, which is highly regarded internationally but comes with costs that not every fishery can afford.

Some programs attempt to provide a broader picture of sustainability, combining assessments of fish stocks with social and economic indicators, ecosystem assessments and management measures.

The scope, scientific rigour and transparency behind the many initiatives can be highly variable, although they all generally involve assessment against predetermined requirements, using fish biomass as a starting point.

To help users evaluate the different programs, the Global Sustainable Seafood Initiative (GSSI) has a Global Benchmark Tool that assesses the assessors. GSSI is a public–private partnership focused on seafood sustainability with more than 90 stakeholders industry-wide. GSSI aligns global efforts and resources to address seafood sustainability challenges.

To date, the GSSI has recognised nine sustainability certification schemes relating to aquaculture operations and fisheries, including the Marine Stewardship Council program mentioned above, which relates to fisheries internationally.

Sustainability indices for management

Although gaining community support is essential, sustainability indices are also important management tools, because they shed light on the factors that influence stock levels. This understanding is crucial to ensure these levels are kept within (or returned to) the sustainable range.

The effectiveness of fisheries management based on sound science was, once again, demonstrated recently when Southern Bluefin Tuna (*Thunnus maccoyii*), a formerly overfished and depleted stock, was rated as sustainable. This result comes after decades of careful management to rebuild numbers while allowing controlled fishing to support jobs and communities.

Sustainability indices use reference points to determine what stock levels are sustainable in each case. These points are the operational or measurable benchmarks that identify targets to be achieved on average, limits to be avoided and triggers to initiate management responses. Reference points are usually set in relation to fish abundance (biomass), fishing mortality (removals from the population due to fishing) or both.

Best-practice management involves setting reference points for both biomass and fishing mortality. Estimating stock biomass as well as fishing mortality is important, because biomass varies in response to non-fishing variables (for example, environmental effects) as well as fishing pressure.

The effectiveness of fisheries management based on sound science was, once again, demonstrated recently when Southern Bluefin Tuna, a formerly overfished and depleted stock, was rated as sustainable.
Photo: Shutterstock

The three main reference points used are:

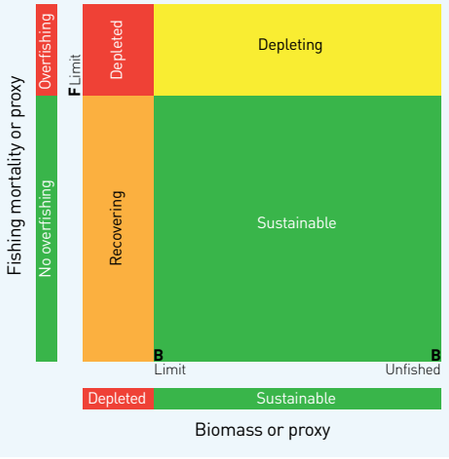
- Target reference point: the point around which biomass and fishing mortality would ideally fluctuate.
- Limit reference point: the lowest biomass or highest fishing mortality a stock can withstand without becoming depleted. Management should be such that there is a very low likelihood of dropping below a limit reference point. Immediate management intervention is required if a limit reference point is breached.
- Trigger reference point: typically, intermediate between target and limit points, this provides the cue to initiate management responses to bring the stock back towards the target reference point.

Reference points should be set according to clearly defined management objectives for a stock. Common management objectives include maximising sustainable food production, maximising economic returns from fishing, or maintaining a stock that is important for broader ecosystem function, such as an important prey species, at a precautionary biomass level. While pursuing these objectives, there is the ongoing need to avoid breaching limit reference points.

Limit reference points tend to be set where irreversible (or slowly reversible) recruitment impairment would occur.

R&D PLAN OUTCOME 5
Community trust, respect and value

Figure 1: Diagrammatic representation of the framework used by the Status of Australian Fish Stocks Reports.



Within the FAO for status reporting framework, a stock is considered to be:

- *overexploited* if present biomass is found to be less than 40 per cent of unfished biomass;
- *fully exploited* if present biomass is between 40 and 60 per cent of unfished biomass; and
- *underexploited* if present biomass is more than 60 per cent of unfished biomass.

Customising reference points

When fisheries managers set reference points, they use species-specific information to account for a stock's population parameters, where possible. These may include characteristics such as life span, growth rate and reproductive age. There is a delicate balancing act in management to account for the natural variability of a species over time, fishing activity and responses to other environmental factors.

A species with a short life span, fast growth rate and young reproductive age may have lower reference points for biomass (allowing greater fishing effort), than a species with a long life span, slow growth rate and older reproductive age.

However, species with a fast growth rate and short life span typically have large natural variations in their abundance and excessive fishing pressure that coincides with a period of naturally low abundance or poor recruitment can cause a stock to collapse. So, in some cases, dynamic reference points may be needed to better reflect current circumstances and adapt to changing ones.

In other cases, a stock's reproductive potential (for example, egg production) may be estimated. Some fisheries scientists have argued that measuring egg production would capture changes in fecundity, egg viability and sex ratio within a stock. In a different context, the Daily Egg Production Method (DEPM) is generally the most practical method for estimating spawning biomass for small pelagic species (for example, Sardines).

The role of a stock within its ecosystem is also an important consideration when setting reference points. Key prey or forage species, for example, may require conservative reference points to maintain ecosystem integrity.

SAFS

Every two years, the FRDC funds and manages the collation of the SAFS Reports. These bring together available biological, catch and effort information to determine the status of Australia's key wildcatch fish stocks from state, territory and Commonwealth fishery jurisdictions using a framework as shown in Figure 1.

SAFS Reports are used by a range of stakeholders, including fisheries managers and scientists, consumers and the seafood sector (including retailers). The reports are available on the SAFS website (fish.gov.au) and via a user-friendly app, so consumers can use the findings to inform their purchases.

SAFS Reports represent a composite consideration of biomass and fishing mortality; for example, a *sustainable* status requires evidence that both biomass and fishing mortality are above the limit reference point.

The SAFS framework does not define standardised levels of biomass or fishing mortality as limit reference points. Rather, the limit reference point for biomass is defined as the point at which recruitment (the process by which new generations of young fish join the population) is likely to be impaired. Similarly, the limit reference point for fishing mortality in SAFS is the level of fishing pressure likely to either drive the stock towards the point of recruitment impairment, or prevent its recovery if impairment has already occurred. Teams of authors from each jurisdiction work together to define these points for each stock.

Since July 2018, SAFS summary information has been used to inform Australia's progress against UN Sustainable Development Goal 14.4.1 (the proportion of fish stocks within biologically sustainable levels). F

MORE INFORMATION
www.fish.gov.au;
www.ourgssi.org

Hooked on solutions

Evaluating insect meal proteins in aquafeeds, PhD candidates Kat Doughty and Isobel Sewell are drawn to the potential of aquaculture to address food security and climate issues

Words and photos by **Corrina Ridgway**

"I'll get one shot at this," comments Katarina 'Kat' Doughty, concentrating on the water in the research tank as she glides a scoop net towards an evasive trout. Isobel Sewell stands by, ready, if needed, to herd the fish toward Doughty's practised hands.

It's a scene that encapsulates the physical skills that aquaculture requires of its researchers beyond laboratory-based analysis.

The two are PhD candidates at the University of Western Australia (UWA), working together on an FRDC-funded project evaluating protein alternatives to fishmeal in aquafeeds – specifically insect meal.

They admit that before beginning their current research they had little knowledge of the aquaculture sector. But they've since become converts, advocating for its potential in addressing some of the world's biggest challenges: food security and climate change.

Sewell's path

Sewell grew up in WA and spent time on the coast, with family holidays at Rottnest Island and Dunsborough. As with many others who study marine science, she has a long-standing appreciation for the ocean and the environment.

After a degree in Marine Science, Conservation and Wildlife Biology at Murdoch University in Perth, she went on to her master's at the University of Western Australia where the chance to work on the FRDC aquafeeds project came along. Her master's project soon evolved to become the pilot for her current PhD research.

"Learning about the high dietary protein that's required [for aquafeeds], which is often in the form of fishmeal, really shocked me," she says. One thing that drew her to the current project is its circular economy approach, using insects raised on food waste to help solve a feed issue for the aquaculture sector, which in turn has the potential to address human food security. "It's nice to do a project where you know there's a real-world impact," she says.

Doughty's journey

Doughty is originally from Canada, where she studied premedical science before an interest in genetics led her to honours study, looking at the genetic adaptation of the Guppy (*Poecilia reticulata*) to increasing water temperatures. A master's soon followed, with similar research involving farmed Chinook Salmon (*Oncorhynchus tshawytscha*).

"That got me into aquaculture," she says. "I worked on feeds and hybridisation through genetic breeding programs. It opened my eyes to a lot of global issues and how efficient aquaculture is and how, as a young industry, we have a real opportunity to drive positive change."

She went on to manage the nutrition laboratory for the Canadian Government's aquaculture sector before being offered her PhD opportunity in Australia.

The project Doughty is working on with Sewell is in conjunction with sector partner Future Green Solutions, a Perth-based business that produces insect meal using the Black Soldier Fly (*Hermetia illucens*).

Their trials use Black Soldier Fly larvae produced solely on food waste. Carrots, broccoli, bread, spent grains from brewers and leftover wheat dust are collected and processed into a pulp at Future Green Solutions. The larvae live in and eat the waste substrate. Given this, when compared to other aquaculture diets, the insect meal diet has a much lower environmental impact.

Black Soldier Flies are generalised eaters. With their pupae-dominant life cycle and narrow temperature and humidity thresholds, they are easy to manage, posing a low biosecurity threat.

Rainbow trout

Doughty is investigating dietary substitution and maintenance of Rainbow Trout (*Oncorhynchus mykiss*). This carnivorous salmonid species is farmed on every continent except Antarctica.

"If they can handle massive changes in diet ingredients, it's a good baseline to move to other species," explains Doughty. →

Isobel Sewell (left) and Kat Doughty (right) share a similar vision of a more sustainable global aquaculture sector, able to provide a protein resource.

"A lot of my friends are happy to come and help on the weekends, they love the hands-on experience. Now that Kat and I are doing research here, there's been a lot more conversation about aquaculture. People are interested, in that it's such a tangible solution." Isobel Sewell

Below Isobel Sewell's PhD work is proving rewarding, both in results and experience gained in the aquaculture field.

Below Kat Doughty's research is unique, given that it has looked at extended use of insect-based feeds. These adult Rainbow Trout have been raised on insect-based feed.

Doughty started her investigations in April 2019, running nutritional composition analyses of the flies before establishing feed trials. The pellets have up to 30 per cent insect inclusion; that being the standard commercial inclusion of fish or poultry meal in Rainbow Trout aquafeeds.

Most aquafeed trials are run with juveniles over a short period of time; however, Doughty's trial is also addressing the longevity and maintenance of adult trout.

Assessing the long-term effects of a specific diet is vital. The aquaculture sector has been cautious about relying too heavily on a single protein substitution since the prolonged use of soybean meal in Atlantic Salmon (*Salmo salar*) feeds was found to cause nutritional deficiencies.

"My juveniles were fed diets including insect meal for 21 weeks and I continued to feed the fish for another 18 months," she says. This included breeding adults. The results have not yet been finalised, but fish health was maintained for the full trial.

Once processed, the data will give Doughty applied results that can be used by producers with confidence about the long-term dietary effects on maintenance and reproduction.

Barramundi and marron

Meanwhile, Sewell is evaluating diets based on Black Soldier Flies for Barramundi (*Lates calcarifer*) and marron (*Cherax cainii*). She is backing up growth trials with analysis of biological indices such as gut histology and microbiome analysis, blood samples and the basic nutritional composition of fillets.

She has trialled numerous diets that compared several variables. Commercial and reference diets have been compared to insect meal alternatives, which in turn have been further teased out by comparing pellets using full-fatted or defatted larvae.

Two years in, her preliminary data based on growth trials and blood analysis is looking promising. "For Barramundi, it looks like performance is the same across all diets, which is what we're after – we want to perform the same or better," she says.

Although they're still analysing marron data, early results indicate insect meal diets may outperform the reference and commercial diets and they suggest that Black Soldier Fly meal will be viable for both Barramundi and marron.

Future directions

The FRDC project provides scope to push other research areas once key milestones are met. Doughty hopes to do some extra research, possibly value-adding the insects, rather than increasing the number required in the feeds.

"It's not necessary work for the initial incorporation of insect meal in aquaculture diets, it's really for my curiosity," Doughty admits.

Tying research into the broader global environmental and consumption picture is vital for the pair. They're passionate about aquaculture for food security and environmental benefits.

"Globally, it's the most efficient and least environmentally destructive way to produce massive amounts of protein. Feed conversions are generally two to one," Doughty explains.

Paired with her research background, Doughty is keen to push forward into the global policy and advisory arena. She points out, "I'd like to understand how we can globally implement these practices, making sure it's easy and accessible to do, but also ensuring proper implementation. I'd love to be able to get to a point where I'm doing that."

Doughty believes it will become increasingly important to rely more on aquaculture and less on other terrestrial production to address global climate change.

"I'm not saying aquaculture's a perfect solution, but if you compare it to other foods per kilo of edible protein, it's remarkably better," she says.

Sewell, for now, is focused on her current work: "[Aquaculture] is really multifaceted and I don't think people realise that," she says.

The pair are the only women they know of involved in aquaculture research in WA and they say working together in the FRDC project has been a timely benefit.

"Other areas in UWA have 10 or so people who work together. It's just us, so being able to share the workload is great," says Sewell.

But she believes that both the lack of people and the lack of women in aquaculture research will soon change. She reports that many of her peers had no idea about the impacts or depth the sector has to offer, but have since been impressed.

"A lot of my friends are happy to come and help on the weekends, they love the hands-on experience," she says. "Now that Kat and I are doing research here, there's been a lot more conversation about aquaculture. People are interested, given that it's such a tangible solution." **F**

MORE INFORMATION
Aquaculture investment opportunities
www.growag.com
FRDC RESEARCH CODE
2016-114 , 2019-172

Global innovation in the box

An environmentally friendly alternative to the ubiquitous polystyrene boxes used in the seafood sector is poised to enter the market, developed by fishers, for fishers, with many benefits including superior thermal performance

By **Catherine Norwood**

A small Queensland fishing business is challenging the US$30 billion global polystyrene industry to adopt a new environmentally benign material for cold-chain packaging, especially for temperature-sensitive products such as seafood.

Polystyrene dominates the packaging industry (and landfill sites) worldwide, largely because there seem to be few, if any, alternatives with the same weight, durability and thermal traits. That, however, did not deter Tom and Kath Long, whose company, TomKat Line Fish, supplies upmarket restaurants with reef fish.

Their journey towards a better box began with an invitation to join a Fish-X workshop in Brisbane in 2018, part of an innovation program funded by the FRDC. The Longs' original intention was to improve the marketing for their fishing business, which they established in 2012 on principles of environmentally responsible practices.

Kath says they quickly realised that the single-use polystyrene boxes and plastic liners they were using to airfreight their fish to market did not fit the aspirations of the business; they needed to find an alternative.

The FRDC provided a travel bursary that allowed the Longs to attend the Seafood Expo Global 2018 in Brussels to search for other options. When the Longs realised there were no real alternatives, they did what all needs-based innovators do: they set out to invent their own.

Tom was a plumber before turning to fishing and knew of a number of insulation materials that he believed could be repurposed to provide alternative packaging. The outcome of their research and development is the TomKat KoolPak®, a tough, lightweight container with thermal qualities needed for transporting and storing fresh foods and other cold-chain products such as medicines.

The KoolPaks are reusable and recyclable, and each component – the box, lid and thermal liner – can be tracked throughout its life, including end-of-life write-off at a recycling centre. Another high-tech touch is that the internal temperature can be monitored without opening the container.

Tom Long sees the reuse and flat-pack features as integral to making the boxes as cost-neutral and resource-efficient as possible. A simplified life cycle analysis of the KoolPaks highlights the significant environmental benefits of reuse.

"The Australian seafood sector uses 10 million polystyrene boxes a year. To replace those with a box that can be used at least five times would only require two million boxes," he says.

For a business, the cost of a $30 box drops to $6 when used five times. In-market testing indicates KoolPaks can easily be reused 10 times; some trials have reused boxes more than 20 times. The flat-pack design offers additional savings by minimising transport costs and storage space required for empty boxes.

Working with collaborators in the food processing sector, the Longs have also developed cleaning processes, along with hanging racks for vertical storage of the flattened boxes between uses. "Our aim is to provide solutions right along the supply chain to make our boxes as easy as possible to use," Tom says.

In 2019, the Longs received an AusIndustry Accelerating Commercialisation Grant of $273,400, which proved critical to progressing the KoolPak from prototype to tech-enabled product ready for commercial manufacture, with international patents pending.

The Longs have begun small-scale local production at Kurrimine Beach, in Far North Queensland. A full-scale manufacturing plant is planned for the region during 2022, with the help of an Advanced Manufacturing Growth Centre Grant and the Advance Queensland Ignite Ideas Fund. The initial production line will be for 59-litre KoolPaks (570 x 370 x 370 millimetres). Other sizes are planned, including one for the Atlantic Salmon sector. F

Tom and Kath Long with the TomKat KoolPak, packed with their premium reef fish.
Photo: Richard Curzon Photography

MORE INFORMATION
Tom and Kath Long, www.koolpakbox.com
https:bit.ly/3Bsi65a

FRDC RESEARCH CODE
2017-058

New projects

The FRDC board has recently approved the following research projects

Project number	Project	Applicant	R&D Plan outcome
2021-096	Southern Rock Lobster planning and management for a national research, development and extension program	Southern Rocklobster Ltd	1 2 3 4 5
2021-095	Integrating extension into research projects: tangible pathways to enhance adoption and impact	Horticulture Australia Ltd	1 2 3 4 5
2021-088	FRDC data governance framework – development and implementation support	More Than Machines Pty Ltd	1 2 3 4 5
2021-086	Tuna champions v2.0: Bluefin and beyond	Institute for Marine and Antarctic Studies Hobart	2 3 5
2021-082	Nature-based solutions for prawn farm effluent using seaweed	University of the Sunshine Coast	1 2
2021-080	Australian Council of Prawn Fisheries Industry Partnership Agreement management and community engagement, people development programs	Australian Council of Prawn Fisheries Ltd	1 2 3 4 5
2021-078	Improving the management of wildlife interactions in pelagic longline fisheries	Tuna Australia Ltd	2 5
2021-075	Understanding water quality risk for the sustainable and efficient production of Pacific and Sydney Rock Oysters	University of Technology Sydney	1
2021-061	Development of a guideline to investigate and understand disease outbreaks of unknown cause	Agriculture Victoria	1
2021-050	Maintaining cultural practices and building knowledge and capacity to support sustainable fishing of the Gynburra on Narungga Sea Country	Southern Fishery and Ecosystem Solutions	1
2021-038	Shark depredation in Australian fisheries: understanding the scope of the issue and identify potential mitigation options	Fisheries Research and Development Corporation	1
2021-028	Can novel seismic survey sources mitigate potential impacts to fisheries?	Institute for Marine and Antarctic Studies, Hobart	1
2021-025	Resolving the biological stock structure of Southern Ocean crab fisheries	Deakin University Warrnambool Campus	1
2021-009	Identifying biological stocks of Silver Trevally and Ocean Jackets for assessment and management	NSW Department of Primary Industries Mosman	1
2021-001	The emerging billfish fishing grounds of northern Australia: fisheries description, movements, and hotspots	Charles Darwin University	1
2020-123	Strategically targeting research on Western Rock Lobster (*Panulirus cygnus*) and its ecosystem to suit the needs of the fishing industry and stakeholders	Department of Primary Industries and Regional Development, Hillarys	1 2 3 4 5
2020-120	Assessing the effectiveness of Indigenous Reference Group research and development projects to deliver change	Land to Sea Consulting	1 2 3 4 5
2020-100	Proof of concept for innovative new octopus shelter pot and trigger trap designs.	Innovation Fishing Pty Ltd	1
2020-070	Overcoming propagule supply bottlenecks for seaweed production	University of Technology Sydney	1
2020-053	Commercial delivery of genetically improved Sydney Rock Oysters	Australian Seafood Industries Pty Ltd	1

R&D Plan 2020-2025 outcomes

1 Growth for enduring prosperity
2 Best practices and production systems
3 A culture that is inclusive and forward thinking
4 Fair and secure access to aquatic resources
5 Community trust respect and value

Final reports

Oysters Australia Strategic Plan 2019–208

This project provided funding for Oysters Australia (OA) to develop a strategic plan to coordinate oyster industry research, development and extension (RD&E) across Australia as part of its Industry Partnership Agreement (IPA) with the FRDC. OA is a national body that was formed in 2011 by Australia's community of oyster growers. It is a not-for-profit, unlisted public company, with the members being the official oyster industry bodies in New South Wales, Tasmania and South Australia. The strategic plan outlined the following vision: 'A vibrant Australian oyster industry, celebrated by the community, which adopts world-class research to achieve sustainability and prosperity, with a GVP of $175m by 2025.' The plan outlines five RD&E programs and a list of priority projects for which research proposals will be called. The strategic plan is an integral part of the IPA between OA and the FRDC, and OA will continue to work closely with the FRDC to manage the portfolio of projects.

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National Aquaculture Council stakeholder consultation 2019–207

This project reviewed the future of the National Aquaculture Council (NAC), the peak body representing Australian aquaculture sectors. The NAC board initiated the project to gain an understanding from its members and stakeholders of their future needs and expectations in terms of industry representation. More than 30 interviews were conducted with a range of stakeholders from across the aquaculture sector. The project found that there is a high level of support for a powerful and influential peak body to advance the aquaculture sector. It was apparent from the initial engagement that, in its present form, the NAC was falling short of expectations. NAC found itself at a crossroads where it had three options: gear up to a full-service peak industry representative body with a professional executive officer that has accountability for delivering a return to members; scale down to an informal industry forum or annual think tank without a board or governance structure; or create a secretariat for aquaculture within Seafood Industry Australia or a shared services model. The project recommended that this report be circulated to the NAC board for further discussion. The NAC board then used the outputs from the research to decide on the organisation's future.

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Note: *The NAC board decided to disband the council. Its functions have been taken up by Seafood Industry Australia.*

National Snapper Workshop 2019–085

This workshop was funded in response to the concerning status of some of Australia's key Snapper (*Chrysophrys auratus*) stocks. Snapper is an iconic Australian fish species distributed from Southern Queensland to Western Australia and supports important commercial, recreational (including charter boat) and Indigenous fisheries. The broad geographic distribution of this species, together with its economic, social and cultural importance makes it one of Australia's most significant fishery resources. The purpose of the workshop was to develop a national, consolidated approach to support the sustainability and responsible use of Australia's Snapper resources. The well-attended workshop involved fisheries managers, scientists and key stakeholders from across Australia and New Zealand. It was held in Adelaide from 12–14 November 2019 at the South Australian Research and Development Institute's Aquatic Sciences facility at West Beach. The workshop developed a best-practice approach ('toolkit') to managing Snapper across Australia, based on seven key initiatives (or tools) distilled from presentations and breakout sessions. The workshop also proposed a range of recommendations to continue to work together and share data and build better knowledge systems to inform modelling and harvest management strategies across Australia.

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Recreational fishing objectives in NSW 2019–021

This interim report provides an update on workshops with recreational fishers, scientists and managers to investigate recreational fishing objectives for three stocks of recreational importance in NSW: Mulloway (*Argyrosomus japonicus*), Yellowtail Kingfish (*Seriola lalandi*) and Snapper (*Chrysophrys auratus*). The study forms part of a broader research project investigating the integration of recreational fishing into harvest strategies for multi-sector fisheries.

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Biosecurity risks from shellfish reef restoration 2019–005

Although attempts to restore lost shellfish reefs in Australian estuaries are gaining momentum, there remains resistance around the potential biosecurity risks associated with using recycled mollusc shell waste (oysters, mussels, scallops). The project identified existing risk mitigation methods being used in Australia and examined known potential biosecurity hazards that could be translocated through recycling of mollusc shells. The project was also able to identify appropriate sanitising methods required to reduce the risk of translocation of pests and diseases when using recycled mollusc shell waste.

More information: **Ben Diggles**
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Developing POMS-resistant oysters for NSW 2018–164

This report details a collaborative project investigating the reinvigoration of the triploid Pacific Oyster (*Magallana gigas*) farming sector in NSW estuaries affected by Pacific Oyster Mortality Syndrome (POMS). This project was a proof of concept to investigate if new instant-induction techniques were able to produce triploid Pacific Oyster spat →

with commercially viable levels of POMS resistance. Data and performance of the stock was monitored prior to the summer POMS occurrence window. Mortality data collected during and after POMS events (summer 2019–2020) showed that 50 to 70 per cent survival was observed after the first event and very low levels of mortality were observed in a second POMS event. Unfortunately, the Hawkesbury growing region was subsequently affected by a large flood event that saw very low salinities and subsequent mortality in the triploid Pacific Oysters, which significantly compromised this project.

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The value of man-made marine structures
2018–053

This report outlines the social and economic values and benefits associated with man-made marine structures (MMSs) in Western Australia. During 2019 and 2020, researchers created seven online surveys that focused on understanding the social and economic benefits and values that recreational and commercial fishers, divers and other users gained from using MMSs in WA. This was complemented with 11 focus groups that included representatives from the commercial and recreational fishing sectors, as well as the oil and gas sector, regulators (state and federal), conservation non-government organisations, scientific researchers and the general community. The information generated by this project provides a strong foundation to facilitate understanding of the values of MMSs across diverse user groups. The work also made recommendations to increase the social acceptability of the structures. Finally, a database of MMSs in WA was compiled and is accessible online. A guidebook was produced outlining the different methods of identifying social and economic values, along with the types of data required, and the approaches to collecting this data. The guidebook also outlines the advantages, disadvantages and resource needs for each method.

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SafeFish
2018–004

SafeFish provides services on four major platforms: governance; input into food safety standards; research into technical food safety issues; and building food safety capability in the seafood sector, seafood regulators and researchers. Although the SafeFish project cannot necessarily mitigate all issues related to food safety, the services it provides go a long way in assisting the seafood sector to respond to issues in a fast, effective and unified manner to decrease the potential ramifications. The sector and regulators have demonstrated that they value and rely on the work undertaken by SafeFish and appreciate the role that it plays as a conduit.

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Blood flukes in Southern Bluefin Tuna
2017–241

Cardicola forsteri was the dominant blood fluke species detected in farmed Southern Bluefin Tuna (*Thunnus maccoyii*) in 2018. Our results have shown that traditional microscopy methods used to detect blood flukes (heart flush and gill microscopy) were limited to only detecting adults or eggs. Comparisons between different diagnostic methods showed that molecular methods (for example, quantitative polymerase chain reaction (qPCR)) were more effective at detecting blood flukes. Findings show that sensitivity between molecular testing and microscopy is similar, but microscopy is more labour-intensive and time-consuming and qPCR is more effective at detecting subtle changes in blood fluke infections. This study also demonstrated that a lack of praziquantel treatment (anthelmintic used to treat blood fluke infection) has a significant effect on blood fluke prevalence and intensity, but infection levels observed in this study did not decrease Southern Bluefin Tuna condition or increase mortalities. Further investigation is required to identify whether praziquantel dosage rate influences the presence of another species of blood fluke, *C. orientalis*, in farmed Southern Bluefin Tuna.

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Future Oysters CRC-P Communication and Adoption
2017–233

The Future Oysters CRC-P Communication and Adoption project facilitated communication of the CRC-P findings to growers and the wider community and attendance of industry members at annual oyster sector conferences in each state. It also invited feedback from growers. CRC-Ps are smaller versions of full Cooperative Research Centre programs. CRC-Ps run for up to three years with a budget of up to $3 million and they have a focus on collaborative sector-led research programs. The Future Oysters CRC-P project was developed to undertake the research and development needed to build and evolve the Australian oyster aquaculture sector, due to the severe impacts of disease on oyster production in Tasmania, South Australia and New South Wales at the time of its initiation. The trigger for the project was the sudden spread of the viral disease Pacific Oyster Mortality Syndrome (POMS) from NSW to Tasmania in February 2016.

More information: **Matt Cunningham**
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Future Oysters Management and Extension
2016–800

The project was conducted as part of the Future Oysters CRC-P to support the establishment of its governance structures as well as manage its budget and establish communication, extension, education and training plans. Aims of this project also included the monitoring and evaluation of progress for the CRC's research work, maintaining its strategic direction and coordinating and delivering reporting on its Department of Industry, Innovation and Science milestones.

More information: **Matt Cunningham**
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Irradiation dose for prawn virus treatment
2017–190

Prawns infected with White Spot Syndrome Virus (WSSV) that are harvested as bait receive a gamma irradiation treatment at a dose of 50 kilogray (kGy). The wholesale sector, however, indicated that a reduction in treatment dose to

25 kGy or lower would be required to provide meaningful cost benefits.

This project tested if lower gamma irradiation doses were still effective at inactivating the virus, but results were uncertain and the recommendation remains that prawns harvested within the WSSV movement restriction area for packaging and sale as fresh/frozen fishing bait should continue to be treated at a dose of 50 kGy.

More information: **Stephen J. Wesche**
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Freshwater-fish-attracting structures
2017–019

This project investigated the effectiveness of different groups of fish attractors at attracting Australian Bass (*Macquaria novemaculeata*) and Golden Perch (*Macquaria ambigua*) in an impoundment to improve recreational angling. The results demonstrated that both species used the fish attractors as habitat and their abundance at fish attractor sites generally increased. The results were combined with past international studies to develop a best-practice guideline for the use of fish attractors in Australian impoundments.

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Prawn RD&E management and communication
2016–412

This project enabled the Australian Council of Prawn Fisheries to coordinate, commission and extend its RD&E investments under the Industry Partnership Agreement (IPA) 2016–2020 with the FRDC. The report documents the process and plans behind each of the IPA's programs, including Community Engagement, People Development and Industry Communications.

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Managing our Human Dimensions Research
2016–128

The Human Dimensions Research (HDR) Subprogram focused on social science and economic research and improving the effectiveness of human dimensions RD&E for Australian fisheries and aquaculture. This project was established to manage and ensure delivery of the Subprogram from 2017 to 2020.

The outcomes of investment in RD&E by the HDR Subprogram have been positive for Australian fisheries and aquaculture. These outcomes include:

- stronger levels of community trust and acceptance, and a more positive impact within reach through more effective engagement;
- the ability to harness behavioural insights to support compliance, innovation and adoption of best practice;
- evidence of the contribution of Australian fishing and aquaculture to economic and social wellbeing at the national and state level;
- incorporation of improvements in price and productivity into fisheries management; and
- strengthening of resilience against future uncertainty and global shocks through learnings from impacts and responses to the COVID-19 pandemic and disruption.

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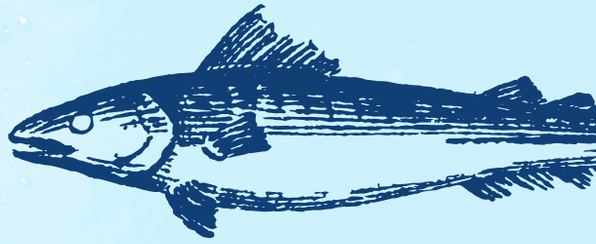

Movers and ...

Claire Webber has joined the South Australian Sardine Industry Association (SASIA) as the full-time executive officer, taking over from Paul Watson.

Kirsten Rough has replaced Claire at the Australian Southern Bluefin Tuna Industry Association (ASBTIA) as acting executive officer.

Sue Grau, previously with Oysters Tasmania and Australian Forest Products Association NSW, has joined the Tasmanian Salmonid Growers Association as CEO.

Lachlan McKinnon has moved out of the commercial eel fishing and export sector to take on a role as the fishing liaison officer with Star of the South offshore wind farm project in Gippsland, Victoria.

Barbara Venn has become the executive officer of the Marine Fishers Association Inc (MFA) in South Australia. Former EO **Gary Morgan** is now the independent chair of MFA.

Sarah Berry has joined the Australian Prawn Farmers Association as research and administration coordinator.

Chris Gillies has left The Nature Conservancy Australia and will be working in social ventures focused on carbon, finance and marine conservation.

Mehdi Doroudi has been promoted to chief executive of the Department of Primary Industries and Regions South Australia (PIRSA).

Keith Rowling has left PIRSA to take up consulting and **Guy Leyland** has retired from the Western Australian Fishing Industry Council (WAFIC).

Steven Wojtkiw is the new chief executive officer at Seafood Industry Victoria.

Sue Rana has joined the FRDC as corporate affairs manager and **Ryan Mullins** is the new FRDC finance officer, replacing Shania Miller.

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