

FISH

FISHERIES RESEARCH & DEVELOPMENT CORPORATION NEWS



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MARCH 2019

THE FISHERIES'
FOOTPRINT

ENVIRONMENTAL
INVESTMENTS

EMERGING
AQUACULTURE
OPTIONS

**New market
opportunities**

AMSA 2019

MARINE SCIENCE FOR A BLUE ECONOMY

7-11 July 2019
Fremantle, Perth

On behalf of the local organising committee, we would like to invite you to attend AMSA 2019, a nation-wide conference that will be hosted in Perth on the 7 – 11 July at Fremantle Esplanade.

AMSA (www.amsa.asn.au) is Australia's peak professional marine science body with hundreds of members from around Australia. We are proud to be at the forefront of marine science in Australia, and our annual conferences allow us to showcase cutting edge research from leaders in the field while strengthening the network and collaboration between marine scientists.

The theme of AMSA 2019 is "Marine Science for a Blue Economy". The theme focuses on science that will contribute to safeguarding the health of our oceans and marine life while also sustaining the economic and societal benefits that accompany a growing nation. Invited national and international plenary speakers will impart their knowledge relating to the blue economy, and symposia topics will be inclusive of a wide range of disciplines including the critical blue economy challenges outlined in Australia's National Marine Science Plan. The theme, and the conference itself, is an exciting venture that will help facilitate and foster collaborative partnerships between industry and marine science researchers well into the future.

We look forward to welcoming you in July.

AMSA 2019 Local Organising Committee

Key Dates

Abstracts Open	Dec 2018	Abstract Outcomes	Mar 2019
Early Bird Registration opens	Dec 2018	Early Bird Registration closes	Apr 2019
Call for Abstracts Closes	15 Feb 2019	Conference	7 – 11 Jul 2019

Keynote Speakers



Dr Cass Hunter
Indigenous social ecological researcher,
Coastal Development and Management Program,
Oceans and Atmosphere, CSIRO



A/Prof Peter Macreadie
Head of Blue
Carbon Lab



Mr Tim Moltmann
Director, Integrated Marine
Observing Systems (IMOS)

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Rock oysters show their tropical potential

By Annabel Boyer

Despite the unique challenges of aquaculture in northern Australia, the commercial potential of native Blacklip Oysters is gathering momentum

When John and Annette Collison moved to Bowen in Far North Queensland in 2014 after more than 32 years growing oysters in New South Wales's Shoalhaven region, they planned to enjoy a restful retirement in the tropical north, close to their son Nathan Collison.

But old habits die hard, and after spotting a few wild oysters on rocks, John Collison decided he might try to grow some, "just to see what happens".

After four years trialling methods to grow wild-caught oyster spat and rear tropical oysters on a lease outside Bowen, the 68-year-old has demonstrated that the farming of native Blacklip Oysters (*Saccostrea echinata*) is a real commercial possibility. With half a million juveniles in the water this year, he expects the venture to be profitable in a year or two.

"Blacklip Oysters are an opportunity just waiting to happen," he says.

They are sweet tasting and relatively

fast growing; one stand-out specimen grew to 70 millimetres in just eight months. For comparison, Pacific Oysters generally take about 18 months to reach 75 millimetres, the standard harvesting size.

Tropical rock oysters occur naturally along the coasts of most of northern Australia. The remains of middens along Australia's coastline are testament to generations of Indigenous Australians feasting on oysters. More recently, they have been wild-harvested off the rocks and bottled for sale.

But it is the prospect of cultivating Blacklip Oysters that has John Collison and a growing number of others excited.

A trial farm on South Goulburn Island has been gradually scaling up its efforts over the last six years. Later this year, the community in the Northern Territory expects to harvest its first significant crop to supply restaurants in Darwin.

"Everyone in Darwin keeps asking me, 'Where are the oysters?'," says Warruwi Elder Bunug Galaminda, from the Yagbani

Aboriginal Corporation on South Goulburn Island. "The whole community is behind this. It's been an uphill battle for the past six years, but now everyone wants to get on board."

Gauging interest

The past year in particular has seen gathering momentum around oyster cultivation in northern Australia from diverse interests that include the FRDC, other government agencies, researchers, existing oyster producers and Indigenous communities.

In October last year, the FRDC funded a workshop in Darwin that brought together a range of players from Western Australia, the Northern Territory, Queensland and NSW, all interested in seeing Blacklip Oysters develop as a commercial crop. The workshop identified research priorities and production challenges, as well as helping to establish networks and project partnerships.

Efforts are underway to address hatchery and husbandry issues, with research aiming to enable commercial spat production of the species.



Opposite page
(Left to right) Vernon Garnarradj, Jimmy Galaminda and Maurice Gawayaku at the Yagbani trial farm at South Goulburn Island, NTs.
Photo: Paul Armstrong, Northern Territory Fisheries

This page
1. Nathan Collison on the Bowen Fresh Oysters lease.
Photo: John Collison
2. Maurice Gawayaku and Jamie Milpurrr installing longline posts at the Yagbani oyster farm.
Photo: Paul Armstrong, Northern Territory Fisheries
3. Market size Blacklip Oysters from South Goulburn Island.
Photo: Paul Armstrong, Northern Territory Fisheries
4. John Collison collecting spat on his oyster lease.
Photo: John Collison

More research is also needed to clarify the species and naming as there is still confusion about whether Blacklip Oysters are a single species, or a sub-species in a larger species complex.

“So far we’ve identified two distinct genetic populations of *Saccostrea echinata* in the Northern Territory,” says Matt Osborne, who leads the Aquaculture and Regional Development programs of Northern Territory Fisheries.

“But in Western Australia it gets more complicated as to which oysters are there and whether they are different strains or species.”

Investigations into the different species and the genetic make-up of those populations will help set up protocols to protect and preserve local oyster populations. Further investigation of the genetic diversity of northern Australia’s populations will also give information on which strains or species grow where, and which do well in particular conditions.

“Until now, very little research has been done on the Blacklip Oyster,” Matt Osborne says.

“We are working to understand more about the oysters, their natural breeding cycles, the speed at which they grow and the different triggers that induce spawning and settlement. This will help us to assess their commercial viability.”

Pilot projects underway in various parts of WA and the Northern Territory are allowing researchers to monitor variables such as oyster growth and water quality, and do the groundwork to underscore food-safety and quality-assurance processes. These projects are also important learning opportunities for new oyster growers.

Remote economic opportunities

The Yagbani Aboriginal Corporation on South Goulburn Island is one of several Indigenous communities in northern Australia interested in oyster cultivation as a culturally appropriate, sustainable economic opportunity from the land and the sea under their custodianship.

South Goulburn Island has just 300 inhabitants, but they are united in their support of the potential for oyster cultivation to bring employment and revenue.

An initiative of the community-owned Yagbani Aboriginal Corporation, oyster cultivation could become the first non-government economic enterprise on the island.

The trial under way already provides regular work for five people. They regularly inspect and grade the oysters, and keep the baskets free of the algae, barnacles and sea

squirts that proliferate in tropical waters.

In WA, Murujuga Aboriginal Corporation has partnered with the FRDC, the Pilbara Development Commission, Maxima Pearling Company and the City of Karratha. In an area famous for mining, oyster cultivation is an opportunity for economic diversification.

General manager of Maxima Pearling Company Steven Gill says the partnership is a win for all.

“We are able to bring our knowledge of aquaculture from our experience growing pearls, and combine that with traditional knowledge from our Indigenous partners,” he says.

“They have knowledge of the local landscape and weather; where the oysters grow; the life cycle, such as when they spawn; and the time of year the oysters are ready to harvest.”

Steven Gill says competition from cheaper pearls in Asia means Maxima is interested in trying out native rock oyster cultivation on some of WA’s 65,000 hectares of pearl leases. It has pilot projects underway in several different parts of the state.

The FRDC is providing 50 per cent of the funding for the Pilbara pilot, which is working on the basic husbandry practices appropriate for the area. These include how many →



Left Steven Gill (Maxima Pearl Company) and Ryan Hall (City of Karratha) installing spat collecting equipment in Flying Foam Passage.

Below right Wayne Hutchinson (FRDC) and

Jonathan Bilton (Albany Multispecies Mollusc hatchery) sorting adult oysters.

Below left Oyster baskets from the Pilbara region. Photos: Pilbara Development Commission

oysters to put in a basket, where in the water column works best, and the kind of gear that is best in the regions they are trialling. Rangers from the Murujuga Rangers program have been monitoring the oysters and checking the lines.

Matt Osborne is also undertaking a mapping project to identify other potential commercial oyster-growing locations in the Northern Territory. The FRDC is funding this project, which will assess whether a potential site is culturally appropriate, close enough to a community to make a venture viable, and suitable from a food-safety perspective. This will include identifying whether cadmium, a heavy metal known to occur in tropical areas, is present at potential sites.

Securing spat

The issue of consistent spat supply in commercial quantities is one of the key concerns for prospective oyster farmers in the Top End.

When John Collison began to farm oysters around Bowen, he found himself catching oyster spat from the wild on plastic oyster slats – something he had not done for decades. With no established hatchery, it was his only option.

But he found he was getting large amounts of spat from the smaller local varieties, rather than from the Blacklip variety that he was interested in cultivating. He says it is almost impossible to tell the species apart until the oysters have grown for about 12 months. Sorting through the oysters for the Blacklips is an expensive and time-consuming process.

The Darwin Aquaculture Centre is also working on the spat issue. It is developing

“With the right nurturing of both oysters and growers, the harvest of Blacklip Oysters could soon become a commercial reality. Tropical oysters harvested in winter could neatly fill demand between other oyster harvests in south-east Australia.”

a hatchery manual for Blacklip oysters and recently produced 200,000 spat for the South Goulburn Island trial. Matt Osborne says the centre hopes to be producing commercial quantities of Blacklip Oyster spat within three years, although this service will ultimately need to be provided by industry.

James Cook University in Queensland is considering setting up an experimental hatchery, which might assist John Collison in the long term. In the meantime, he is building a collection of broodstock that he hopes to send to the Albany Shellfish Hatchery in WA once the necessary biosecurity protocols have been established.

The Albany hatchery has supplied quantities of other tropical rock oyster spat to projects in the Pilbara and the Kimberley, from locally harvested wild broodstock.

Northern challenges

The unique challenges and delights of northern Australia include highly variable tides, cyclones, crocodiles and deadly jellyfish,

just to name a few. All of these factors complicate the process of oyster farming.

For instance, in Bowen, John Collison says he and his son wear stinger suits to protect themselves against lethal species of jellyfish, such as Irukandji and Box Jellyfish, when they need to get into the water to inspect their oysters. Most of the time, they work from a punt.

On South Goulburn Island, workers use decoys – likened to floating dog toys – to keep crocodiles away from oyster baskets. Despite their large numbers, crocodiles have not caused any problems so far. Matt Osborne says the large tides in the region mean that most husbandry work can be conducted safely on dry land.

The much higher and variable tides in the north do require changes to Australia’s southern oyster farming techniques. But FRDC program manager Wayne Hutchinson says oysters are also farmed in extreme tidal conditions in other places around the world.

“In France, oysters are farmed in places where the tidal zone is 15 kilometres out to sea, which means that workers have to get out really quick to retrieve and check on the baskets,” he says. “This shows that oysters can be cultivated in a whole range of different conditions.”

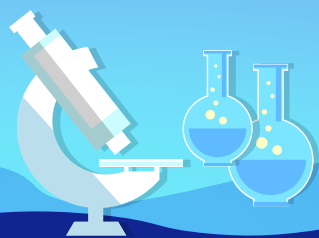
For John Collison, the major change has been the heat. He has built an air-conditioned cool room, which extends the out-of-water life of his oysters from three days to about six, during grading and handling.

He is also concerned that many novice farmers are likely to enter this space, and that the experience needed to nurture young oysters to maturity without a land-based nursery will prove challenging.

But with the right nurturing of both oysters and growers, the harvest of Blacklip Oysters could soon become a commercial reality. Tropical oysters harvested in winter could neatly fill demand between other oyster harvests in south-east Australia.

John Collison says Bowen already has the infrastructure to air-freight coral trout to Asia, which could be used for oysters in the future.

“With domestic demand and several international markets on our doorsteps – Indonesia, Hong Kong and Singapore – the potential is mind-boggling,” he says. **F**



Nominate for science awards

The American Fisheries Society is requesting nominations for the International Fisheries Science Prize (IFSP). The IFSP honours an individual for his or her contribution to global fisheries science and/or conservation and is presented once every four years at the World Fisheries Congress. The prize will consist of a commemorative medal, plaque and US\$5000. The next congress meets in October 2020 in Adelaide.

Nominations for the IFSP close on 31 May 2019 and nominees must belong to member societies of the World Council of Fisheries Societies.

More information: <https://wfc2020.com.au/wp-content/uploads/2018/11/2020-international-fisheries-science-prize-announcement.pdf>



CALL FOR SUBMISSIONS ON EU FREE TRADE AGREEMENT

Australia and the European Union (EU) have launched negotiations for a free trade agreement (FTA), offering a once-only opportunity to negotiate a reduction in tariff and non-tariff barriers affecting Australian seafood exporters to the 28 EU countries.

The Australian Government has invited formal submissions from industry sectors, interested individuals and groups on the potential opportunities and impacts of an FTA with the EU.

FRDC has engaged Jim Fitzgerald to consult with Australian seafood industry stakeholders and prepare a formal industry submission to the Australian Government.

To register your interest in the Australian–EU FTA and to raise issues you would like addressed in the submission, contact Jim Fitzgerald or FRDC general manager communications, trade and marketing, Peter Horvat. **F**
More information: Jim Fitzgerald, Jim.Fitzgerald@frdc.com.au, 0402 130 766, or Peter Horvat, Peter.Horvat@frdc.com.au.

APPLY FOR A NUFFIELD SCHOLARSHIP

Nuffield Scholarships offer primary producers a life-changing opportunity to travel overseas to study an agricultural topic of choice. Participants take part in a conference with scholars from around the world, travel for six weeks in a group across three continents, and embark on an individual international study program, reporting on their experience and findings.

To join the ranks of some 400 Australian Nuffield scholars, including several sponsored by FRDC, apply between April and June 2019 for the 2020 intake.

More information: www.nuffield.com.au

Australia Day Honours

Sime Sarin, a longstanding member of the Port Lincoln seafood community and president of the Australian Southern Bluefin Tuna Industry Association for many years, is among several fisheries figures honoured in the 2019 Australia Day awards. He was recognised as a Member (AM) in the General Division of the Order of Australia for significant service to the fishing industry, to business, and to the community of Port Lincoln. Sime Sarin's fishing-related enterprises include founding the Sarin Group of companies in the 1960s and Australian Fishing Enterprises in 1987, and co-founding the Port Lincoln Tuna Processors in 1973. Sime Sarin was inducted into the Australian Seafood Industry Hall of Fame in 2017 and has been involved philanthropically with a range of community organisations.

Also recognised with an Order of Australia (AM) honour was **John Pollock** for significant service to primary industry through a range of roles. These

include positions with the Australian Fisheries Management Authority – currently as chair of the Bass Strait Central Zone Scallop Management Advisory Committee and previously as chair of the Torres Strait Tropical Rock Lobster Resource Assessment Group and the Torres Strait Finfish Management Advisory Committee.

Awarded the Medal (OAM) in the General Division for service to the fisheries sector was **Ronald Forster**, who is a Port Lincoln shark cage diving operator, and owner and director of Sea Marine Holdings, a Southern Bluefin Tuna farming operation. He also helped to found the Port Lincoln Tuna Classic Fishing Competition.

Chef and co-founder of the Appetite for Excellence national hospitality awards **Luke Mangan** received an OAM for service to the tourism and hospitality industry.

Queensland Seafood Industry Association (QSIA) life member **Denis O'Connell** was awarded an OAM

for his service to the community of the Gold Coast, including its seafood community. He was made a life member of QSIA in 2010.

Dolphin Research Institute founder and executive director **Jeffrey Weir** received an OAM for service to marine conservation. He conducts education programs in partnership with schools, including the creation of the 'i sea, i care' (ISIC) marine ambassador program.

Flying instructor and pilot **William Kiernan** also received an OAM for service to the aviation and transport industry. His contributions include pioneering prawn spotting from the air for the local fishing industry in the 1960s.

Receiving the Public Service Medal (PSM) was **Mehdi Doroudi**, deputy chief executive of the Primary Industries and Regions, SA, previously head of Fisheries. He was recognised for outstanding service to informing policy, and to the management of primary industries in SA. **F**

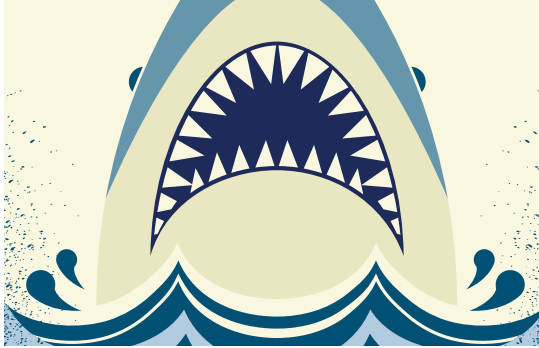
TECHNOLOGY

SHARK BITES LEAVE DNA CLUES

When sharks take a bite out of line-caught fish while the fish are still hooked below water, it is hard to visually identify which shark species is responsible. Known as shark depredation, this occurs for both recreational and commercial catch, and can have economic, social and ecological consequences.

But the bite marks leave something behind: traces of shark DNA. Researchers at the Department of Primary Industries and Regional Development in WA have collected some DNA samples to definitively identify the species involved in all sampled incidences.

Knowing which shark species are involved is fundamental to developing effective management strategies. The WA study is the first to develop a molecular method to identify species involved in depredation events in commercial line-based fisheries without reliance on direct observation.



WORDS

MARINE DEBRIS

Any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment.

MICROPLASTICS

Plastic fragments or particles five millimetres or less in size, either in their primary form, or as a result of the breakdown of larger pieces of plastic.

ENVIRONMENT

**Seabirds drawn to plastics**

As the amount of plastic increases in the marine environment, a growing body of international research is investigating its impact. A study published at www.nature.com in January 2018 investigated what drives plastic ingestion by seabirds, examining 1734 individual seabirds of 51 species. The study found that seabirds at the highest risk of debris ingestion are those that forage at the surface, especially by surface seizing, diving and filtering; those with a crustacean-dominated diet; and those that forage in or near marine debris hotspots. The storm petrel is one species at the highest risk of debris ingestion due to its foraging behaviour.

Another report (Savoca et al., 2016) showed that microplastics in the ocean actually attract seabirds – through their smell. Plastics left in a marine environment for one month produce a dimethyl sulfide signature. Seabirds associate this chemical signature with their food, so it tricks them into thinking plastic is a meal.

Marine ecologist Claire van der Geest says plastics in the marine environment are associated with the death of seabirds and turtles, due to nutritional deprivation and toxic chemicals from the plastics. The plastics either kill animals directly or impair physiological functions, such as growth rates and reproductive fitness. **F**

Source: CSIROscope

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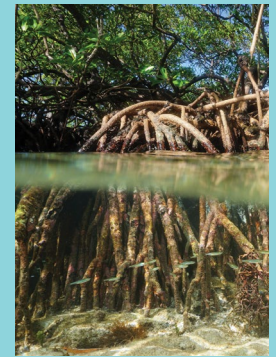
BYCATCH STRATEGIES

Dedicated to “all who are interested in sustainable fisheries”, *The European Landing Obligation* is an open-access book published in 2019 to coincide with the obligation’s full implementation.

For Australian readers, it identifies strategies being used in the European Union to deal with bycatch and discard issues.

Edited by Sven Sebastian Uhlmann, Clara Ulrich and Steven J. Kennelly, the book comprehensively examines the European Landing Obligation policy and evaluates its economic, social-cultural and ecological impacts. Available for download at <https://link.springer.com/content/pdf/10.1007%2F978-3-030-03308-8.pdf>

INNOVATION

**LIVING SEAWALL AIDS WATER QUALITY**

Volvo has teamed up with the Sydney Institute of Marine Science and Reef Design Lab to create a Living Seawall in Sydney Harbour. Consisting of 50 tiles that mimic the root structure of native mangrove trees, the Living Seawall provides a habitat for marine life. Installed along an existing seawall structure, the wall is made from 3D-printed moulds using concrete and recycled plastic.

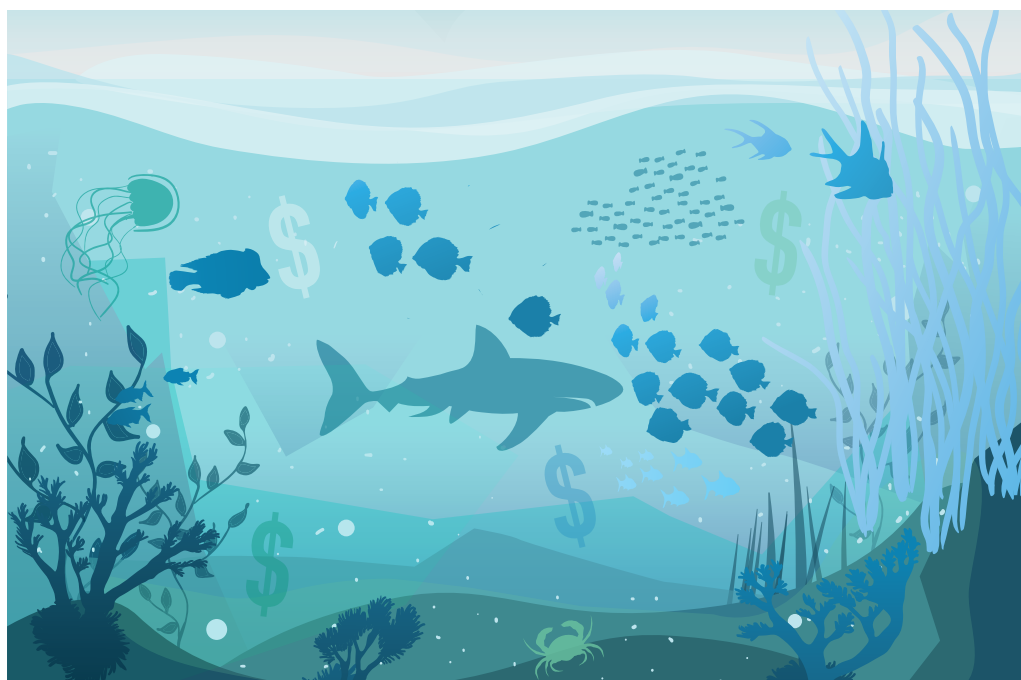
It has been designed to attract filter-feeding organisms that will absorb and filter out pollutants, such as particulate matter and heavy metals, helping to keep the water clean. Researchers will monitor the Living Seawall for the next 20 years to see if it improves biodiversity and water quality.

More information:
www.volvocars.com/au/About/Australia/Living-Seawall



Benefit test to optimise research investment

Ongoing assessment of project outcomes is helping the FRDC ensure it gets the best return from its research dollars



By Catherine Norwood

FRDC research projects completed in the 2016-17 financial year are expected to return a benefit of almost 6 to 1, according to the results of an economic analysis of the investment. These benefits will accrue over 30 years from the time of the original investment.

Conducted by Agtrans Research and Consulting in conjunction with the FRDC's *Research, Development and Extension Plan 2015-20*, the economic analysis is part of an ongoing program to evaluate the effectiveness of FRDC investments.

The analysis showed that 20 randomly selected projects completed in 2016-17 will average a benefit-cost return of 5.7 to 1 – an improvement on the 2015-16 projects, which had a return of 4.5 to 1.

The best performing of the 2016-17 projects was the FRDC's investment creating the Centre for Aquatic Animal Health and Vaccines, which is part of the Tasmanian Department of Primary Industries, Parks, Water and Environment in Launceston. This new, biosecure facility has a 30-year benefit-cost ratio of 15 to 1.

Senior research agronomist at Agtrans Research and Consulting Talia Hardaker says FRDC's 2015-16 results were on par with the national benchmark. This was established in 2016 in a review conducted for the Council of Rural Research and Development Corporations (RDCs). The review assessed 300 projects from across all 15 RDCs.

"In general, in agriculture we would expect

"In general, in agriculture we would expect accrued benefits of between 2 and 5 to 1 over 30 years. With a result of 5.7 to 1 for the latest evaluation, the FRDC is performing relatively well."

Talia Hardaker

accrued benefits of between 2 and 5 to 1 over 30 years. With a result of 5.7 to 1 for the latest evaluation, the FRDC is performing relatively well," Talia Hardaker says.

"When we have results from additional years, we will be able to aggregate our findings. This might help managers identify constraints to adoption and how resources can be better allocated."

She says researchers are already being asked to consciously consider their projects from beginning to end, and to include pathways to impact, to optimise the benefits.

Projects that have industry ownership and participation had better adoption, accrued greater benefits, and tended to have high benefit-cost returns – as demonstrated by the Centre for Aquatic Animal Health and Vaccines, jointly funded by the Tasmanian Salmonid Growers Association.

The FRDC's second-best performing project

from 2016-17 was the emergency response to the outbreak of Pacific Oyster Mortality Syndrome in Tasmania, with a 9.3 to 1 benefit-cost return. This was followed by a project to revise the *Australian Shellfish Quality Assurance Program Manual* in response to FRDC research into paralytic shellfish toxins, with a ratio of 5.6 to 1.

The projects for evaluation, which were selected randomly from the 96 projects completed in 2017, represented all five of the FRDC's research programs: environment, industry, communities, adoption and people development.

Talia Hardaker says it is difficult to put a monetary value on the outcomes of some projects.

"For example, there is no market value on the 'sustainability of ecosystems'," she says. "There is a lot of research being done to develop ways to assess this, but it is complex and it hasn't been included in our evaluations."

She says the FRDC works with a public resource, which makes it unique in terms of the RDCs – and that a significant portion of its research is public good in nature.

"It's also clear from the projects we are evaluating that improving social licence is a driver behind some of the fisheries research, not just a spill-over benefit. Reputation is something the FRDC is specifically targeting, more so than the other RDCs."

The full details of projects assessed and the findings are available from the FRDC's website (www.frdc.com.au). **F**



Fish stocks update

By **Annabel Boyer**

New species and new ways of analysing data make the latest reports on Australian Fish stocks the most comprehensive yet – and available on your smartphone



Crimson Snapper

Table 1. Examples of stock status changes 2014–2018

Species	2014 Stock status	2016 Stock status	2018 Stock status
Blacklip Abalone			
Victorian Central Zone Fishery	Depleted	Depleting	Depleting
New South Wales	Recovering	Sustainable	Depleting
Victorian Western Zone Fishery	Depleted	Sustainable	Sustainable
Tasmanian Eastern Zone Fishery	Recovering	Sustainable	Depleting
Blue Swimmer Crab			
Cockburn Sound	Depleted	Depleted	Recovering
Shark Bay	Depleted	Recovering	Recovering
Gulf St Vincent	Recovering	Sustainable	Sustainable
Snapper			
West coast	Recovering	Recovering	Recovering
Shark Bay inshore – Freycinet Estuary	Recovering	Sustainable	Sustainable
Ballot Saucer Scallop			
Ballot's Saucer Scallop Abrolhos Islands and Mid-West Trawl Managed Fishery	Depleted	Depleted	Sustainable
Shark Bay Scallop Managed Fishery	Depleted	Recovering	Sustainable
Black Jewfish Northern Territory	Depleted	Depleted	Recovering

The latest edition of the Status of Australian Fish Stocks (SAFS)

reports is set to be launched at the Australian Bureau of Agricultural and Resource Economics and Sciences Outlook conference in Canberra on 5–6 March.

The reports provide a snapshot of how Australia's fish stocks are tracking. The 2018 edition is the most comprehensive so far, bringing the number of species assessed from 83 to 120, including many of Australia's favourite commercial and recreationally caught fish species.

The reports are a significant achievement for the fisheries science community. More than 100 fisheries scientists worked on the 120 species reports, which were then independently reviewed by a further 50 fisheries scientists.

Designed to inform the community, consumers and businesses of the sustainability status of Australia's fish populations, the reports can also assist in highlighting priorities for research and management. They provide a roadmap to ensure that sustainable stocks remain that way, and identify where action is needed to address species and stocks of concern.

Since the inaugural 2012 SAFS reports, each new edition has broadened the number of species covered. At 120 species and 406 stocks, the reports cover a majority of the wild harvested production volume across Australia.

Of the stocks in 2018, 254 stocks were assessed as sustainable, 23 as depleting, 18 as recovering, 29 as depleted and 28 as negligible. A further 54 were not able to be fully assessed and were classified as undefined. (See Table 2, Stocks assessed in 2018.)

Key changes

In developing the 2018 edition of the SAFS reports, the FRDC and the SAFS advisory working group conducted a review aimed at improving upon the 2016 edition of the reports. In this edition, minor changes have been made around stock status classification categories: the 'environmentally limited' classification has been removed, the 'overfished' classification has been replaced by 'depleted', and transitional stock categories are now 'recovering' and 'depleting'.

Species and common names have also changed; for example, Saucer Scallop (*Ylistrum balloti*) has been changed to Ballot's Saucer Scallop.

To address these changes and develop a comparison tool across all editions of the reports, the FRDC engaged Andrew Penney, director of Pisces Australis. He has developed a method that uses the reports to produce trends over time. The report on developing the comparisons is available on the FRDC and www.fish.gov.au websites (Research code 2017-100).

Tracking species recovery

From the outset in 2012, the aim of the SAFS reports has been to report on stock status trends over time. Fisheries and the marine environment are constantly changing. They are dynamic systems and the reports provide an insight into how species are faring and where management controls are needed, for example, to reduce catch or to protect fish during spawning.

Table 1 highlights cases where stocks have gone from depleted to recovering, or depleting to sustainable, as managers have put in place mechanisms such as reducing catch to support fish populations.

Broader impacts

While the reports provide a picture of the status of our fisheries stocks, the process of putting the reports together has

gone a long way to harmonising how fisheries jurisdictions share knowledge and undertake stock assessments.

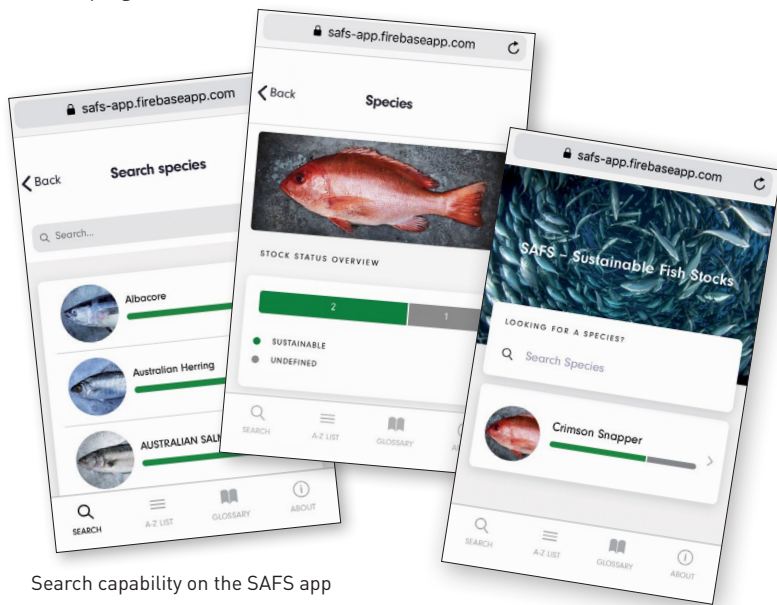
In writing the reports, many early-career scientists have also had the opportunity to work closely with and learn from senior scientists. About 100 fisheries scientists from all jurisdictions work on the reports and for some species all jurisdictions contribute information.

In the future this knowledge could allow for a more cohesive management approach from management agencies.

SAFS app

The SAFS reports are available online at www.fish.gov.au, and also via a new smartphone app the FRDC has developed, available on the App Store and Google Play.

The app distils information from the SAFS reports into clear language. This will make it easier for the public and consumers to check on the sustainability status of different species, especially while they are buying seafood. **F**



Search capability on the SAFS app



ADDITIONAL SHARKS AND RAYS REPORTS

A 'report card' on 194 shark and ray species in Australian waters indicates that the majority are sustainable and in a healthy state. These included 180 shark and 14 shark-like ray species which comprise 196 stocks in total. Australia has one of the most diverse and distinctive shark and ray faunas in the world. A quarter of the 320 or so species occurring in Australian waters are endemic.

The shark report card project brought together all the information available from scattered and disparate sources to assess the status on individual species, and to provide a clear and concise overview of the state of Australia's sharks and rays. While a considerable amount of information is available in peer-reviewed literature, a large amount of data is not formally published.

The report card found that, overall, Australia's sharks and shark-like rays are in relatively good condition, with 126 stocks (64.3 per cent) assessed as sustainable. A further 39 (19.9 per cent) were assessed as undefined, meaning there was insufficient information to determine their status. Of the 196 stocks, only 17 (8.7 per cent) were assessed as depleted.

The report card highlights the species of concern that are either still in decline or depleted, and species for which management needs to be introduced to ensure stocks do not become depleted. The results of the assessment indicate that interactions with fisheries are sustainable for the large majority of species. **The report card on Australia's sharks and rays can be accessed at www.fish.gov.au.**

Table 2. Stocks assessed in 2018 (added 2012, 2014, 2016, 2018)

Year	No. stocks by type					No. stocks by status					
	No. species	No. stocks	Biological stock	Management unit	Jurisdictional stock	Sustainable	Negligible	Depleting	Recovering	Depleted	Undefined
2018	120	406	139	160	107	254	28	23	18	29	54

37 NEW SPECIES

- | | | | |
|---|---|---|--|
| Australian Herring (<i>Arripis georgianus</i>) | Brownlip Abalone (<i>Haliotis rubra conicopora</i>) | Mirror Dory (<i>Zenopsis nebulosus</i>) | Royal Red Prawn (<i>Haliporoides sibogae</i>) |
| Baldchin Groper (<i>Choerodon rubescens</i>) | Eastern Sea Garfish (<i>Hyporhamphus australis</i>) | Ocean Jacket (<i>Nelusetta ayraudi</i>) | Sawsharks (<i>Pristiophorus</i> spp.) |
| Bastard Trumpeter (<i>Latridopsis forsteri</i>) | Elephantfish (<i>Callorhinchus milii</i>) | Ocean Perch (<i>Helicolenus barathri</i> & <i>H. percoides</i>) | School Mackerel (<i>Scomberomorus queenlandicus</i>) |
| Bight Redfish (<i>Centroberyx gerrardi</i>) | Estuary Cobbler (<i>Cnidogobius macrocephalus</i>) | Pearl Perch (<i>Glaucosoma scapulare</i>) | Silver Warehou (<i>Seriotelella punctata</i>) |
| Black Bream (<i>Acanthopagrus butcheri</i>) | Grey Morwong (<i>Nemadactylus douglasii</i>) | Periwinkle (<i>Trochidae, Margaritidae, Solariellidae, & Tegulidae</i> spp.) | Spangled Emperor (<i>Lethrinus nebulosus</i>) |
| Blue Threadfin (<i>Eleutheronema tetradactylum</i>) | Hapuku (<i>Polyprion oxygeneios</i>) | Rankin Cod (<i>Epinephelus multinotatus</i>) | White Teatfish (Sea Cucumber) (<i>Holothuria fuscogilva</i>) |
| Blue Warehou (<i>Seriotelella brama</i>) | Jackass Morwong (<i>Nemadactylus macropterus</i>) | Redfish (<i>Centroberyx affinis</i>) | Yellowfin Whiting (<i>Sillago schomburgkii</i>) |
| Bluespotted Emperor (<i>Lethrinus punctulatus</i>) | John Dory (<i>Zeus faber</i>) | Ribaldo (<i>Mora moro</i>) | Yellowtail Scad (<i>Trachurus novaezelandiae</i>) |
| Bluespotted Flathead (<i>Platycephalus caeruleopunctatus</i>) | Mahi Mahi (<i>Coryphaena</i> spp.) | Roe's Abalone (<i>Haliotis roei</i>) | |
| Bluethroat Wrasse (<i>Notolabrus tetricus</i>) | Mangrove Jack (<i>Lutjanus argentimaculatus</i>) | | |



Dan Fish, general manager of Aquaculture at Clean Seas with a Yellowtail Kingfish
Photo: Clean Seas Seafood Limited

Yellowtail Kingfish growing availability for consumers

By Catherine Norwood

New information on what to feed Yellowtail Kingfish, and when, will help produce more fish more quickly for the domestic white fish market



Steven Clarke
Executive officer of the Kingfish for Profit research program, South Australian Research and Development Institute

The independent Agtrans Research benefit-cost analysis also suggests that over a 15-year time frame a \$17.20 benefit will be realised for every dollar invested in this program.

Putting Yellowtail Kingfish (*Seriola lalandi*) on more Australian dining tables, as a ‘white flesh’ fish option for domestic household consumption, is the long-term ambition behind the recently completed national ‘Kingfish for Profit’ (K4P) research program.

The research program has brought this consumption goal a step closer, improving both the production efficiency and profitability benchmarks of Yellowtail Kingfish aquaculture.

The K4P findings have given the industry confidence that its key production benchmarks for growth, feed conversion and fish survival rates are all achievable. This paves the way for a substantial expansion of production that is expected to make Yellowtail Kingfish an affordable white-fleshed companion to Atlantic Salmon for domestic consumers.

Over the life of the K4P project, Australian Yellowtail Kingfish production has been slowly but steadily increasing. Clean Seas Seafood in South Australia has more than doubled its Yellowtail Kingfish sales since 2015 to more than 2500 tonnes. In 2018, the company announced an expansion from south and central Spencer Gulf to Fitzgerald Bay in the north.

Huon Aquaculture, at the NSW Department of Primary Industries (DPI) Port Stephens Marine Aquaculture Lease, has progressed from stocking the first fingerlings in sea cages at Port Stephens to growing fish to market size. These trials have demonstrated excellent fish growth, product quality and demand.

Late last year Huon announced it would expand its Yellowtail Kingfish operations to a new 2200-hectare lease near the Abrolhos Islands, off Geraldton, in Western Australia. It is also looking at new sites in NSW and will wind down operations on the research lease.

Indian Ocean Fresh Australia has been operating off Geraldton, WA, refining Yellowtail Kingfish production over the past decade. While not

an official partner in the K4P project, it was involved in early discussions and will have access to the research findings. Indian Ocean Fresh Australia has undertaken other trials, including the evaluations of feeds, a comparison of broodstock from different regions, and treatments for flukes and bacterial infections. It also has some 800 hectares for future farming near the Abrolhos Islands.

Collaborative initiative

The Australian Government provided a \$3.65 million grant through the Department of Agriculture and Water Resources Rural R&D for Profit program to fund the K4P initiative. Contributions from other partners including the FRDC brought the total project funding to \$7.3 million.

The K4P initiative was coordinated through the FRDC's New and Emerging Aquaculture Opportunities Program. The South Australian Research and Development Institute (SARDI) and NSW DPI were the lead research agencies. Commercial partners included Yellowtail Kingfish producers Clean Seas Seafood and Huon Aquaculture and feed manufacturers Ridley and Skretting Australia.

Executive officer for the project Steven Clarke, at SARDI, says the cross-industry and cross-region collaborations established were fundamental to the success of the project and building individual and industry-wide research capacity.

Building the national research capacity in finfish aquaculture specifically for Yellowtail Kingfish, but with applications to the aquaculture sector more broadly, was an important part of the overall K4P program. The project also expanded Australia's capacity for Yellowtail Kingfish research, employing three postdoctoral researchers, and supported six PhD candidates, two Masters student interns and four Honours students.

Fishmeal substitution

Feed is the major input for aquaculture, accounting for about 60 per cent of costs, and was the main focus of the K4P program. Among the most expensive, but critical dietary components are fishmeal and fish oil, which are usually imported into Australia. These come from global wild fisheries resources, and reducing reliance on these inputs is crucial to the financial and environmental sustainability of the local industry.

Research findings have identified acceptable levels for a range of potential ingredient substitutions, creating more flexible and potentially cheaper feed formulation options.

The best performance in the search for alternatives to wild-derived fishmeal was achieved using cheaper fishmeal made from fishery waste. Other proteins trialled also showed good digestibility and had the potential to reduce feed costs substantially without jeopardising fish health or growth rates.

For sub-adult Yellowtail Kingfish 'fishmeals' made from poultry by-product, lupin, high-quality soy protein concentrate, krill meal, meat, faba beans and wheat were found to be highly digestible. Some raw materials such as corn gluten meal and blood meal were comparatively poorly digested.

This information was used to formulate better diets in subsequent trials at both SARDI and NSW DPI, which successfully identified options to reduce wild-derived fishmeal in Yellowtail Kingfish feeds by as much as two-thirds.

Feed ingredients and nutrition

Yellowtail Kingfish aquaculture has been underway in Australia for around 20 years, pioneered by Clean Seas Seafood in South Australia, with

practices in part adapted from similar species around the world.

The K4P project builds on the sizeable earlier research investment funded by the FRDC and other national research initiatives such as the Seafood Cooperative Research Centre, and new findings have identified nutritional requirements unique to the Australian *Seriola* species.

This includes the confirmation that higher levels of the amino acid methionine are critical for optimising growth rates of juvenile *Seriola lalandi*, compared to other closely related *Seriola* species.

Project leader at NSW DPI Mark Booth says this finding is a real step forward and should improve commercial feed formulations to optimise growth rates for Australian producers. The finding emerged from a series of closely related trials aimed at identifying the specific requirements of juvenile fish for taurine and amino acids such as cysteine and histidine.

Project leader at SARDI David Stone says his group also determined the optimum omega-3 fatty acids levels and protein-to-energy ratios for larger sub-adult Yellowtail Kingfish. Information about this and other fish nutrient needs has further improved feed formulations to optimise growth rates for Australian producers.

New data has allowed for updated models to map the energy and nutritional requirements for Yellowtail Kingfish at different life stages and in different water conditions and temperatures. This has allowed more accurate predictions of growth and feed demand.

The Australian Government provided a \$3.65 million grant through the Department of Agriculture and Water Resources Rural R&D for Profit program to fund the K4P initiative. Contributions from other partners including the FRDC brought the total project funding to \$7.3 million.

Regional trials

The two research locations for the K4P project, in Adelaide, SA, and Port Stephens, NSW, effectively provide data for modelling fish growth in both warm and cold water conditions, representative of much of the temperature range experienced by existing commercial Yellowtail Kingfish farms.

Trials centred at the South Australian Aquatic Sciences Centre at West Beach, in Adelaide, investigated the needs of larger sub-adult fish of one to four kilograms. Trials involving broodstock and juvenile fish of less than one kilogram were centred at the Port Stephens Fisheries Institute in NSW.

Revised feeding strategies to promote growth and fish health were also among the findings, which are expected to improve feed utilisation efficiency. One early trial result at SARDI showed that feeding sub-adult fish raised in cold water (10°C to 16°C) to satiation six days a week, rather than a twice-weekly 'maintenance' ration, increased the growth rate of large sub-adult Yellowtail Kingfish during winter. This also improved feed conversion ratios (FCR), with a potential cost saving of \$350,000 a year if extrapolated to a 2000-tonne Yellowtail Kingfish farm. →

Right Juvenile Yellowtail Kingfish trials were undertaken at the New South Wales Department of Primary Industries research centre in Port Stephens. Photo: Catherine Norwood

Other feeding strategies identified to enhance production outcomes include:

- feeding fish twice daily to satiation when water temperatures are 20°C or more to ensure each fish has the opportunity to consume enough feed to support their growth potential;
- feeding fish at least once daily when water temperatures drop below 20°C;
- reducing feed inputs when dissolved oxygen in the water is low or decreasing (such as when there is minimal tidal movement during a neap or dodge tide), as fish require adequate levels of oxygen to support the optimum metabolism of their feeds;
- increasing the lipid content of diets fed to large sub-adult fish during winter to improve weight gain and FCR; and
- feeding broodstock natural foods such as pilchards and squid to improve fecundity and the health of progeny.

Gut health

The K4P project also developed a tank-based challenge test and undertook microbiomic studies to assess the links between Yellowtail Kingfish nutrition and health. These projects, both at SARDI, were led by Marty Deveney and Andrew Oxley, respectively.

Sampling gut microbiome using rectal swabs has helped to map fish health in a non-destructive way and established a baseline for what makes a 'normal' healthy gut microbiome for Yellowtail Kingfish. This provides a critical reference to identify disease as well as fish responses to feed formulations. One trial identified a feed formulation that helped to increase beneficial gut microflora, suggesting specific feeds could be developed to address disease issues.

Industry outlook

At the beginning of the K4P project in 2016, national Yellowtail Kingfish production was estimated at about 1200 tonnes. The FRDC anticipated this this would increase to about 5000 tonnes by 2022, which industry is on track to deliver.

By the end of 2018, as the project was winding up, production projections had increased along with allocations of potential farm sites. The final impact assessment of the K4P project by Agtrans Research and Consulting is based on projections of 48,000 tonnes of Yellowtail Kingfish a year by 2030. This represents growth of 4000 per cent over 15 years.

Steven Clarke says the independent Agtrans Research benefit-cost analysis also suggests that over a 15-year time frame a \$17.20 benefit will be realised for every dollar invested in this program. The analysis recognises that further social and environmental benefits may also accrue as a result of the K4P project, but values for these have not been included in the assessment.

Research leaders David Stone and Mark Booth both caution that findings from tank trials and laboratory research need testing and validation in commercial environments to ensure the results are transferable to commercial farms. However, some findings are already helping producers reduce costs and improve production efficiencies. **F**



PRACTICAL FISH HEALTH SKILLS

One of the major benefits to come from the Kingfish for Profit (K4P) initiative is the extension of fish health and nutrition expertise to a new generation of fisheries science students and professionals working in aquaculture.

This included a two-day Yellowtail Kingfish Health Training Workshop held in Adelaide and Roseworthy, South Australia, in September 2018, organised to address a knowledge gap identified by project participants.

It provided a practical overview of the anatomy of Yellowtail Kingfish and the pests and disease issues of this and other species, and also touched on those of the new and emerging aquaculture sectors including Barramundi and Cobia.

Executive officer for the K4P program and organiser of the workshop Steven Clarke, at the South Australian Research and Development Institute, says funding for the workshop came from the FRDC's Aquatic Animal Health Training Scheme, which is part of the FRDC's People Development Program.

There were 26 participants from the aquafeed manufacturing, Barramundi, Cobia and Yellowtail Kingfish aquaculture sectors, including six PhD candidates from the K4P project.

Topics discussed included biosecurity, recognising pest and disease symptoms, specimen sampling procedures, diagnostic methods and management strategies.

Steven Clarke says the workshop provided a valuable opportunity to learn practical skills and to create professional networks across the developing finfish aquaculture sectors, including industry, researchers, fish health officers and veterinarians.

The K4P initiative was part of the Australian Department of Agriculture and Water Resources Rural R&D for Profit program.



Market science identifies consumer triggers

Smart strategies and partnerships have provided the pathway to success for the Love Australian Prawns campaign



Photo: Adpower

Using a research-based strategy, the Love Australian Prawns campaign has achieved some unprecedented milestones in the Australian seafood sector. Now in its sixth year, the campaign was initiated by the Seafood Cooperative Research Centre and the FRDC. It is the only industry-funded, voluntary, national marketing program for an entire seafood category.

Over the past five years, the value of Australian prawns has increased markedly. Complex market factors have contributed to this, but the Love Australian Prawns campaign is recognised as playing a key role, increasing the preference and price without relying on marketing tropes and large advertising budgets.

When the campaign first launched in 2013, it identified key triggers that lead to consumer purchases. Market research also identified a discrepancy between what consumers say motivates them and their actual behaviour. Campaign coordinator Ben Hale says this research allowed the campaign to “push the right cognitive and emotional buttons” without the need for vast sales, merchandisers or media.

Rather than trying to change everyday meal planning, the campaign prioritised ‘special occasion’ marketing that increased value over volume. This strategy is geared to serve an industry that is limited by what can be caught or grown.

Retailers

Marketing through independent seafood retailers was a priority from the outset.

Ben Hale says support of these outlets translates into prime window, shelf and counter space. Love Australian Prawns campaign materials are now carried by 400 retailers.

He says retailers can now select from the range of materials available and choose those most relevant to their customers using an online, automated system. This helps reduce the costs of printing and distribution.

Since mouthwatering images and videos trigger emotional responses, and these trigger purchases, the campaign has generated a high-quality library of prawn recipes, images and videos.

This content is crucial in kick-starting purchases from online and social media, as well as for use in traditional print media and at point of sale.

This campaign investment culminated in the release of *The Great Australian Prawn Cookbook* last year. About 2700 copies have been sold from the Love Australian Prawns online store, and they are also sold through seafood retailers.

Supermarkets

Love Australian Prawns has achieved brand recognition among 20 per cent of Australian households. This has been done through strong partnerships with supermarkets rather than a large, saturation media spend.

Ben Hale says Woolworths, for example, has carried more than three million Love Australian Prawns recipe books in store. It supports the brand at point of sale, using the campaign logo as a quality mark for local product in its weekly catalogue, which lands

in four million homes every single week.

Supermarket campaigns extended to Coles in 2019 with an Australia Day recipe.

From retailers to restaurants

Ben Hale says the focus for the future is greater recognition and preference for Australian prawns through food service providers.

White-linen restaurants are often already aware of their supply chain and the importance of the provenance story to their customers. Trials are now underway to foster a similar pride in seaside pubs, surf clubs and cafes.

The trials have used a novel ‘prawn bucket’ marketing tool. The bucket is designed to create theatre around the dining experience: to boost sales while injecting the Love Australian Prawns brand into the dining table at the moment of consumption.

With professional point-of-sale marketing and image assets made available to restaurants, venues can run their own promotions and develop marketing momentum without a large investment.

The response from diners and restaurants participating in trials has been positive, with the 1000th meal recently served.

Along the way, the FRDC has supported the Love Australian Prawns campaign with research projects looking at the market, and ensuring product quality. **F**

If you're a prawn producer and aren't part of the Love Australian Prawns campaign, find out more about how the campaign works and how individual producers benefit at www.australianprawnmarketing.net.



Direct approach to China

Traditional importers, hotels, restaurants, wet markets and e-commerce deliveries of live rock lobsters to consumers' homes are all part of the mix for the Geraldton Fishermen's Co-operative's venture into China

Story **Catherine Norwood** Photos **Geraldton Fishermen's Co-operative**

To survive as a foreign business in China, particularly as a fresh food business, you need to be nimble. This sage advice is born of the experience of Matt Rutter, CEO of the Geraldton Fishermen's Co-operative (GFC). Since establishing its own China-based business just three years ago, the GFC's various twists and turns demonstrate how adaptable you need to be to succeed.

The co-op trades exclusively in Western Rock Lobster (*Panulirus cygnus*), sold under the Brolos brand. And while the Western Rock Lobster industry is "not all about China", Matt Rutter says the country is the dominant player, and the market with the greatest opportunity for growth – at the highest prices.

"No one else in the world values rock lobster more than the Chinese," he says. "So the majority of the product flows there naturally. It brings massive benefits back to Australia and the local economy."

In 2018, GFC members represented 60 per cent of the commercial Western Rock Lobster quota, which equated to more than 3700 tonnes of the 6300-tonne total allowable commercial catch for the year.

Of that, about 96 per cent was exported live to China, with the remainder sent as a mix of live and frozen product to markets in Japan, Taiwan, the US, South-East Asia, the Middle East and domestic markets.

A new era

Matt Rutter says 2018 was a 'watershed' year for the GFC's trade with China.

The China–Australia Free Trade Agreement (ChAFTA), which came into effect from 2016, which progressively reduced tariffs on rock lobster from 15 per cent in 2016 to six per cent and then three per cent in 2018.

"The drop to three per cent was the tipping point and basically completely opened the doors

into China," Matt Rutter says. "It made it economical for Chinese importers to buy product direct."

By April 2018, with a strong increase in direct sales, the GFC decided all of its sales destined for China would be sold directly to buyers in China, rather than to buyers redirecting product through other countries.

This decision has allowed the co-op to strengthen its direct marketing channels in the lead-up to the total removal of the tariff this year. It has also been able to reconfigure its distribution networks – the third such change in just three years.

First steps

The GFC first began investigating its own business opportunities in China in 2014, with ChAFTA negotiations already under way. In 2016, when the rock lobster tariff was 15 per cent, it established a foreign-invested commercial enterprise in Guangzhou.

Opening an office and a bonded warehouse allowed the GFC to hold live and frozen product effectively 'in transit', pre-duty and pre-customs clearance, for distribution in China or trans-shipment to other markets.

Cross-border trade had some benefits, including lower tariffs. But, as the Chinese tariff reduced, the advantages of the bonded warehouse diminished. So in 2017, the GFC closed the bonded warehouse and opened new holding facilities in Guangzhou, Beijing and Shanghai. At these facilities, the product was cleared and ready for immediate sale, with distribution centres in each city.

"This strategy was initially built around e-commerce, delivering live rock lobsters to consumers' homes," Matt Rutter says.

"We had facilities within the SF Express cold-chain warehouses, and we could pack rock lobsters direct into retail packaging and send it to

homes within five to 10 hours of being packed. E-commerce is a really rapidly growing market in China and we wanted to explore that."

Exploring other markets

While e-commerce has not been as successful as the GFC had hoped, due to the expensive nature of the product, Matt Rutter says the process did help to establish "a footprint", with live holding facilities in three cities. And this gave the co-op the opportunity to explore other markets as well.

"As free trade has kicked in, we have started to explore delivering direct to businesses, rather than to customers – B2B rather than B2C," he says. "We're finding the opportunities in this B2B market are larger than those in the B2C market. So we've evolved again to better service those business markets, although we are continuing with the Chinese customer e-commerce site."

As 2019 kicks off, Australian rock lobster imports are officially tariff free in China, and the GFC is relocating its Guangzhou and Shanghai holding facilities closer to wet markets and businesses. It will suspend the Beijing warehouse for the time being, servicing that market via Shanghai and Guangzhou instead.

The larger hub in Guangzhou will take advantage of the GFC's holding facilities adjacent to Perth airport and direct flights to Guangzhou.

"We can use Guangzhou as a distribution centre into the rest of China, which will give us some economies of scale," Matt Rutter says. "The Shanghai hub will move into one of the wet markets."

The GFC's rock lobster holding pens have been designed to be highly mobile – they can be simply loaded onto the back of a truck and moved to a new location. Matt Rutter says this design reflects the continual evolution of operations in China and the speed of change. "You need to be nimble so that you can evolve as you learn more about the market, and it is a highly complex market," he says.



New markets for Western Rock Lobsters are opening in China.

A multiplicity of markets

In fact, Matt Rutter adds, China is not one market, but hundreds. The country has at least 15 cities with a population of 10 million or more, and 100 cities with a population of around one million. And in each of these cities, the demand for rock lobster is shaped by different factors, including preferred size and cultural dining traditions. In inland cities such as Chengdu (population 7.8 million) in Sichuan province, known for its spicy foods, the experience of rock lobster is almost entirely new.

The development of China's sophisticated cool-chain logistics over the past five years has allowed seafood to safely travel further, creating new market opportunities.

Matt Rutter says having its own facilities also allows the GFC to diversify its supply options for buyers. Large importers can use traditional 'carriage paid to' terms, taking responsibility for the product from the point of departure from Australia. Others, particularly smaller buyers, can use 'delivered duty paid' arrangements and opt to buy direct from the GFC's facilities in China, collect it from the destination airport, or have it delivered directly to their doorstep.

An increasing demand

According to Matt Rutter, it has always proven

difficult to quantify the return on the investment in China because so many variables influence the price of a fresh food product such as rock lobster. These could include anything from the volumes caught in Australia on any one day, to whether it is a lucky year to get married in China.

"But there is increased demand for the product and we have opened new markets," he says.

"We are servicing twice the number of customers that we were 12 months ago, and many of those customers are further down the supply chain, so we are capturing a larger share of the final price. And we are only selling to the highest paying customers, so we are confident we have a higher baseline price for our product, although peak prices remain highly volatile.

"2018 has been a huge year for us. But we have to remain nimble, to remain open to market opportunities and to be constantly watching the trends in China. Because if you can't change quickly in response to those things, then you will quickly become redundant." **F**

Matt Rutter will speak about the Geraldton Fishermen's Co-operative's market journey in China at the 2019 Australian Bureau of Resource Economics and Sciences Outlook Conference in Canberra on 5–6 March, 2019.



Above Geraldton Fishermen's Co-operative members travelled to China last year to visit rock lobster holding facilities and explore local seafood markets.



Left Researchers use a sampling sled to capture prawns in NSW estuaries in order to identify the most valuable habitat. Photo: NSW Department of Primary Industries

Saltmarsh value to fisheries productivity uncovered

By Aisling Fontanini

Saltmarshes receive new recognition for their crucial role in the food chain and the economic productivity of coastal fisheries



Matt Taylor
 NSW Dept Primary Industries

"In seagrass-limited systems such as the Hunter and Clarence Rivers, saltmarsh is particularly important for supporting prawn populations"

Geoff Hyde has been commercially fishing prawns in the New South Wales

Hunter River region for almost 70 years and boasts of being able to buy his first car in cash after a good day's fishing on the river. "The amount of prawns in those days was incredible," he says.

But he saw prawn numbers begin to decline after tidal floodgates were installed on Hexham Swamp in the 1970s to provide more freshwater and grazing land for livestock. As a result, he has been a long-time advocate for the return of saltwater tidal flows to the swamp to restore its role as part of prawn nursery grounds.

In 2013, land managers completed works to re-open floodgates and reconnect the tidal flows from the lower estuary to the Hexham wetland. This research found a high number of prawns in the reconnected area, a finding Geoff Hyde says speaks for itself.

He is one of several commercial fishers who have assisted researchers involved in a four-year FRDC-funded research project to unravel how land management practices have changed the dynamics of wetlands and the fisheries that rely on them, particularly the Eastern King Prawn (*Melicertus plebejus*) fishery.

And although recently retired, he has welcomed the research findings that show estuarine habitats – and saltmarsh in particular – are a crucial part of the fisheries food chain and a major contributor to the region's economy.

Matt Taylor from NSW Department of Primary Industries led the multidisciplinary project team that included researchers from the University of Newcastle, Griffith University, and the University of New South Wales.

Their aim was to unravel the complicated relationships between fishery productivity and estuarine habitats in three NSW estuaries: the Clarence River north of Coffs Harbour, and the Hunter River and to a lesser extent Lake Macquarie, both near Newcastle. They wanted to establish the potential impact of habitat repair on the Eastern King Prawn and other important estuarine species.

Role of estuaries

Available aerial imagery documents a 74 per cent loss of saltmarsh habitats in the Hunter River from the 1950s to the 1990s. In the Clarence River, 64 per cent of saltmarsh has been lost, as has 79 per cent of seagrass cover, since the 1940s.

While seagrass is regularly touted as an important source of food and nursery habitat, Matt Taylor says this research shows "it's not all about seagrass".

"There are really strong links between saltmarshes (and to a lesser extent mangroves) and the broader estuarine ecosystem where most of the fishing takes place. In seagrass-limited systems such as the Hunter and Clarence Rivers, saltmarsh is particularly important for supporting prawn populations," he says.

Eastern King Prawn

The research focused initially on Eastern King Prawn as a commercially important species that is fast growing, abundant, and reproduces quickly. The 2015-16 annual catch in NSW was more than 500 tonnes, and in Queensland 2300 tonnes, with a combined value of about \$40 million.

"It is NSW's most valuable prawn fishery," says Matt Taylor. "The prawns are a tasty, high-quality product, and fetch a high price."

And NSW estuaries provide important nursery grounds for Eastern King Prawns, he says.

While adult prawns actually reproduce in northern NSW and Queensland waters, the larvae then ride south on the East Australian Current, seeking

estuaries such as those in the Hunter and Clarence Rivers and Lake Macquarie. Entering their post-larval phase, the prawns settle into these estuaries where they grow to adults, before heading to sea, and northwards to reproduce.

In an effort to understand how prawns and other commercial species were interacting with estuarine habitats, Matt Taylor's team combined extensive field sampling, laboratory experiments, and numerical modelling. The results provided some unexpected findings.

Saltmarsh scrubs (*Sporobolus virginicus* and other species) become submerged during spring tides for up to six hours a day and stretch more than 760 hectares in the Hunter River and 280 hectares in the Clarence River. The tidal flooding of these vast saltmarsh areas creates opportunities for estuary animals to leave the adjacent channels and come up onto the marsh surface.

Matt Taylor says it was a surprise that Eastern King Prawn and Eastern School Prawn (*Metapenaeus macleayi*) were not found directly in these inundated saltmarsh habitats, unlike similar species in other parts of the world. In fact, from the many thousands of animals caught in fyke nets over the saltmarsh surface, only eight were Eastern King Prawn.

He says this shows there isn't a strong direct interaction between the prawns and the marsh surface, although he did find high densities of prawns within the subtidal marsh channels.

Saltmarsh diet

Matt Taylor says the importance of saltmarsh to fisheries in the Clarence and Hunter River estuaries seems to lie in an indirect trophic relationship. Isotopic analysis showed that saltmarsh is the dominant source of prawn nutrition in these two estuaries. It was responsible for as much as 95 per cent of the diet in commercially fished prawns in the Clarence and 47 per cent in the Hunter.

"There are animals that are feeding on the saltmarsh grass, but the saltmarsh grass, like a lawn, grows and dies. The animals that feed directly on the grass, and the detritus derived from the saltmarsh, are being washed through the system to support the food web in the broader estuary," Matt Taylor says.

Saltmarsh was also a significant nutritive habitat in both estuaries for a range of commercially fished species such as Mulloway (*Argyrosomus japonicus*), Dusky Flathead (*Platycephalus fuscus*), and Sea Mullet (*Mugil cephalus*). Recent work by the University of Newcastle has also confirmed this pattern in other NSW estuaries where seagrass is much more abundant than it is in the Clarence and Hunter River estuaries.

Strategic restoration

Researchers used stable isotopes, chemical signatures that are accumulated in the bodies of the prawns as juveniles, as tracers to identify important nursery areas. By catching prawns as they emigrated through the mouth of the estuary and comparing them with the chemical signatures found in prawns captured throughout the estuary, researchers were able to deduce which areas emigrating prawns were most likely to have come from.

Quantitative sampling found some of the highest Eastern King Prawn densities in the lower part of the rehabilitated Hexham Swamp. This has gone a long way to vindicate Geoff Hyde's advocacy for the restoration of tidal flows to wetlands in the Hunter River system. The isotope analysis has also helped to predict which areas in the Hunter and Clarence River estuaries are likely to have the most positive impact on prawn productivity if habitat restoration is undertaken.

As part of this project, results were combined with other fisheries data sources, which allowed the research team, for the first time, to estimate an



Above These Eastern King Prawns captured at Ballina, NSW, will have grown to adulthood in more southern estuaries. Photo: NSW Department of Primary Industries

economic value derived from these saltmarsh and mangrove habitats through the fisheries harvest they support.

Economic value

"This really does allow economic comparisons between the different uses you can have for reclaimed saltmarsh, which is essential for mounting an economic case for habitat repair," Matt Taylor says.

The model used data from several important commercial fisheries in the study, including Yellowfin Bream (*Acanthopagrus australis*), Mulloway, Dusky Flathead, Luderick (*Girella tricuspidata*), Sea Mullet, Giant Mud Crab (*Scylla serrata*), Blue Swimmer Crab (*Portunus armatus*) and Eastern School Prawn.

For each species, the model considers the proportion of exploited biomass that is attributed to nutrition from saltmarsh and mangrove habitats. For example, Mud Crab in the Hunter River estuary derive 46 per cent of their nutrition from saltmarsh grass, and 24 per cent from mangroves. By applying historical catch and market value data, incorporating uncertainty, and making a few simple assumptions, the model estimates the potential economic value of the fisheries harvest that may be supported by different estuarine habitats.

It found that, each year, saltmarsh habitats on average support \$7.2 million of revenue in the Clarence River and \$1.3 million in the Hunter River through the extraction and commercial sale of the fish and crustaceans listed above.

Mangrove habitats account for \$3.5 million and \$600,000 of income in the Clarence and Hunter estuaries, respectively.

"These are probably conservative estimates, because they do not account for the value of recreationally harvested biomass that is also supported by these habitats," Matt Taylor says.

The research findings are already being used to plan future habitat repair in NSW, including prioritising areas for restoration and mounting a supporting business case. The approach developed by this project is also being incorporated in another FRDC-funded project, 2017-175, as part of a large program to develop a Natural Capital Accounting framework for Australia, being led by CSIRO. **F**

Peter Macreadie and PhD candidate Ashley Whitt measure a blue-carbon core taken from a mangrove swamp at Stony Creek, beneath Melbourne's West Gate Bridge.



Story Bianca Nogrady
Photos Donna Squire, Deakin University

The push for blue carbon

While blue-carbon scenarios abound, investment hinges on the details – including the development of a rigorous, internationally accepted accounting system

The term ‘carbon farming’ usually conjures images of land-based agricultural and forestry initiatives. But there’s a new kid on the carbon-farming block, and it occupies the rich ecological niches that hug Australia’s extensive coastline.

As an island nation, Australia boasts one of the longest coastlines in the world: nearly 60,000 kilometres in total. While some of that coastline is occupied by beaches, large swathes are also home to mangroves, saltmarshes and seagrass beds. These are the sources and sinks for ‘blue carbon’ – the carbon stored in coastal marine sediments and plants.

Former Federal Environment Minister

Greg Hunt advanced the concept of blue carbon at the 2015 United Nations Climate Change Conference in Paris. Since then, interest has been growing in how Australia can capitalise on this carbon resource – and, in doing so, help restore ecosystems that are also vital for fisheries.

Australia was one of the first countries to include blue carbon in its National Greenhouse Gas Inventory, and was instrumental in launching the International Partnership for Blue Carbon at the Paris climate conference.

For fisheries, blue-carbon initiatives could offer multiple benefits. They could address climate change and ameliorate the related flow-on effects to fisheries, as well as improve, restore and protect critical fishery habitats (see page 18).

Boutique carbon

Blue carbon can be thought of as ‘boutique’ carbon, says Catherine Lovelock, professor in the School of Biological Sciences at the University of Queensland, because it offers so much more than simple carbon sequestration.

“We can plant a mallee forest, and maybe we’ll help some biodiversity, but mangroves are habitat and nursery for many commercially valuable coastal marine species, including Mangrove Jack, Barramundi, Mud Crabs and Banana Prawns, as well as being home to molluscs and other crustaceans,” she says. “Mangroves also act as a buffer zone to protect against storm surges and extreme events, such as cyclones and tsunamis.”



MORE INFORMATION

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“We’ve got two to three metres deep of old seagrass or old mangrove, and that’s basically thousands of years’ worth of carbon locked away.” Mat Vanderklift

Blue carbon also has far greater capacity than land-based carbon, says CSIRO marine ecologist Mat Vanderklift. In a typical land-based scenario, the availability of oxygen speeds up the decomposition of organic matter. Some of the carbon is sequestered in the soil, and some is taken up by trees and plants; but much of it soon returns to the atmosphere.

In contrast, the soils of mangroves, saltmarshes and seagrasses exist in a low-oxygen, wet, salty environment. Decomposition is much slower, and the carbon is locked into the sediment at far greater rates.

“We’ve cored into seagrass meadows and they can be thousands of years old,” says Mat Vanderklift. This means these marine soils also accumulate far more carbon than soils on land.

“We’ve got two to three metres deep of old seagrass or old mangrove, and that’s basically thousands of years’ worth of carbon locked away,” he says.

Blue-carbon farming

Blue carbon is of particular interest to the Queensland Government’s Land Restoration Fund – a \$500 million initiative set up specifically to expand carbon farming, with a focus on projects that also deliver environmental and economic benefits. The fund is set to announce the results of its first round of pilot project funding early this year. Don Butler, a scientist working on the fund, says this is likely to include blue-carbon projects.

“There’s a recognition that the carbon market can be used to change the economic frame around land restoration,” he says. “When you think about what kind of land restoration is in the interests of Queensland, coastal land restoration definitely is.”

One scenario for blue-carbon development is removal of bunds – or earthen walls – that block tides from entering estuarine saltmarshes. Since European settlement, thousands of bunds have been built by pastoralists up and down the Queensland coast to keep out salt and create ponded freshwater pastures in which cattle can graze.

A 2017 CSIRO report identified the introduction of tidal flow back into mangroves and tidal marshes as a significant blue-carbon farming opportunity. This is not just in terms of the carbon sequestration that could then take place in the estuarine soils, but also in the avoided emissions from removing methane-producing freshwater pastures.

“That fits with the Land Restoration Fund’s broader purpose, which is about land restorations, and that type of activity is about restoring estuarine wetland, which has fisheries benefits as well,” Don Butler says.

Another blue carbon-farming scenario involves avoiding the disturbance and degradation of coastal ecosystems. Peter Macreadie, associate professor of Environmental Science and head of the Blue Carbon Lab at Deakin University, describes one project working with cattle farmers to fence off shorelines. This prevents the cattle disturbing coastal soils and causing erosion.

“We’re hoping that a lot of these systems come back on their own, and we’ve got other areas where we know that they’ve been damaged over time, and we can go in and plant or encourage recovery,” he says.

Sea-level rise could also provide an opportunity for landowners along coastlines to work with the rising water, rather than be hampered by it.

“We could be planning to encourage sea-level rise to go into those areas and find new economic opportunities for landholders to be offset and compensated for the loss of land they have as a result of sea-level rise,” Peter Macreadie explains. “They’re actually farming mangrove forests, for example, instead of cattle.”

Roadblocks to blue-carbon trading

While the enthusiasm for blue carbon is clear, a few hurdles must still be overcome before Australia can start trading blue-carbon offsets on the carbon market.

The first is that Australia does not yet have an agreed method for blue-carbon accounting. This is something that must be established by the Australian Government’s Emissions Reduction Fund before blue-carbon trading can launch, Catherine Lovelock says.

“We can’t do carbon projects in Australia that don’t go through the Emissions Reduction Fund, because they’re worried about double-counting of carbon dioxide,” she says.

There’s no word on when that method will be finalised, but there’s a clear sense of

Below Researchers from Deakin University’s Blue Carbon Lab use a multi-pronged approach to understanding blue-carbon dynamics.



impatience among those in the industry.

Another hurdle is that the science of blue-carbon accounting, while fairly advanced in Australia, still has some ‘known unknowns’. One of these is the question of whether seaweed fits within the blue-carbon portfolio.

Catherine Lovelock says that while seaweed ecosystems are highly productive, they do not necessarily sequester carbon long term.

“There’s no sediment accumulation. To be a carbon project, you have to work out how that seaweed gets to the bottom of the ocean and doesn’t come back out again as carbon dioxide.”

An even bigger challenge is accounting for the avoided emissions associated with turning methane-producing freshwater, ponded pastures back into carbon-sequestering saltmarshes and mangroves.

“We need to know how much methane that system is giving off, so that we can say, when we convert it, we’ve basically avoided that methane emission,” Catherine Lovelock explains. “That could double the value of our projects, because in some cases the carbon sequestration part might actually be quite small.” →



Far Left Paul Carnell and Peter Macreadie use a Russian peat corer to take a blue-carbon sample from a coastal site that has been earmarked for restoration. Photo: Donna Squire, Deakin University

Left Sediment cores are extruded to determine blue-carbon content and the rate of sequestration. Photo: Simon Fox, Deakin University

Another question is how to map Australia's blue-carbon resources, says Mat Vanderklift.

"Seagrasses live underwater and they're not usually visible, so mapping them is a bit harder than mapping a mangrove, where we can use satellite-based methods," he says.

And if blue carbon is to command a higher price as a 'boutique' product on the carbon market, there's also a need to account for those additional environmental and social benefits.

"We're looking at the social and livelihood benefits, so doing things like measuring what are the fishery benefits of a mangrove or a seagrass," Mat Vanderklift says. "We know they're there, but can we quantify them?"

Then there's the question of who owns this potentially lucrative carbon resource. While the intertidal zone falls under the ownership of the state and federal governments, Rowan Foley, CEO of the Aboriginal Carbon Foundation, highlights the case of Blue Mud Bay in the Northern Territory – where the High Court recognised the rights of the Yolngu people over the intertidal zone in 2008.

"The mangroves and the seagrasses are largely in that intertidal zone, so the fact that native title rights have been demonstrated in that area is very good, because it opens up that whole door for us," he says.

Catherine Lovelock suggests that carbon-farming operations on public land might operate under a similar model to aquaculture leases. Governments may not want to do these projects themselves, but may want to facilitate them.

"It's just something a project would have to negotiate," she says.

Offsetting with blue carbon

While so many blue-carbon initiatives are in the pilot stage, awaiting the development of an accounting method – and in some cases, hoping to inform that process – the fisheries industry is waiting for the chance to invest in blue carbon.

In 2016, Western Australia's Austral Fisheries became the world's first seafood sector company to become carbon neutral. Austral CEO David Carter says the company would have preferred to go with blue-carbon offsets, with the potential to benefit coastal and estuarine ecosystems and fisheries, but the methodology to do so had not been adequately developed at that time.

Bryan Skepper, general manager of the Sydney Fish Market, says the market has already achieved a 17.8 per cent reduction in its carbon emissions and attained carbon-neutral status. It is now working towards a target of 20 per cent reduction by 2020, in partnership with Qantas and the Future Planet program.

But the Sydney Fish Market's ultimate aim is to offset its carbon emissions with blue carbon. A blue-carbon working group the market is participating in has already applied for funding for a blue-carbon project on the Mossman floodplain and Burdekin delta in Queensland.

"If companies start to invest in mangroves and seagrass beds, which are the nurseries for the fish we harvest, then we get a double win out of it," Bryan Skepper says. "We're not only offsetting our carbon; we're creating habitat or rehabilitating habitat that enables the fish stocks to breed, which if you're really successful with it, enables the sustainable catch rates to increase." **F**

TAKING STEPS TOWARDS CARBON-NEUTRAL FISHERIES

In 2017, participants in the National Seafood Industry Leadership Program challenged the seafood sector to become carbon neutral by 2030.

In response, the FRDC and CSIRO hosted a workshop in July 2018 that invited representatives from industry, government and non-government organisations to discuss the challenges and opportunities around achieving carbon neutrality – with an emphasis on blue-carbon offsets.

The workshop identified several steps that could help the seafood sector move towards becoming carbon neutral:

- Develop and deliver sector-relevant resources that outline the benefits of carbon neutrality, the various options to achieve it, and how to go about it.
- Engage with carbon market organisations and standards providers to ensure that 'scene-setting' activities related to carbon abatement, such as data collection and standards development, are relevant to the seafood sector.
- Connect with organisations and initiatives already working towards carbon neutrality through both land-based and blue-carbon offsets in Australia and around the world, with the aim of establishing future seafood sector projects.

For fisheries and seafood businesses looking to take the first step towards becoming carbon neutral, both the Queensland Seafood Industry Association and the UK peak body Seafish have developed online emissions calculators:

- <http://emissionscalculator.qsia.com.au>; and
- www.seafish.org/GHGEmissionsProfiler/v1

For more details, the full workshop report can be found at: www.frdc.com.au/project/2018-060



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Where to next for recfishing research?

The diversity of recreational fishers adds to the complex task of defining the recfishing experience, and the challenge of identifying research priorities

By Catherine Norwood

Recreational fishing representatives from around the country came together in a workshop last November to mark the beginning of an 18-month process to develop the FRDC's next Recfishing Research, Development and Extension (RD&E) Plan.

State and national peak recreational fishing bodies, the tackle sector, fisheries management and research, and recreational fishing media were all represented in the one-day workshop, held in Melbourne. The event was hosted by the FRDC's Recfishing Research subprogram advisory committee, and chaired by natural resource and fisheries management expert Peter Neville.

Executive officer for the FRDC's Recfishing Research program Owen Li says several of the issues identified at the workshop gave existing research priorities a more specific focus. Among these were initiatives to optimise recreational fishing experiences, positively influence public perceptions, and build the skills of sector leaders.

CEO of Recfishwest Andrew Rowland spoke on the role of recreational fishing peak bodies in "protecting, promoting and developing sustainable, accessible, enjoyable and safe fishing for the community".

Participants discussed how this might mean different things to different people; for example, catching more fish, spending time outdoors, or seeing other wildlife – even when no fish were caught. They also agreed that more research was needed to identify expectations across different recreational fisheries and demographic groups.

The importance of effective communication emerged as a major theme. This ranged from how to provide information about the latest research findings and best practice to fishers, to the gathering of ideas and concerns from fishers themselves.

Colin Tannahill, managing director of Shimano Australia and president of the Australian Fishing Trade Association, highlighted the role of tackle shops as places for exchanging information, not just purchasing fishing gear.

Other ideas included the strategic use of social media, investing in selected recreational fishers as 'influencers', and incorporating ongoing communication with stakeholders as part of research projects.

Fishing media representative Jo Starling outlined changes in the way people look for information, saying this had implications for the way research was communicated.

She said that while the aim of making fisheries science more accessible and digestible to recreational fishers remained the same, the delivery needed to change. Younger people preferred messages spread by 'influencers' (active participants who are not necessarily considered experts) as opposed to the authoritative 'experts' relied upon in the past.

Owen Li says the meeting highlighted the need to communicate more effectively with diverse recreational fishing audiences, including women and migrants, and to better represent the recreational sector to the general public. Delegates also identified a need to invest in:

- support for habitat recovery and enhancement;
- improved knowledge translation and use;
- understanding and reducing depredation of catch (for example, sharks and seals eating hooked and released fish); and
- understanding fish welfare, such as the impacts of hooking, and how or whether fish experience pain.

Owen Li says consultation will continue as the FRDC's 2020–25 Recfishing RD&E Plan is developed. He expects projects from a finalised list of research priorities aligning with existing priorities may be put to tender later in 2019. **F**



Photo: Patrice Gilles

OWEN LI FRDC EXECUTIVE OFFICER RECFISHING RESEARCH SUB-PROGRAM

Owen Li pictured with a Brown Trout (*Salmo trutta*), officially took on the role of executive officer for the FRDC's Recfishing Research program in September 2018.

He has a Bachelor of Marine Biology and a PhD in environmental social sciences from James Cook University. His PhD thesis looked at ways to improve communications between government, researchers, natural resource managers, and recreational and commercial fishers.

Owen Li is based at the University of Wollongong, where he is also the communications coordinator on an international aid project involving several South Pacific countries. He has previously worked as a consultant to develop recreational fisheries communication tools; on boating safety; and on the sustainability of WA's marron fishery.

As a recreational fisher himself, Owen Li says he is definitely a land-based angler, with a love of lure and fly-fishing. He is mostly a catch-and-release fisher, although the odd Mangrove Jack and Barramundi does end up on his dinner table. ■

Farmed kelp to balance nutrients

The success of native kelp propagation offers new cropping opportunities and broader environmental benefits

By Catherine Norwood

Thanks to the adaptation of seaweed aquaculture techniques to native kelp species, seedlings can now be reliably produced in hatcheries. This is providing the foundation for trials to cultivate native kelp in pursuit of commercial and environmental benefits.

Tasmania's largest Atlantic Salmon producer, Tassal, is investigating the potential of native kelp plantations on its aquaculture leases, with trials adjacent to fish pens at several of its south-eastern production sites.

Kelps could potentially help offset increased nutrients in the water as a result of Atlantic Salmon production, says Craig Sanderson, a marine biologist who has been leading Tassal's research in this area for the past three years. This method of combining complementary marine crops is known as integrated, multi-trophic aquaculture.

In particular, kelps could take up nitrogen generated as part of the process of fish farming.

The additional nitrogen would help boost plant growth, reducing the environmental footprint of fish farming – a key element of Tassal's broader eco-aquaculture program. Craig Sanderson says it is the lack of biologically available nitrogen that most commonly limits the growth of kelps and seaweeds in general.

His earlier research indicated that nitrogen originating from fish pens is quickly dispersed in the water column. It is difficult to detect any elevation in nitrogen levels more than 100 metres down-current of fish pens.

"So if kelp is grown next to pens, the front few rows might benefit from additional nitrogen, but as you move further away there would be less benefit," he says.

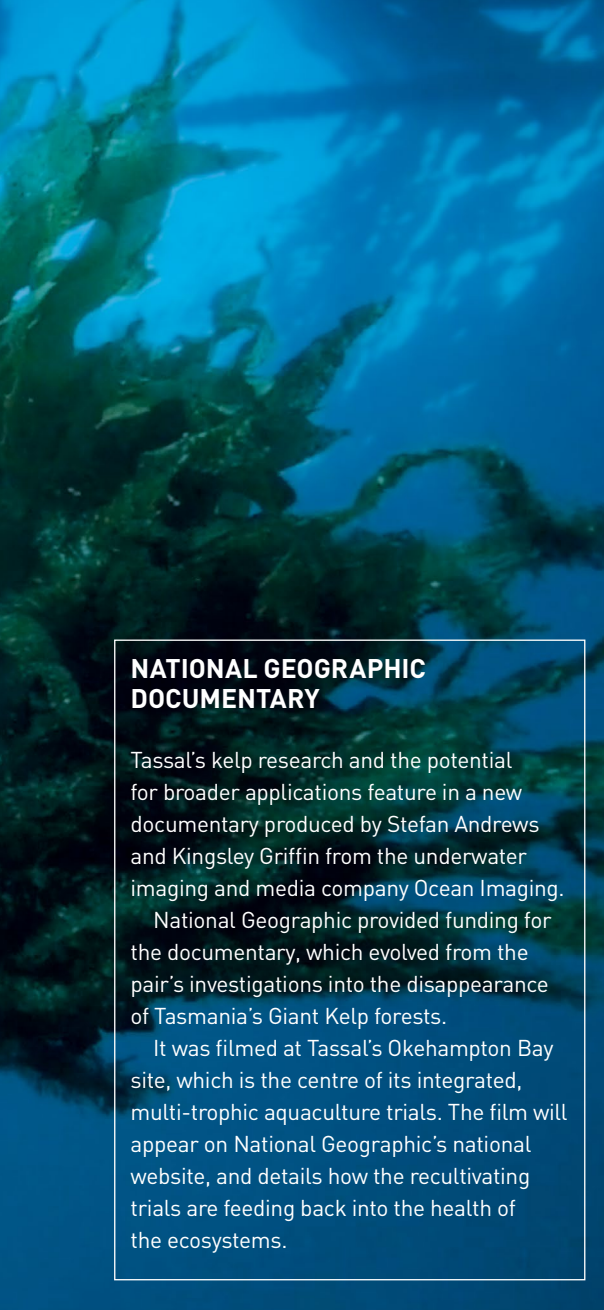
Tassal therefore has a broader focus on maintaining the nitrogen balance across larger areas, such as the D'Entrecasteaux Channel as a whole, rather than just growing kelp immediately adjacent to Atlantic Salmon pens. Atlantic Salmon

farming operates in the D'Entrecasteaux Channel under a nitrogen cap to prevent nitrification issues in the waterway. The Tasmanian Government has set the cap based on research from the CSIRO, funded by the FRDC. The research determined that land-based sources of nitrogen were also a significant source in conjunction with aquaculture and naturally occurring nitrogen inputs, such as cooler waters.

Seaweed production in the channel as part of aquaculture operations could help take up nitrogen and maintain the nitrogen balance for the channel as a whole.

Giant Kelp the stand-out

Of more than 1000 seaweed species native to Tasmania, just three have been identified by Craig Sanderson as potential candidates for Tassal production: Giant Kelp (*Macrocystis pyrifera*), Golden Kelp (*Ecklonia radiata*) and Tasmanian Kombu (*Lessonia corrugata*). All three are brown seaweeds with existing markets.



MORE INFORMATION

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FRDC RESEARCH CODE: 2017-177

Left Giant Kelp or *Macrocystis pyrifera* grown on longlines adjacent to salmon cages at Okehampton Bay October 2018. Photo: Stefan Andrews

NATIONAL GEOGRAPHIC DOCUMENTARY

Tassal's kelp research and the potential for broader applications feature in a new documentary produced by Stefan Andrews and Kingsley Griffin from the underwater imaging and media company Ocean Imaging.

National Geographic provided funding for the documentary, which evolved from the pair's investigations into the disappearance of Tasmania's Giant Kelp forests.

It was filmed at Tassal's Okehampton Bay site, which is the centre of its integrated, multi-trophic aquaculture trials. The film will appear on National Geographic's national website, and details how the recultivating trials are feeding back into the health of the ecosystems.

The seaweeds are closely related to the Japanese species *Wakame* (*Undaria pinnatifida*) and *Kombu* (*Laminaria japonica*). These are widely cultivated throughout Asia, usually on longlines – a technique Tassal is adapting to the native seaweeds.

Craig Sanderson says work over the past three years has identified Giant Kelp as the frontrunner for larger-scale production trials.

Giant Kelp is the most easily cultivated and fastest growing of the three species. It has existing markets for human consumption, for the production of alginates, in fertilisers and in aquaculture feeds. It is also being assessed as a potential source of fucoidan – an antioxidant and anti-inflammatory chemical extracted for use in nutraceutical products.

Propagation

During the past year, an FRDC-funded project has helped to refine the techniques used to produce kelp plants from spores for cultivation.

Kelps have a microscopic stage in their life cycle, known as the gametophyte. Gametophytes can be grown in the laboratory in flasks almost indefinitely by keeping them under red lights. Culturing this stage therefore provides an ongoing supply of seed stock, as an alternative to searching for plants in their reproductive phase in the wild.

The project's aim is to grow the gametophyte stage of all three species. Blue light or white light can be used to trigger reproductive development and the release of sperm and eggs, which give rise to new plants.

These reproductive techniques have been established by researchers led by Catriona Hurd at the Institute for Marine and Antarctic Studies at the University of Tasmania. Cameron's Oysters provided the original hatchery facilities for Tassal's early trials, but last year the trials moved to the Spring Bay Seafoods facilities at Triabunna.

The kelp is seeded onto either one-millimetre or three-millimetre twine, which is then wound around 20-metre lengths of 12-millimetre rope. The ropes are set into the water attached to longlines in a process similar to that used in mussel production.

For the past three years, kelp has been set out on longlines at sites including Okehampton Bay, D'Entrecasteaux Channel, Port Arthur and Dover throughout the year to determine the best time for outplant.

Currently March and April appear to be the best times to take advantage of winter and spring growth. Summer planting trials demonstrated minimal production and were subject to fouling and nutrient stress.

Craig Sanderson says this means it is more likely that new crops will be set out each year and harvested line and all, rather than ongoing cutting of kelp growth. Harvesting is expected to occur in October when the plants are at their peak.

The 2018 trial mostly used two different subspecies of Giant Kelp. One has come from northern Tasmanian waters, which Craig Sanderson may indicate it is more tolerant of warmer water conditions. Both subspecies successfully produced a harvestable quantity of seaweed. Tasmanian Kombu was also successfully cultivated this year on longlines, albeit in small quantities.

"We're confident in the hatchery stage, and in setting the kelp at sea," Craig Sanderson says. "We're now at the stage of managing the crop to optimise growth and the quality of the product."

"We've been learning what sort of conditions are the best to grow the seaweeds in, what the best way to put them out to

sea is, [and] how they behave at the various sites, each of which has different growing conditions and potential problems."

Among these problems have been warm water temperatures, big swells, and flushes of freshwater affecting growth. Wild mussels and other epiphytes have colonised some of the kelp longlines, smothering the plants. And when the kelp plants are seeded too densely onto the lines, they compete with each other for nutrients and light, reducing overall harvestable growth.

A farm-scale trial designed to produce commercial quantities of seaweed for specific markets is now proposed for 2019.

"Nitrogen uptake is one benefit for Tassal, but the seaweed will also need to pay for itself as a crop," Craig Sanderson says.

As part of the FRDC-funded work, Deakin University will conduct a nutritional analysis of the kelp produced during 2018, which will help determine potential markets. Heavy metal content will be determined, as well as naturally occurring iodine and inorganic arsenic; two elements of particular concern in seaweeds generally.

All Tassal's trials are undertaken within the company's lease areas, and kelps have been included on the company's aquaculture licences.

Replanting in the wild

While developing propagation techniques, more plants have been produced than are needed for the trials. The excess Giant Kelp seedlings in particular have been made available to see if the species can be re-established in areas where it has disappeared.

In the past, Giant Kelp forests on the Tasman Peninsula rose 20 metres or more from the ocean floor. Eaglehawk Dive Centre at Eaglehawk Neck on the Tasman Peninsula once did brisk business showcasing the spectacular sight to visiting divers. But the forests have disappeared from the peninsula over the past decade, largely as a result of warm waters from the southward extension of the East Australian Current. Giant Kelp is now listed as a threatened species.

Dive centre owner Michael Baron has secured some experimental permits and replanted two sites where the kelp forests were once thick. Seeded twine obtained through the Tassal program is wrapped around bricks, which form a substrate for the growing plants.

With plantings in three consecutive years, some Giant Kelp has already reached up to six metres, offering positive signs that replanting of some areas may be possible. **F**



Left Sue Poole (left) and Philippa Tyler prepare randomised fish samples for one of the taste tests.

A research project that arose from questions put to consumers about why they do not buy seafood is throwing new light onto the fresh versus frozen debate, with some surprise early findings.

The issue has come to a head after a 2016 FRDC consumer survey revealed three key reasons for the aversion of non-seafood eaters – smell, uncertain freshness and lack of knowledge about preparation. All these issues could be resolved by supplying seafood as a ready-to-cook frozen product, but this runs head-on into perceptions that freezing seafood reduces its eating quality.

To test this perception, the FRDC commissioned the Queensland Department of Agriculture and Fisheries (DAF)'s seafood team, led by principal scientist Sue Poole. The team was asked to develop and run a series of 'taste tests' among both professional seafood chefs and consumer panels, to build a statistically valid position on whether fresh seafood really can be distinguished from the correctly frozen and thawed product.

The data is still being analysed. But if it shows that most people – including chefs with highly attuned palates – cannot pick the difference, then the results will not only confound conventional wisdom but have significant implications for supply chain management and product development.

Early observations from the research show trained palates can detect a difference in taste and texture between fresh and thawed product, but only after considerable discussion in a workshop scenario. This was an unexpected outcome for the chefs involved.

Sue Poole explains that the project was structured to collect data based on a sensory analysis of fresh and frozen fish. The species used in the tests were Barramundi, Spanish Mackerel, and farmed Cobia and groper. All were presented first as sashimi and then as cooked fish.

Triangle test

The tastings were based on a sensory science method called the triangle test. Three samples are presented: two being the same (fresh or thawed) and one different (fresh or thawed). The samples are presented in multiple, random combinations, and tasters are asked to identify the sample that is different and to give a reason why – including stating if they are just guessing. If a significant number of people can accurately detect fresh versus frozen across the large number of random presentations, then the taste difference becomes scientifically quantifiable.

Sue Poole says the testing began with a focus group comprising four prominent seafood chefs in Brisbane. In the first session, fresh and thawed samples were presented side by side.

"The chefs believed the fresh flesh had slightly more sheen, which is what we expected," she says. "But when it came to the actual tasting, they struggled to pick any difference. This surprised everyone because they all have keen palates. Eventually, as a group, they were able to correctly identify the fresh and frozen, but only after a lot of discussion."

"When we presented the cooked samples, however, there was no consensus. Everyone struggled, and everyone admitted to struggling."

Even with their agreement on the sashimi, Sue Poole says the chefs still made the point that while they did pick the difference, it still was not relevant to "the real world" because side-by-side comparisons are not made in a restaurant. "So they said they would not necessarily have been able to pick any difference if there was no immediate comparison being made," she explains.

"In a subsequent discussion, all the chefs said access to properly frozen and thawed seafood would present advantages such as extending the seasonal availability of different species, reducing waste and allowing better stock

Seafood quality frozen in time

Story and photos Brad Collis

When it comes to seafood, 'fresh is best' has been the mantra for eons. But is it? A fascinating food science project may lead to a challenging rethink of this belief



Sue Poole

Principal Scientist, Department of Agriculture and Fisheries

"What we are now doing is accumulating accurate, reliable data on the impact of freezing on taste and texture for both sashimi products and cooked product"

management by fishers.” Following the focus group experiment, the DAF seafood team ran the same triangle test with tasting panels drawn from the general public. The results of these tests are still being analysed.

Fresh or frozen: which is best?

In the meantime, Sue Poole says the tests are already pointing to the need for more seafood education, including a better understanding of what is even meant by the word ‘fresh’.

“For us, it means a product that has been chilled. And no matter how close to capture this happens, the product will deteriorate over time yet still be labelled fresh.

“By contrast, fish that is frozen close to capture will retain that quality, so it can be argued that this is likely to provide a better eating experience ... the qualifying elements being species and correct freezing and thawing.

“Freezing needs to happen very quickly. It must get from zero to past minus 3°C as fast as possible to avoid damaging ice crystals forming in the flesh. Once past minus 3°C, the commercial standard for frozen seafood is minus 30°C, although some companies are now freezing to minus 60°C and even minus 90°C.

“But this science is already done,” she says. “What we are now doing is accumulating accurate, reliable data on the impact of freezing on taste and texture for both sashimi products and cooked product.”

Sue Poole adds that the next step – if no statistically relevant taste differentiation between fresh and thawed is found – is to determine how long this quality state can be sustained. That is, how long can a fish product stay frozen before a more obvious difference does kick in?

“While change happens very slowly in a freezer, it is still happening,” she explains. “So the question now is ‘how long can we freeze different seafood products ... weeks, months or even longer?’”

Project rationale and implications

FRDC general manager for communications, trade and marketing Peter Horvat says the rationale for this project arose from the survey in which the FRDC was keen to understand why some people simply avoided eating seafood, leaving aside those with allergies.

“We surveyed 2000 people and it became clear that the issue was much more complex than someone simply saying they don’t like seafood,” he says. “There were some clear reasons stated, many of which related to issues of freshness.

“My take-out from the survey was that if we could supply frozen product, you would be addressing most of the negatives the survey showed up: freshness, no odour issues, pre-prepared fillets for easy cooking, and value for money from the product able to be kept in the freezer and not go off.

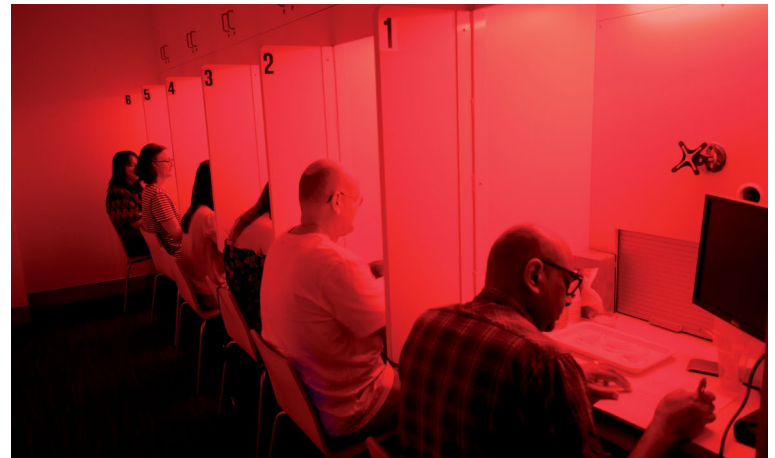
“But what we didn’t know was whether or not the frozen product would deliver the same perception of quality as fresh. There’s a lot of rhetoric around this, but we needed to test it scientifically and use chefs whose day-to-day job is cooking fish ... because if they can’t detect a difference, then the average consumer is not likely to either. So that’s what we have set out to quantify.”

Peter Horvat explains that the research also has other implications for suppliers, particularly exporters who are looking to put Australian product such as Barramundi into European markets.

“If you can send a frozen product to Europe by sea, it is markedly cheaper than airfreight. So it potentially delivers a lot of supply chain benefits, such as lower transportation costs and longer shelf life, which extends through to the consumer.” **F**

Below Taste testers get to work in Queensland Department of Agriculture and Fisheries’ food laboratory.

Bottom The DAF seafood team, from left, Philippa Tyler, Carl Paulo, Paul Exley and Sue Poole.



FOOD TASTERS SEE RED

If you have seen the film *Hunt for Red October* – or any submarine film, for that matter – you will get an idea of what it is like to be a taste tester at the Queensland Department of Agriculture and Fisheries’ Food Pilot Plant.

When operating, the tasting room is illuminated only by a dim red light (as happens in a submarine before surfacing at night). However, for the tasters, this is not to adjust their vision, but to hide any visual references in the samples they are about to taste.

Sensory scientist Philippa Tyler says that taste is subconsciously influenced by what you see and this needs to be eliminated to get a true taste value.

Each taster is assigned an individual cubicle. When ready, a hatch slides open and a tray slides through with three numbered

samples for what is known as the ‘triangle test’. Two of the samples will be the same and one different. In this experiment, the samples are either fresh or thawed raw fish. The taster marks on a sheet the number of the sample they believe is different and states why. The red room becomes very quiet. No one is allowed to speak; everyone concentrates on what their palate is experiencing. Finally, a decision has to be made, even if the explanation boils down to a guess.

The numbered samples represent a sophisticated statistical method to ensure the tasters cover the full range of randomised options, across several fish species.

This frontline food science could be the start of a whole new era for Australian seafood. **■**

Taking on the plastic problem

Preventing plastic from entering the marine food chain and maiming ocean wildlife is driving efforts to reduce, reuse and recycle

Story Catherine Norwood Photos Southern Bluefin Tuna Industry

A commitment to making the 2019 national industry conference, Seafood Directions, a plastic-free event provides an important opportunity to raise awareness about plastic pollution in marine environments.

According to members of last year's National Seafood Industry Leadership Program (NSILP), it is also an opportunity to demonstrate what positive action the seafood sector can take to make a difference.

Fishers are significantly affected by plastics in the ocean – even though it is not an issue they are solely, or even largely, responsible for, says Michael Hobson, a commercial fisher and food service operator at Port Albert, Victoria.

He was a member of the NSILP Plastic Free Fish project team last year, along with Adrienne Laird from the Northern Prawn Fishery Industry (NPF) Pty Ltd, Toby Jeavons from the Victorian Fisheries Authority and Brad Callcott from Pacific Reef Fisheries.

The team's research identified the extent of the plastic pollution issue and potential impacts for the Australian seafood sector.

A global issue

Recent studies have estimated that approximately eight million tonnes of plastic end up in the world's oceans every year. This contributes to the deaths of the marine animals that become entangled. Plastic can also find its way into the stomachs of seabirds, sea mammals, fish and other marine life, affecting the entire food chain.

The attributes of plastic that make it so attractive as a material, including its durability, are

also the attributes that make it so dangerous and long-lived. Products might break down, but the plastic itself remains in the environment. Greenpeace researchers have found plastics in water and snow samples in areas as remote as Antarctica.

CSIRO research has identified that almost three-quarters of the rubbish on Australia's coastline is plastic, and that it comes from Australian sources. Research from the Australian Institute of Marine Science has also reported widespread microplastic contamination of waters in north-western Australia. More recently, a study of juvenile Coral Trout from the Great Barrier Reef has identified that tropical fish are ingesting both plastic and non-plastic marine microdebris (particles of less than five millimetres).

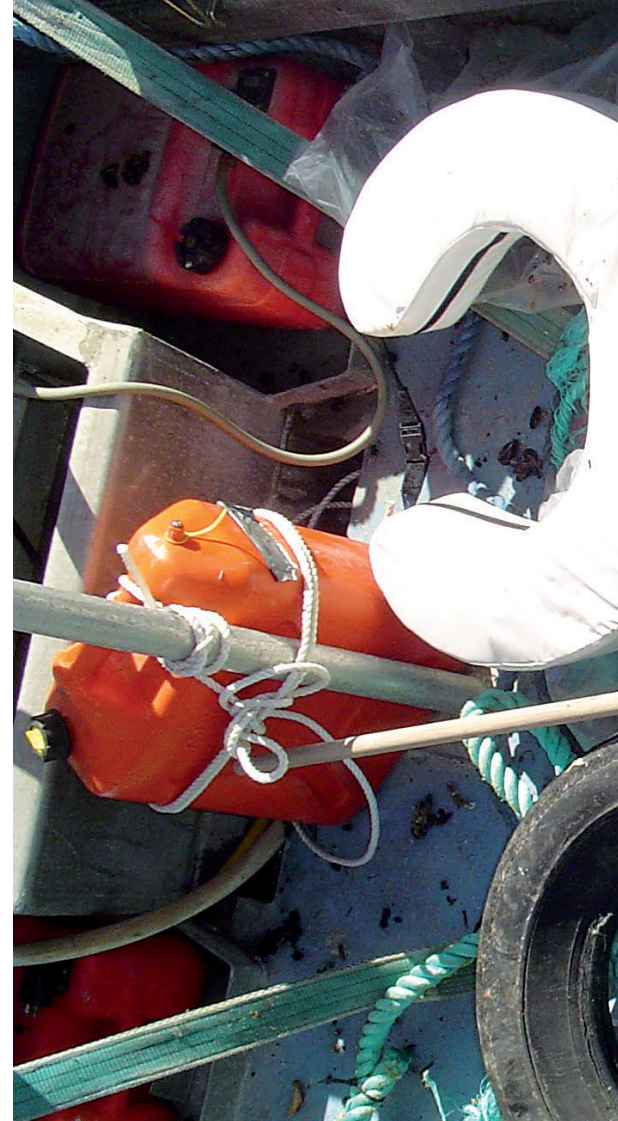
With mounting local and international evidence about the impacts of plastic and its infiltration of the seafood food chain, NSILP's Plastic Free Fish team worked with OceanWatch Australia to incorporate efforts to reduce plastic as part of the OceanWatch ocean pledge (www.oceanwatch.org.au).

Local initiatives

Toby Jeavons says the aim is for individuals, organisations and businesses in the seafood industry to take the pledge below, reduce their reliance on plastic, recycle plastics where possible and seek alternatives to plastic products.

The team has put out a call to industry to take this pledge:

"The seafood industry is directly dependent on the health of the marine environment and sustainable fish stocks. Reducing the use of plastic



within industry and diverting plastic from landfill strengthens our commitment to environmental responsibility, increases our contribution to protecting the future of global fishery resources, and improves our social licence to operate. The Australian seafood industry can lead by example and add to the global momentum of plastic use reduction."

In addition to a plastic-free 2019 Seafood Directions, the team is working with the organisers of other seafood industry events to reduce plastic use.

Brad Callcott has initiated an independent plastic audit at Pacific Reef Fisheries, where he is operations manager of the aquaculture operations in Ayr, Queensland. He hopes this will identify areas where the business can reduce plastic use, and perhaps provide a first step in creating a framework to help other businesses to assess their own plastic use and alternatives.

Recycling options

"We are looking at the packaging of our seafood and seeking alternatives to virgin plastics," Brad Callcott says. "We also know that the bags used for aquaculture feed are an issue."



Left Plastics and rubbish collected during beach clean-ups by members of Southern Bluefin Tuna Industry Association.

PLASTIC USE REVIEW

FRDC has previously funded a desktop review (2004-410) into the feasibility of reducing plastic use in the seafood industry. This research, undertaken by OceanWatch, found high levels of plastic use in the commercial wildcatch sector, including equipment such as nets, lines and floats. However, it also identified that a high number of fishers and fishing co-operatives had already introduced plastic and waste minimisation initiatives in conjunction with efforts to reduce costs.

The most difficult hurdle, the report said, was disposal of plastic waste products. This was particularly the case in the post-harvest sector, including seafood wholesalers, retailers and the general public as consumers of seafood.

Opportunities for plastic alternatives in the seafood industry were identified as part of this project, outlined in Table 1.

These were being recycled in China, he says, but Pacific Reef has been stockpiling them since China’s decision last year to ban this type of material for recycling.

“We’ve purchased a baling machine for feed bags, which has reduced the volume of this waste by about 90 per cent, making it more easily transported to a recycler or to landfill if necessary. We’re working to find a solution and talking with our feed supplier who is also keen to find a recycling solution.”

In Victoria, Michael Hobson says that since taking part in the NSILP project, he has audited his own restaurant and fish-and-chip shop at Port Albert. His businesses made changes that include swapping from polystyrene takeaway food containers to cardboard boxes and paper bags.

He says it has proven much more difficult to eliminate the plastic that comes from their suppliers.

“There’s not really the willpower in the food service sector to change, and often it is difficult to find alternatives to plastics. We’ve really struggled to replace the plastic containers for our homemade tartare sauce, for instance.” →

Table 1: Typical plastic items used in the seafood sector supply chain and possible alternatives

PLASTIC ITEM	RECYCLABLE	POSSIBLE SCRAP VALUE	ALTERNATIVES	POSSIBLE ALTERNATIVES AVAILABLE
Polyethylene and polypropylene	•	•		Recycling options only
Monofilament lines	•	•		Recycling options only
Ropes	•	•		Recycling options only
Buckets (consumable containers)	•	•		Recycling options only
Floats (foam)	•	•		Recycling options only
Floats (plastic)	•	•		Recycling options only
Fish boxes (hard plastic)	•	•		Recycling options only
Tuna bags		•	•	Recycling or re-use options
Tuna mats	•			Recycling or re-use options
EPS boxes	•	•	•	Coolseal-type boxes
Produce bags including bait bags	•	•		Starch-based biodegradable bags
Sheeting	•	•		Starch-based biodegradable sheets
Carry bags	•	•	•	Starch-based biodegradable bags. Other degradable bags. Calico bags. Paper bags. Non-woven bags.

SOURCE: OCEANWATCH AUSTRALIA, FRDC PROJECT NO. 2004-410



Above Bags of rubbish collected by members of Southern Bluefin Tuna Industry Association.

Adrienne Laird says the NPFI has signed up to the OceanWatch ocean pledge. The industry organisation will work to ensure its events, be they board meetings or stakeholder workshops, are plastic free – no plastic for catering, for example.

“We’re also looking at how we might be able to recycle fishing nets,” she says. “But logistically it’s difficult to bring together nets from our ports in Karumba, Darwin and Cairns for recycling. We’ve found a company based in Tasmania who can recycle the nets and other plastics but the distances make it difficult.”

“The NPFI is also a signatory to the Global Ghost Gear Initiative and, when possible, our operators retrieve ghost gear they encounter during the fishing seasons.”

From a personal perspective, Adrienne Laird says working on the project opened her eyes to the extent of the plastic problem in Australia, and globally.

“We can’t completely eliminate plastic use in the industry, but we can reduce our use and recycle more.”

At home she has introduced cornstarch garbage bags, steel straws and reusable produce bags, and returns soft plastics to the supermarket for recycling.

“The issue is so huge it can be disheartening,” she says. “But I’m proud of the efforts we’ve made, and I think it all makes a difference. And I believe Australia’s seafood industry can lead the way and be an example of the changes that can be made.” **F**



ACTION UNDER WAY

RECYCLING IN AQUACULTURE

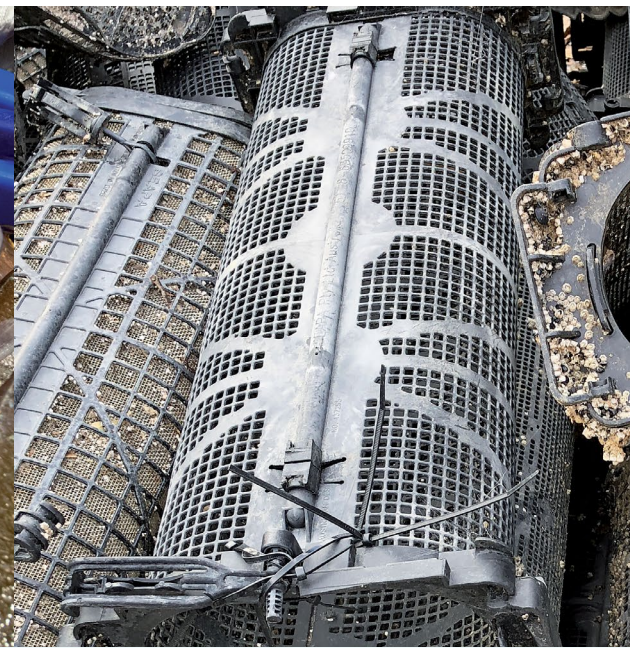
In 2017-18 the Tasmanian Atlantic Salmon industry and fish pen manufacturers recycled 637 tonnes of plastics. Local recycler Envorinex remanufactures items such as pipes, feed pipes, stanchions, nets, floats, ropes, feed bags (high-density polyethylene, low-density polyethylene, soft plastics) into new products. Tassal is also moving to 100 per cent recycling of major plastic waste across its Atlantic Salmon farming operations.

The Tasmanian oyster industry began a recycling project in 2018 to develop a method for tackling some existing stockpiles of old equipment and an ongoing industry model. Oyster baskets are proving difficult to recycle, as some components are made from plastics that Envorinex cannot process or have cable ties attached. The industry is continuing to research options, including mulching before separating plastic types and changing to basket manufacturing.

SUPPLY CHAIN PLASTICS

The Sydney Fish Market (SFM) introduced its plastic-neutral plan in January 2018.

A key initiative is a polystyrene processing machine that recycles 150,000 fish boxes each year, rescuing the equivalent of 100 tonnes of polystyrene from landfill. SFM is also returning its iconic blue fish crates to the manufacturer for recycling at the end of their 10-year life span.



Above Oyster baskets waiting for recycling. Above left The Sydney Fish Market recycles its iconic blue crates.

BEACH CLEAN-UP CAMPAIGNS

The many beach clean-up initiatives already in place include the adoption of 155 kilometres of coastline in the Port Lincoln area by members of the local aquaculture sector, who conduct beach clean-ups at least once a year. This is part of a proactive community campaign that addresses both general rubbish and debris from the industry. The clean-ups are coordinated by the Australian Southern Bluefin Tuna Industry Association, and local oyster and mussel producers also take part.

PACKAGING ALTERNATIVES

Two Australian innovations are in development to create an out of cold chain alternatives to polystyrene, although neither product is commercially available yet.

Victorian developer Andy Moulynox has patented the Dreamweaver shipper, a fully recyclable material that can be customised to any size. Following successful recycling and temperature trials, he is in the process of raising investment to establish a manufacturing plant.

More information
andy@dreamweaverfoodanddesign.com.au

Queensland-based fishers Tom and Kath Long have also developed the reusable and recyclable TomKat KoolPak (patent pending) for the transport of seafood, which has been successfully temperature tested. Commercial production partners are being finalised.

More information tomkatlinefish@bigpond.com

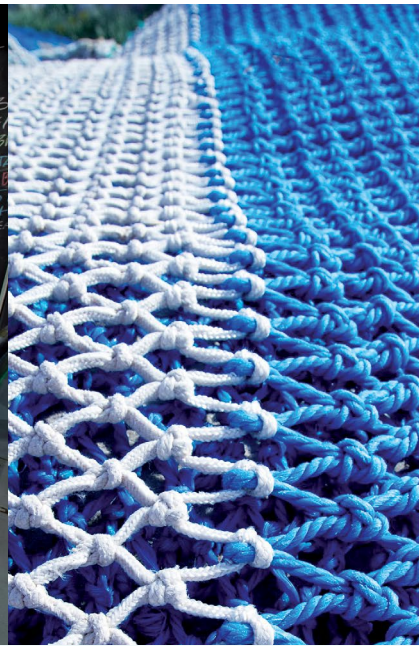


MORE INFORMATION

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Michael Hobson, portalbertwharf@bigpond.com;
Toby Jeavons, toby.jeavons@vfa.vic.gov.au



Above The Fish Shoppe provides a model for fishmongers planning to go plastic free.



Above Logistical issues often prevent nets from being recycled.



Above Land-based waste forms the majority of ocean debris.

RETAIL SALES

At the South Melbourne Market in Victoria, The Fish Shoppe is providing a case study for other retail businesses looking to eliminate single-use plastics, including plastic bags.

Josh Pearce and Renee Vajtauer, who operate The Fish Shoppe, are committed to being fully plastic free this year. They have replaced the plastic bags and sheets used for wrapping and packaging seafood with paper and cornstarch alternatives that are biodegradable and compostable.

The two greatest challenges remaining are slap sheets and oyster trays, Josh Pearce says. The Fish Shoppe sells half-shell oysters in plastic trays, which are made of recyclable plastic. But that means they must be collected for recycling. A plastic-free alternative would be better; cardboard trays are a possibility.

More information Josh Pearce, jp@thefishshoppe.com.au

CLOTHING FIBRES

Synthetic clothing fibres such as polyester, nylon and acrylic, are among the plastics that have made their way to the most remote parts of the world. The fibres often accumulate in laundry wastewater. Water authorities in some cities, particularly in the Great Barrier Reef catchments, use membrane bioreactors to remove these fibres, which would otherwise end up in our waterways.

At sea, however, there are no water treatment plants to capture the fibres. In one initiative, Austral Fisheries is installing specialised lint filters on vessel washing machines to remove synthetic fibres from the water that is discharged.

PLASTIC MICROBEADS PHASED OUT

Microbeads are small, solid, manufactured plastic particles of less than five millimetres. Often made of polyethylene or polypropylene, they do not degrade or dissolve in water. They have been used in a range of products, including rinse-off cosmetics, personal care and cleaning products, as a cheap alternative for natural exfoliating or abrasive ingredients, such as shell or seed particles.

The Australian Department of the Environment and Energy says microbeads are not captured by most wastewater treatment systems. If they are washed down drains after use, they can end up in rivers, lakes and oceans.

Once in the water, microbeads can damage marine life, the environment and human health.

They have the potential to adsorb toxins and can be transferred (along with any accumulated toxins) up the marine food chain.

Several countries, including the UK, the US and New Zealand, have banned plastic microbeads for wash-off personal hygiene products and cleaning agents.

Meanwhile, the Australian Government relied on a voluntary phase-out by July 2018. A report for the Department of the Environment and Energy was released in May 2018, ahead of the voluntary deadline. It indicated that of approximately 4400 supermarket, pharmacy and cosmetic store products inspected, 94 per cent were already free of plastic microbeads or other non-soluble plastic polymers. ■

FISH MAG PLASTIC FREE

Every few years, the FRDC surveys readers of *FISH* magazine to see how we are going in the eyes of our readers. In the past, many of our readers have expressed concern that the magazine is mailed in plastic sleeves.

As a marine science organisation, the FRDC has many of the same concerns as our readers in relation to the problem of plastic pollution. The plastic-like sleeves that *FISH* magazine is

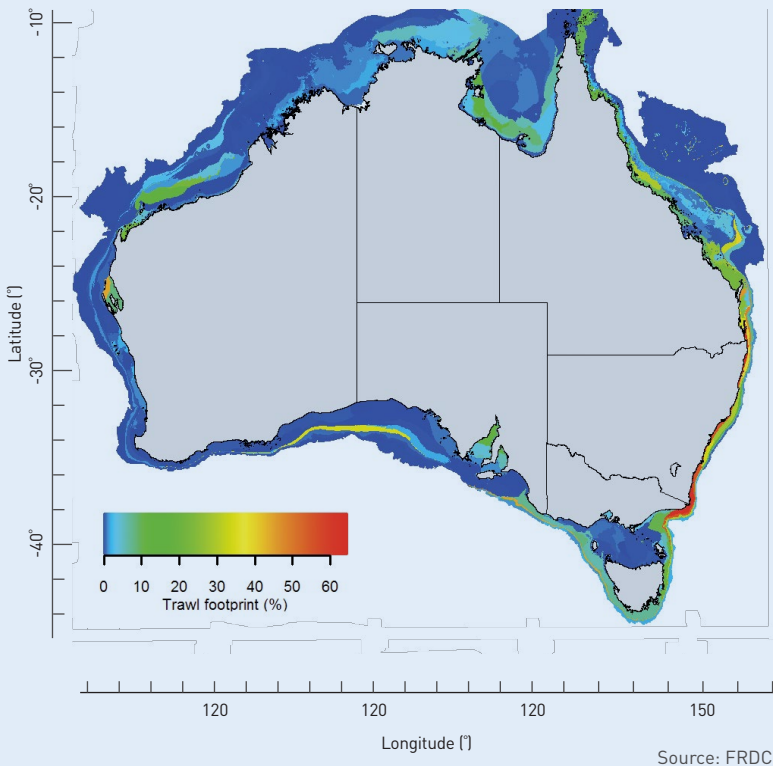
mailed in are actually made from a trademarked, degradable, plastic-like film called biowrap.

It has the durability and strength of plastic, but is completely degradable and ultimately breaks down to water, carbon dioxide and a small amount of biomass in the presence of oxygen. It can also be recycled prior to degradation.

You can find out more about biowrap here: www.biowrap.co.uk



AUSTRALIA'S TRAWL FOOTPRINT



Seabed mapping paints clearer trawl picture

By Melissa Marino

The first national study of Australia's trawling footprint has identified contact with less than 3.5 per cent of the seabed



Roland Pitcher
Researcher

"Our recommendation is that fisheries managers, government departments and the FRDC need to consider these regions as future priorities for research to discover and map what lives on the seabed, and then to make quantitative risk assessments"

Australia's seabed is incredibly diverse, ranging from kelp forests to coral reefs, and rocky escarpments to sandy plains. Some of these seascapes are sensitive to the impact of trawl fishing, while others are less so.

A recent FRDC project has mapped the footprint of Australia's trawl sector, as well as mapping these seabed ecosystems, or eco-regions, to identify broad types of sea floor habitats in trawled areas.

The project, which defined and mapped 217 different eco-regions, also found that trawling has occurred over just 3.5 per cent of the continental shelf and slope seabed. This represents just 1.2 per cent of Australia's 8.2 million square kilometres of marine estate.

"Combining the trawl footprint with eco-region mapping allows fisheries managers to focus more closely on the sea floor eco-regions where most trawling occurs, to identify and map any sensitive habitats and put mitigation strategies in place," says CSIRO's Roland Pitcher, who led the research.

Trawl footprint

Overall, the findings showed that Australia's trawl footprint was relatively small. Most of the 217 seabed eco-regions defined and mapped had little or no exposure to trawling.

Roland Pitcher has been involved in a parallel international research project that studied 24 regions worldwide. Five of these were in Australia, and had among the smallest trawl footprints of less than 10 per cent. In contrast, four of nine European regions had footprints of more than 50 per cent.

The international research, published in 2018 in the *Proceedings of the National Academy of Sciences of the United States of America*, showed the average trawl footprint – measured using high-resolution trawl effort data – was 14 per cent across all studied regions. (The regions excluded South-East Asia due to a lack of data.)

Roland Pitcher says both the international research and the recent Australian project demonstrate the footprint of trawling on the seabed is substantively smaller than that of agriculture and other human activities on land, which Australian Bureau of Statistics data indicates is up to 45.2 per cent of the continent's land area.

By way of comparison, the total trawl footprint was about 100,000 square kilometres – the equivalent of 1.3 per cent of the landmass. This was based on data covering up to five years of recent fishing activity.

Within the trawl footprint, researchers estimated that between 4000 and 13,000 square kilometres were trawled intensively, which has greater potential to modify sensitive habitats.

This is also why mapping the seabed eco-regions as part of the trawl mapping has been so important. The data can be used to build a national picture of the sea floor for use in marine management decisions, in the same way that soil and vegetation maps are used in land-based decision-making.

"If a habitat is relatively limited, then a relatively small amount of trawling would potentially be more concerning than the same amount of trawling in a habitat extent that is quite large and common," Roland Pitcher says.

Assessing risk

In some eco-regions, including in the Great Barrier Reef and the Torres Strait Prawn Fishery, extensive habitat data is available. Some habitat data is also available for the south-east region, near the southern NSW–Victoria border, and the continental shelf break off Tasmania.

But in many areas, where the trawl footprint is heaviest, we need more information about seabed habitat types, Roland Pitcher says.

Below
Trawler operating in Far North Queensland
Photo: Chris Bolton Fishing

“Our recommendation is that fisheries managers, government departments and the FRDC need to consider these regions as future priorities for research to discover and map what lives on the seabed, and then to make quantitative risk assessments,” he says.

Areas identified as highest priority for further assessment are:

- the Australian east coast from southern Queensland including deep areas of the southern Great Barrier Reef;
- shelf areas of NSW and eastern Victoria to Bass Strait;
- western Tasmania to south-east South Australia near the continental shelf break;
- the outer Great Australian Bight off South Australia and Western Australia; and
- Shark Bay in Western Australia.

“Some eco-regions in these areas have high trawl footprints (between 30 and 65 per cent trawled) and typically have low protection (such as in marine reserves or fishery closures), and will need to be assessed first,” Roland Pitcher says.

When new ecological data has been collected, he says that more accurate assessments can be made about levels of risk from trawling.

For example, if there is a large trawl footprint in a sensitive habitat, the potential for risk is higher. Alternatively, in habitats with high ecological resilience, there might be a high trawl footprint, but the impacts will not be as substantial. And in areas where the trawl footprint is low, there is unlikely to be ongoing risk to habitat.

He says that CSIRO video footage recorded over thousands of kilometres of seabed shows about 95 per cent of the bottom consists of sandy or muddy habitat that appears relatively bare on the surface, and is relatively resilient to trawl nets. But, he says that delicate habitats have been seen in some places, “so the job is to map where they are”.

Way forward

The FRDC-funded report builds on a substantial body of work into trawl impact undertaken by Roland Pitcher and his colleagues.

Past research has often focused on bycatch to determine species at risk. Looking at habitat provides a new insight, says Dan Corrie, manager of the South East Trawl and Great Australian Bight Trawl Fishery for the Australian Fisheries Management Authority.

“For our main fish species we have quantitative risk assessments where we use fisheries data to make informed decisions, but for habitat it’s been lacking,” he says.

“This provides us with information about habitats and their distribution and what the potential impact of trawling is in particular areas.”

Dan Corrie says the research is valuable because it indicates which areas could be affected the most and therefore where management efforts should be focused.

“The management response will largely depend on the outcome of any future risk assessments, but for now, at least from this research, we know if there are any areas we want to focus on.”

The data collected through the research will also help inform the public, because trawling is often portrayed as destructive in the media, Roland Pitcher says.

“But if we actually dig into it and look at what the trawling footprint is, it’s relatively light, especially compared with terrestrial land uses that people accept,” he says.

“This report shows us that the 388,000 square kilometres of the south-east’s marine parks have worked in limiting the trawl footprint to one of the lowest in the world”

Simon Boag, CEO South East Trawl Fishing Industry Association



Simon Boag, CEO of the South East Trawl Fishing Industry Association, says the trawl industry is excited about telling the story this research reveals.

“This report shows us that the 388,000 square kilometres of the south-east’s marine parks have worked in limiting the trawl footprint to one of the lowest in the world,” he says. “This is very different to how some conservation groups portray trawling.”

Dan Corrie says the research provides industry with “a bit of social licence” by helping to put the trawl footprint in perspective.

“There is a perception that trawling is spread far and wide and has a big impact on the benthos. It’s true that where trawling does occur there is a level of impact, but what this research shows is the footprint is not nearly as big as what it may have been perceived to be.”

Roland Pitcher says the research sets a baseline from which updated and new data, including the further mapping of sensitive habitats, can be added to continue building the full picture of the trawl impact in Australian waters.

“There’s largely a good message in Australia’s low overall trawl footprint, but also a message of things we have to do and look at more closely in the future,” he says.

“Those eco-regions identified as high priorities should be looked at to find out what they’ve got in the way of sensitive habitats. Map them, and understand in detail where trawling occurs relative to habitat, so there can be a quantitative assessment of whether there is a risk of ongoing adverse impacts to those habitats or not. That’s what I would like to see happen.”

The report, *Putting potential environmental risk of Australia’s trawl fisheries in landscape perspective: exposure of seabed assemblages to trawling and inclusion in closures and reserves* is available (www.frdc.com.au). **F**



In defence of fishers' social licence



FRDC-sponsored Nuffield scholar Steven Davies has investigated action the fishing sector can take to improve community support for its activities.

Story Melissa Marino Photo Evan Collis

Opportunities abound for fishers who recognise the value of social licence, but serious danger lies in ignoring the issue

The Australian fishing industry has healthy, abundant, well-managed fisheries “in spades”, says Nuffield Scholar Steven Davies. The industry is one of the country’s most important assets, providing consumers with fresh, high-quality seafood produced sustainably.

But in the age of social media and a 24-hour news cycle, the industry’s clean, green and sustainable credentials are under increasing levels of attack – attacks that Steven Davies stresses are generally unfounded and not representative of the industry.

“There is as much fear-mongering as fish-mongering going on in the modern marketplace,” he says.

Addressing this problem is essential to securing the future of the industry, he says. Ensuring public perception aligns with reality will enable our fisheries to survive, thrive and capitalise on the substantial opportunities the growing global middle-class will bring.

This is also the motivation behind Steven Davies’ Nuffield Scholarship study: ‘The Australian seafood industry and the social licence to operate’.

In his study, he has explored how to achieve social licence, how to maintain it, and the impact of both having it and losing it. He defines the social licence to operate as an unwritten, intangible social contract that legitimises businesses and organisations in the eyes of key stakeholders. Lose your social licence, he says, and you could lose your business.

Born and bred into commercial fishing in Port Lincoln, SA, Steven Davies was recently appointed CEO of Perth start-up seafood business Aquatic Life Industries. The business assesses investment in a range of seafood-related opportunities across the seafood production and supply chain.

He was inspired to investigate the social licence topic after finding himself increasingly having to defend his industry.

“Independent scrutiny of any industry should be welcomed, but it must be fair, reasonable and underpinned by facts,” he says.

Australian seafood producers, he says, are

facing a seminal moment amid concerted efforts to undermine the industry and its social licence to operate by 'boutique causes', often driven by single-issue, non-government organisations (NGOs). Actions now will be crucial to determining how the industry is perceived publicly in the future.

FRDC research from 2017 shows that less than half (41 per cent) of Australians believe the Australian fishing industry is sustainable. This is, he says, despite data from the Australian Bureau of Agricultural and Resource Economics and Sciences showing that no Commonwealth fisheries managed solely by the Australian Government are over-fished.

Through his work as a 2016 Nuffield scholar, Steven Davies visited nine developed and developing countries – meeting with a variety of people from commercial fishers to conservationists – to gain an understanding of how to counter these perceptions and maintain social licence through the support of the broader community.

He says that the keys to maintaining a social licence to operate in what is essentially a public resource include identifying your stakeholders, listening to what they have to say, and working with them for a common outcome.

"We all have the same desired outcomes: healthy, abundant, natural aquatic resources. We are actually on the same page – it's just a matter of being proactive in that space to deliver that message."

Joining forces

Handled the right way, coastal communities will value and defend the role of local fisheries, their contribution to tourism, and the social and economic benefits of being associated with a high-quality, sustainable product.

From 'acceptance' to 'approval' to 'advocacy', there are three levels of social licence, Steven Davies says. Businesses should aim for the third, top echelon, where the level of community ownership and buy-in is so great that stakeholders "will literally chain themselves to your oyster infrastructure if anyone wants to take it away".

Engagement is critical in achieving this – and not just with obvious stakeholders, such as customers, importers and regulators – but also with "anybody and everybody who can impact your business in any capacity", he says.

This, he adds, includes Indigenous groups and training organisations, as well as those who may not seem like natural bedfellows: NGOs, environmental advocates and recreational fishers who have significant social currency and

reach. All of these have the potential to become powerful allies; for example, respected ocean photographer and activist Paul Nicklen has 4.8 million Instagram followers, and the Recfish West organisation in WA has 700,000 active fishers.

"So do you want to be pitted against those guys, or do you want to work with them to identify issues of commonality and explore them and move forward together?" he asks. "There are amazing opportunities if you handle it the right way."

Working with stakeholders to achieve social licence in a modern market is a matter of being transparent, and proactively opening the lines of communication to understand stakeholders' desired outcomes. Potential problems must also be addressed before they become public issues.

"We need to recognise that any human activity has a level of impact," he says. "So we can't just say 'we don't have any impact'; but the reality is the level of impact in the vast majority of our fisheries is completely acceptable and sustainable, and that's what we need to promote."

Handled the right way, coastal communities will value and defend the role of local fisheries, their contribution to tourism, and the social and economic benefits of being associated with a high-quality, sustainable product.

Say it loud

"Well-managed commercial fisheries are actually some of the most ecologically sound industries, because they are about the sustainable harvest of a renewable resource," Steven Davies says.

"It's a wonderful thing to boast, but that message isn't necessarily always put out there and recognised by the market."

While fishers do not have to respond to every critic – and indeed, should avoid niche extremists – he says a lack of engagement with local communities and their many and varied stakeholder groups is one of the major obstacles to gaining social licence.

"People have to know that you exist. They have to know what you do. It's about building a visible history as well, so that if you are ever under attack you don't have to engage on the fly but can point to your record."

Other impediments to gaining social licence and maintaining public trust include failing to deliver promises, and the fragmentation of the fishing industry itself, where aquaculture and wild capture fisheries criticise each other.

RECOMMENDATIONS

Based on his research into securing the social licence to operate, Steven Davies' recommendations for the Australian seafood industry are to:

- identify key indicators that affect its social licence;
- understand that social licence is a fundamental fisheries business consideration;
- deliver proactive, positive and consistent messaging based on independent science, in chorus through peak bodies, including via social media;
- establish better connection between producers and consumers;
- encourage and maintain access to wharves and fishers; and
- provide Australian consumers with country of origin labelling at food service outlets.

"It's just not particularly smart, because when you are importing 70 per cent of your seafood, you should be looking for issues where you can band together," he says.

"One thing I will take from this [Nuffield] experience is the importance of industry singing in chorus, putting out a consistent and positive message, which is sometimes missing from the mix. It should always be a race to the top, not the bottom."

These are lessons he is taking to his own work, making engagement with stakeholders a priority and ensuring his business will deliver a consistent, positive message, united with others from industry.

Steven Davies says the Nuffield Scholarship has been invaluable. Along with his topic of choice, he has also learned an "incredible" amount about agribusiness, policy and geopolitics along the way.

With 16 weeks travel overseas, the scholarship program was a big commitment, but worth it for the "lifetime of experience" it provided in a couple of years.

"It was a wonderful thing to do and I would recommend it to anybody," he says. **F**



Seafood dining shares culture

By Christine Fotis

Tasmania's rich traditional fishing culture could provide new fishing and food opportunities for Aboriginal Tasmanians

Above
Scorched scallop, pickled bull kelp and warrigal greens.
Photo: Taimeka Mazur



Emma Lee
Researcher

"One of the things that we've been able to demonstrate is the cultural strength and asset that communities can actually build a business on"

At last year's Dark Mofo festival in Hobart, guests were treated to fireside stories by local Aboriginal Elders while dining on Indigenous seafood delicacies, such as scorched scallops with pickled kelp and warrigal greens. Also on the menu were oysters with eucalyptus cream, alpine mint and sea celery, and wild harvested abalone served with either smoked butter and seablite, or bull kelp and saltbush.

There were six fireside feasts catering for a total of 180 people. This demonstrated a strong public appetite for engagement with Indigenous culture and foods, says researcher Emma Lee, who helped coordinate the events as part of the FRDC-funded 'Wave to Plate' project.

She sees this kind of event as providing opportunities to share culture while developing new business and social enterprises. These could be based on small-scale partnerships with Indigenous communities and local businesses – once policies surrounding the definitions and rights of Aboriginal activity permits have been updated to allow it.

Emma Lee is based at the Centre for Social Impact, Swinburne University of Technology, and is also an adjunct lecturer with the Centre for Marine Socioecology at University of Tasmania. As an Aboriginal person, she has a particular focus on sharing culture through food.

The Wave to Plate project kicked off in March 2017 to identify opportunities and barriers to the greater involvement of Indigenous people in Tasmania's fisheries and food tourism industries.

The idea for the Dark Mofo fireside feast came from a one-day Indigenous fisheries workshop to assess and improve partnership development in fisheries and marine research. Held in Eaglehawk Neck, Tasmania, in February 2018, the workshop brought together 40 participants, including Australian and Tasmanian government representatives, local Aboriginal community members and researchers.

The workshop featured a lunch of seafood harvested under an Aboriginal activity permit. This sparked the concept of the fireside feasts, dished up from the Palawa Fire Pit, as part of Hobart's Dark Mofo festival.

"Dark Mofo has been about gaining the social licence and understanding that people want to get involved in experiencing Indigenous foods," Emma Lee says.

"This was the first time that a ticketed event had been held as part of Dark Mofo, and it was the first time the event had engaged broadly with Aboriginal Tasmanian peoples' communities. The fireside feast was sold out within a week and a half of advertising."

While featuring native ingredients, the menu was prepared by non-Indigenous Huon Valley chefs Asher Gilding and Franca Zingler – a cross-cultural collaboration producing native food for a Western palate.

The Elders participating in the event came from diverse Tasmanian communities, including artist Aunty Netty Shaw and Amnesty International human rights advocate Rodney Dillon.

The event was so popular it will be returning for Dark Mofo in 2019.

However, Emma Lee says one of the greatest barriers to increasing Indigenous participation in activities such as this in Tasmania are the restrictions related to on-selling seafood harvested under Aboriginal activity permits.

The event provided an important opportunity to test the interest in Indigenous cultural and food experiences. But a longer term solution needs to provide greater clarity about what is allowable under the activity permit. This might include considering changes that would better support Indigenous social enterprise.



Aunty Netty Shaw hosting an evening of Palawa Fire Pit at Dark Mofo Winter Feast 2018. Photo: Emma Lee

“People are able to engage in broader community engagement in caring for sea country, in understanding Tasmanian Aboriginal connections to our seafood and our culture, through just being able to sit down and have a feed.”

Emma Lee

“Once we’ve been able to articulate what the barriers are, addressing them just becomes part of the process to remove discrimination,” Emma Lee says.

She says reviewing the Tasmanian Aboriginal activity permit rights and definitions would allow a new focus on modern economies and shared fishery knowledge to produce a different kind of fishery rights access in Tasmania – that of Indigenous cultural fisheries.

This could include managing sea country in partnership with the Tasmanian Government and other fisheries stakeholders, as well as the promotion and sharing of culture and heritage. This might take the form of guided tours, or gathering and serving seafood to share.

“One of the things that we’ve been able to demonstrate is the cultural strength and asset that communities can actually build a business on,” Emma Lee explains. “People are able to engage in broader community engagement in caring for sea country, in understanding Tasmanian Aboriginal connections to our seafood and our culture, through just being able to sit down and have a feed.”

Partners in the research include the FRDC; Department of Primary Industries, Parks, Water and Environment (Tasmania); University of Tasmania; Swinburne University of Technology; and the Tasmanian Regional Aboriginal Community Alliance. **F**



Above
Indigenous wild-catch abalone.
Photo: Emma Lee



Right
Chef Franca Zingler preparing abalone.
Photo: Emma Lee

A home-grown seafood future

Working at the forefront of an emerging sector has provided Ian Lyall with plenty of challenges and a passion for aquaculture

Story and photo **Catherine Norwood**

Ian Lyall admits he has been spoiled when it comes to sampling the best that Australian aquaculture has to offer. It is one of the perks of judging the entries in the Sydney Fine Food Show – as he has done with a team of experienced colleagues every year for the past 18 years.

The competition initially started as a sponsorship deal between the NSW Department of Primary Industries (DPI), where he was working, and the Royal Agricultural Society of NSW to support an emerging sector.

Every competition needs judges, and Ian Lyall was well placed to fill a spot on the judging panel. He is a lover of seafood, wild and farmed; a keen recreational fisher who has tasted the best straight from the sea; a marine scientist with experience in prawn farming as well as freshwater fish; and an advocate for sound government policy to support the future of the aquaculture sector.

Twice a year, he gathers with fellow judges to assess the quality of aquaculture products from across the nation. Colleagues over the years have included seafood provedore John Susman, ABC radio presenter Simon Marnie, and national food and media presenter Lyndey Milan. Sydney Rock and Pacific Oysters and prawns are judged in April, while all other categories, including Barramundi, Atlantic Salmon, Rainbow Trout and other fresh and processed fish, are judged in September.

The Fine Food Show has set the benchmark for what is possible – and Ian Lyall says that benchmark is very, very high.

The aquaculture sector in Australia has come a long way since the early 1980s when he studied marine science at James Cook University. Back then, it made up just 20 minutes of class time during his three-year degree.

Aquaculture was not a career path he had considered. But after university and the customary year spent backpacking overseas, he found himself working in NSW's fledgling aquaculture sector, in a prawn hatchery at Yamba operated by Dalgety's.

He had worked hard in the past, by virtue of holiday jobs as a builder's labourer, but found he was still unprepared for the rigours of animal husbandry.

"It made me appreciate how much hard work is involved in growing animals in water," he says.

The hours were long, time off was limited, and setbacks were frequent in the quest to rear Australian Black Tiger Prawns (*Penaeus monodon*) to the post-larval phase – the crucial first step in the farming process.

Four years of trials eventually produced a reasonably consistent outcome. At this point Ian Lyall took time out, combining his love of outdoor activities with a job on the ski fields for a season, while he considered his options.

There was clearly an opportunity in the emerging aquaculture sector, and he spent several months in reconnaissance, driving across NSW in search of work and planning a business of his own.

He wound up in central NSW, helping to breed and grow freshwater fish such as Silver Perch (*Bidyanus bidyanus*), Golden Perch (*Macquaria ambigua*), and Freshwater Catfish (*Tandanus tandanus*) on a farm in Condobolin.

"Freshwater fish breeding was very different from prawns, not as hard; procedures were already well developed by fisheries researchers from Narrandera," Ian Lyell says. "I also learned a lot about marketing there."

These were the halcyon days of Silver Perch, when they sold for \$25 a kilogram live to the emerging Asian restaurant sector in Sydney.

Ian Lyall says NSW is steering a steady course towards a sustainable aquaculture sector.



"We would harvest, pack the truck with fish and water and oxygen, and leave Condobolin at 10 pm, driving into Sydney to unload at our distributor's place in Sussex Street, Chinatown. He would then take us across the road for a yum cha breakfast."

Family drew him back to the Sydney region. After some time spent consulting, the lure of a regular paycheck to help provide for his young family saw him take a three-month contract at NSW Fisheries, as it was then, working from an office at the Sydney Fish Market.

It was 1994 and the aquaculture landscape was changing. A new *Fisheries Management Act 1994* was expanding beyond traditional oyster cultivation to include other species on land and in marine environments.

When his initial contract ended, Ian Lyall



Below Ian Lyall is a regular judge for the Sydney Fine Food Awards. Photo: Royal Agriculture Society of NSW



stayed on with NSW Fisheries. By the time Sydney played host to the World Aquaculture Conference in 1999 – an event he helped to organise – excitement was mounting around the potential of aquaculture.

“The possibilities for Australia seemed enormous, given what was already happening overseas,” he says. He recognises that NSW has been slower than other states to advance on these possibilities. As aquaculture program leader of the NSW DPI for the past 15 years, he is intimately familiar with the path of progress.

Positive trends

NSW continued to invest in its long-standing oyster industry, which endured successive critical hits, including food safety scares

and disease events, leaving only the most tenacious, adaptable farmers still operating.

Ian Lyall says it has been rewarding to see recent improvements for growers, including an upward trend in production value, which increased 12 per cent in 2017-18, and 20 per cent for the Sydney Rock Oyster industry. (If you are after a benchmark, Tathra Oysters was the leading 2018 Gold Medal winner at the Sydney Fine Food Show.)

The state also invested over many years in freshwater aquaculture, he says. While Silver Perch has not progressed as hoped, Murray Cod (*Maccullochella peelii*) has recently emerged as the hero of this sector, driven by industry on the back of FRDC and Victorian-sponsored research.

“The growth over the past five years has been extraordinary,” Ian Lyall says. “It’s an

iconic Australian species that really captures the imagination in a way that other native freshwater fish species have failed to do. And it is absolutely a world-beater in terms of the quality of the flesh and the taste; it’s unlike any other freshwater fish.”

It is the future of marine aquaculture in the state that has him most excited.

His hope for marine aquaculture builds on the Department of Primary Industry’s successful partnership with Huon Aquaculture to produce Yellowtail Kingfish (*Seriola lalandi*) in conjunction with the national Kingfish for Profit research program (see story page 12). Huon has managed marine trials at the Marine Aquaculture Research Lease at Port Stephens, where fish growth and production have exceeded expectations.

Ian Lyall says this project has not been without challenges, including communication with stakeholders.

We realised there is a real void in people’s understanding of what aquaculture is and the benefits it brings to the community.”

And Australia does need aquaculture to meet its seafood demand, he says. About 67 per cent of seafood purchased in Australia is from imported sources; in NSW this is 87 per cent.

“We are paying for all those food miles to import fish that we could be growing here,” he says.

Winning community support will be critical, he says, by providing transparency and information on the environmental performance of these operations. He says this has been an important part of his contribution to drafting the three NSW sustainable aquaculture strategies during the past decade – for land-based aquaculture, oysters and, most recently, marine aquaculture.

While the sector’s progress may have been slow to date, Ian Lyall says the state’s strategies provide a solid foundation for the future of aquaculture in NSW – a sector for which he sees great promise on the verge of realisation. **F**

Final reports

Abalone and rock lobster habitats 2015-025

This study provides the Victorian Blacklip Abalone (*Haliotis rubra rubra*) and Southern Rock Lobster (*Jasus edwardsii*) fisheries with essential information to improve their management and sustainability.

It quantifies and maps the influence of benthic habitat characteristics, oceanography and biology on larval dispersal, settlement and productivity, with improved resolution of modelled coastal oceanography for the Victorian coast. The work provides hindcast data to 1990, which has informed models predicting patterns of larval dispersal.

Combined with high-resolution sea floor structure data, oceanographic variables and fishery-independent biomass data for abalone, this methodology has for the first time been used to provide estimates of abalone biomass along the Victorian coast. It allows the assessment of geographic trends over 21 years and the identification of important drivers that influence stock productivity.

More information: [Daniel Ierodionou, daniel.ierodionou@deakin.edu.au](mailto:daniel.ierodionou@deakin.edu.au)

Swordfish survival after release 2015-022

This study assessed Swordfish survival rate after a catch and release experience using tags, which detached from the fish after a maximum of 250 days and transmitted their data to researchers via satellite. Swordfish have been identified as a relatively poor candidate for a catch-and-release-only species. Some fish are suitable for release; however, fishers should easily be able to identify symptoms that will significantly reduce the probability of post-release survival, including deep-hooking and barotrauma. Fishers should be prepared to dispatch fish humanely and prepare their catch appropriately for consumption to minimise wastage, even if the intention of the fishing trip was to release.

The recreational Swordfish fishery that has developed in south-east Australia is likely to further expand, as significant interest in the fishery exists. However, it is possible that the fishery will remain relatively niche compared with other game fish targets in the area, such as tuna.

More information: [Sean Tracey, sean.tracey@utas.edu.au](mailto:sean.tracey@utas.edu.au)

Sustainable fishing families 2016-400

An industry is only as healthy and sustainable as its members. In recent years, concern for the health, safety and wellbeing of the professional wild-catch fishing industry has been growing in Australia. In response, this project conducted the first national survey of the health, safety and wellbeing of the Australian professional fishing industry in 2017.

The results provide a baseline for the state of the wild-catch industry members across a range of indicators. These include reported physical and mental health; factors affecting health and safety; factors affecting levels of stress, health and safety behaviours; and access to health services and information.

The project also conducted and evaluated an intensive pilot program on health, safety and wellbeing tailored specifically for fishing families. The program was modelled on an existing, highly successful program with farming families: Sustainable Farm Families™, developed and delivered by the National Centre for Farmer Health at the Western District Health Service, Victoria. The materials and presentations were reviewed and modified to reflect the specific strengths and challenges of the fishing industry. For the first time, this award-winning program is now available for use by fishing communities across the country.

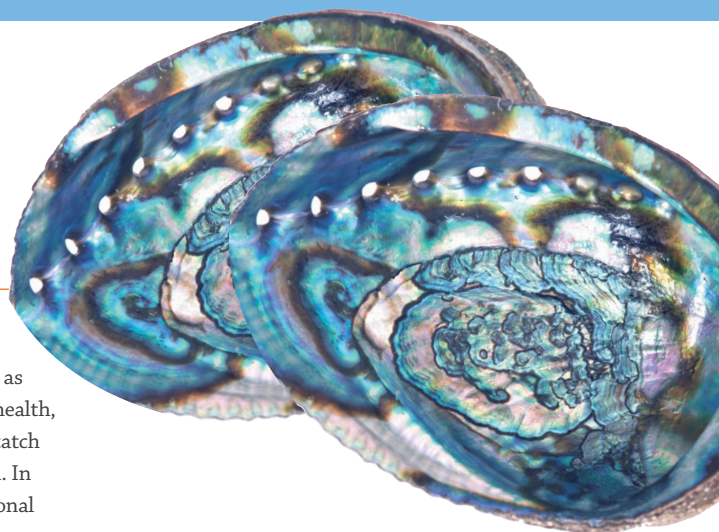
More information: [Tanya King, tanya.king@deakin.edu.au](mailto:tanya.king@deakin.edu.au)

Evaluating habitat enhancements 2014-005

This report investigated the application, needs, costs, monitoring methods and benefits of habitat enhancement structures (HES) in WA. HES are purpose-built structures or materials, strategically positioned in an aquatic environment, to create, restore or improve a habitat for fish, fishing and recreational activities in general.

The project designed, validated and established a world-first monitoring method using recreational fishers to survey artificial reefs with a baited, remote, underwater video system.

It also produced a guide to assist industry, researchers, managers and the community with the HES development process. The HES guide provides direction to stakeholders and decision-makers



looking to undertake new HES projects. It has been promoted in WA and nationally, and has already been an essential component in the development of five HES installations that will be deployed 2018–2020.

More information: [Andrew Rowland, andrew@recfishwest.org.au](mailto:andrew@recfishwest.org.au)

Timing Blacklip Abalone harvest 2015-017

This research responded to a direct request of the Abalone Industry Association of SA. It identified the optimum months to harvest Blacklip Abalone (*Haliotis rubra rubra*) to obtain the highest achievable bled meat yield for any given shell length. This is possible because Blacklip weigh more and bleed less during certain months of the year.

The optimum harvest months were determined using a model adapted from previous work carried out on Greenlip Abalone (*Haliotis laevigata*).

More information: [Ben Stobart, ben.stobart@sa.gov.au](mailto:ben.stobart@sa.gov.au)

Whole-of-chain seafood traceability 2015-711

As food traceability from producer to consumer becomes more important, the seafood industry has been trialling a variety of methods, including radio frequency identification (RFI) tags, to track its catch. In the case of seafood, whole-of-chain traceability can act as a means of assurance of food safety, sustainable fishing practices and product integrity (including protection against substitution).

Following on from recommendations of a 2012 Cooperative Research Centre project, this latest research attempted to evaluate the usability of RFI. The team partnered with Austral, and its crew was able to use the system successfully, although intermittently. Technical issues were partially responsible for the fact that, apart from some preliminary analyses, the system was not tested throughout the supply chain. However, the software

application and data-management platform is now available for use by other seafood operations, with limited customisation needed.

More information: Janet Howieson, j.howieson@curtin.edu.au

Efficient monitoring for the SESSF 2014-203

This project set out to review the methods used to monitor the Southern and Eastern Scalefish and Shark Fishery (SESSF), a multi-species, multi-gear, multi-jurisdictional Commonwealth fishery. Its monitoring and assessment is required to meet the objectives of fisheries management, including the revised *Commonwealth Fisheries Harvest Strategy Policy* and *Commonwealth Fisheries Bycatch Policy*.

Most monitoring and assessment costs are borne by the industry (licensees holding statutory fishing rights to participate in the SESSF). Recently, expanding monitoring and assessment activity has coincided with decreasing commercial returns – primarily as a result of falling prices for some commercial species and the failure to catch all allowed fish.

Future monitoring and assessment activity applicable to the SESSF must be cost-effective for all sectors. This review evaluated existing monitoring and assessment arrangements, and provides recommendations on future monitoring and assessment to cost-effectively meet management and legislative requirements.

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

Blue-carbon workshop 2018-060

Several stakeholders within the Australian seafood industry have demonstrated strong leadership by developing carbon-neutral business practices. In 2017, participants in the National Seafood Industry Leadership Program challenged the industry to become carbon neutral by 2030.

In response, the FRDC and CSIRO hosted a workshop that invited key stakeholders and thought leaders from industry, government and non-government organisations to discuss the overall attitudes of the Australian seafood industry to the concept of carbon neutrality. The workshop also gauged aspirations for investment in coastal blue-carbon offsets as a way of achieving carbon neutrality.

More information: Mat Vanderklift, mat.vanderklift@csiro.au

Fisheries and aquaculture statistics 2016/2017-095

Since 1991, the Australian Bureau of Agricultural and Resource Economics and Sciences has published annual detailed production and trade data in Australian fisheries statistics (now Australian fisheries and aquaculture statistics). This data is published to meet the needs of the fishing and aquaculture industries, fisheries managers, policymakers and researchers.

The latest report provides a reliable time series of economic data about Australia's fishing and aquaculture industries to ensure well-informed investment, management and policy decisions by governments, the fishing industry and the public in general. The report also delivers accurate information about exports and imports of fisheries products, and the value associated with the commercial fisheries and aquaculture sectors. Baseline information used to establish the importance of individual fisheries and trends within fisheries is also presented.

More information: Robert Curtotti, robert.curtotti@agriculture.gov.au

Seafood safety and market access 2015-212

During this three-year project, SafeFish has built strong governance arrangements and has a clear model of operations that is detailed in the SafeFish Charter.

SafeFish has produced technical reports on high-priority issues identified by the SafeFish partnership. These include reports on:

- validation of rapid-test kits for use by bivalve shellfish sectors in detecting paralytic shellfish toxins;
- food-safety risks associated with minimally processed, chilled and extended shelf-life seafood;
- the food-regulatory systems covering bivalve shellfish in place in Australia (to assist with re-negotiating market access for bivalve shellfish to the US);
- an application to allow Australian abalone containing sodium metabisulfite to be exported to China;
- a review of all available tools that can be used in determining the authenticity of Australian seafood products; and
- hazard-identification sheets of current and emerging issues affecting seafood.

The SafeFish work has helped the Australian seafood industry meet its food-safety obligations, provided novel risk-management options, and assisted in maintaining or re-opening markets to Australian products. It has also provided technical support, training and capability to seafood businesses, the seafood industry, researchers and regulators. Another important benefit has been the development of capability to address food-safety and market-access issues in Australia. SafeFish has invested in training regulators, researchers and industry personnel, as well as providing opportunities for travel to technical conferences.

More information: Alison Turnbull, alison.turnbull@sa.gov.au

Access for Indigenous Australians 2014-233

The project was undertaken because Aboriginal and Torres Strait Islander people continue to assert that their rightful place in the use and management of fisheries resources is yet to reach a level that would enable them to meet their cultural, social and economic needs.

Some key issues underpinning this perception were identified by Indigenous fishers at a national workshop supported by the FRDC held in Cairns 2011. Two specific issues identified at the workshop were the basis for this project: the need to identify barriers and opportunities for Indigenous fisheries within legislation and policy, and the need to address non-Indigenous impacts on Indigenous fisheries. →



It will take time for the outcomes to have an impact on end users, such as fisheries managers. However, some information from the project has already been taken up by fisheries decision-makers, through providing audit information to several governmental reviews and inquiries over the past three years.

More information: [Stephan Schnierer, stephan.schnierer@me.com](mailto:Stephan.Schnierer@me.com)

Mapping livelihood values 2015-205

This report contains the results of the largest research project into Indigenous fishing values to date. It has documented how and why the use and management of marine resources is valued by and benefits Indigenous peoples and communities in three different parts of Australia.

The research team interviewed 169 Aboriginal people from three regions between October 2015 and July 2017, collecting qualitative data on the perceived cultural, social, economic and health significance and benefits of customary fishing practices (activities related to the use of fish and aquatic invertebrates). Data was also collected on perceived barriers to customary fishing practices, and the aspirations people held for marine resource use and management in their communities' futures.

The results show that, for many Aboriginal people, customary fishing practices are of immense value and multi-faceted importance. Being able or unable to access customary fisheries can have profound repercussions on the cultural, social, economic, physical and mental health of individuals, families and communities. Recognising and facilitating the values and aspirations of Aboriginal people in the management and use of their sea countries has the potential to generate substantial positive flow-on effects for overall health, wealth and wellbeing.

More information: [Luke Smyth, luke.smyth@aiatsis.gov.au](mailto:luke.smyth@aiatsis.gov.au)

Visiting scientist: Kostas Ganias 2016-103

The daily egg production method is used to estimate the spawning biomass of several Australian fisheries for pelagic species, including the South Australian Sardine Fishery and Commonwealth Small Pelagic Fishery.

Kostas Ganias of Aristotle University of Thessaloniki, Greece, is a world leader in the reproductive biology of small pelagic fishes related to the application of egg production methods. The aim of his visit to Australia was to evaluate and recommend options for improving the methods used to estimate the spawning fraction and fecundity of Australian Sardine (*Sardinops sagax*), Common Jack Mackerel (*Trachurus declivis*), Blue Mackerel (*Scomber australasicus*) and Redbait (*Emmelichthys nitidus*).

Kostas Ganias made some recommendations that have the potential to improve application of the daily egg production method to these two fisheries.

More information: [Tim Ward, tim.ward@sa.gov.au](mailto:tim.ward@sa.gov.au)

Love Australian Prawns evaluation 2016-272

A review of the Love Australian Prawns (LAP) strategy, which compared consumer perceptions and awareness of LAP over time, demonstrated that LAP is achieving its original objectives. One in five Australians now recognises the LAP logo; this sort of awareness is usually only achieved via television campaigns. The industry has experienced an average 20 per cent increase in medium, medium-to-large and large grades between the start of the LAP campaign and the end of 2016.

More information: [Rachel King, acpf.eo@gmail.com](mailto:rachel.king@acpf.eo@gmail.com)

Aquaculture genetics symposium 2018-001

The International Symposium for Genetics in Aquaculture is a triennial, premier aquaculture event that brings together world-leading researchers, industry and students interested in improving aquaculture production and sustainability through genetics. The conference is held on a different continent every three years, and in 2018 it was held in Cairns over 15-20 July.

In 2018, the conference's focal theme was industry implementation and the practice of genetics in industrial aquaculture. The conference provided an opportunity for the Australian industry to be exposed

to how genetics is being used in aquaculture. It showcased not only the frontiers of genetic research applied to aquaculture, but also how the global aquaculture industry is adopting genetics to improve productivity and some of the challenges they have faced and overcome.

More information: [Dean Jerry, dean.jerry@jcu.edu.au](mailto:dean.jerry@jcu.edu.au)

Champions of healthy fish habitat 2015-501

This project was an effort on behalf of the recreational fishing community to improve fish habitat and improve the capacity of fishers to take on this work. OzFish Unlimited coordinated the project on behalf of the Fish Habitat Network – a group of like-minded organisations from government and non-government sectors. The report documents these activities and the outcomes for fishers and fish habitat.

More information: [Craig Copeland, craigcopeland@ozfish.org.au](mailto:craigcopeland@ozfish.org.au)

Mapping shark movements 2014-020

This report focuses on the movement dynamics of two pelagic sharks in SA: the White Shark (*Carcharodon carcharias*) and Bronze Whaler (*Carcharhinus brachyurus*). The project used acoustic telemetry to determine if aquaculture activities correlated with patterns of fidelity and migration, and assessed and compared the use of natural shark foraging areas with areas used for marine industry activities. Additional objectives included the development of industry guidelines for removal and release of pelagic sharks from finfish aquaculture pontoons, and surveys to collect baseline information on perceptions of shark associations with aquaculture and other marine activities.

More information: [Paul Rogers, paul.rogers@sa.gov.au](mailto:paul.rogers@sa.gov.au)





Movers and ...

Brett Molony, previously supervising research scientist at the Department of Primary Industries and Regional Development in WA, has recently accepted the position of research group lead and principal research scientist – coasts with CSIRO Ocean and Atmosphere, based in Perth.

After more than 25 years of service, **Annette Lyons** has left the FRDC.

Leah Fergusson, portfolio officer in the FRDC's Adelaide office, will be taking over her role.

Bernadette Ditchfield was recently appointed as deputy director-general, fisheries and forestry, in the Queensland Department of

Agriculture and Fisheries. She will be the formal Australian Fisheries Management Authority member for Queensland, replacing **Scott Spencer**.

Kim Ellis has been appointed as the new director of the Australian Antarctic Division, taking over from **Nick Gale**. Kim is currently the executive director of the Botanic Gardens and Centennial Parklands in NSW.

Steven Hall is the new chief scientist at Geoscience Australia.

2013 Nuffield scholar **Jodie Redcliffe** will become interim CEO of Nuffield Australia in March. She will fill the role of CEO **Jodie Dean**,

who will be taking maternity leave.

Andrew Gregson has taken the position of CEO of the Tasmanian Salmonid Growers Association from

Adam Main, who has moved to Primary Industries and Regions SA.

FEEDBACK

FRDC WELCOMES
YOUR COMMENTS

frdc@frdc.com.au

MOVERS WE'VE

MISSED?

INFO PLEASE TO:

Annabel Boyer,

02 6285 0415,

annabel.boyer@frdc.com.au



FISH 2.0 REGIONAL INNOVATORS FORUM

The first-ever Fish 2.0 Regional Innovators Forum for sustainable seafood will take place on 2-3 April in Brisbane.

The forum will feature three expert panels with facilitated discussions and debates around key issues and opportunities to grow the value and trade of seafood in the region, including innovative investment strategies, game-changing innovations from the region which are commercially ready, and regional trade of novel seafood products. In between these panel discussions, attendees will hear pitches from a range of seafood innovators from Australia and the Pacific Islands and have plenty of time to network and meet one another.

If you are a growing seafood business, then you may also apply to our special one-day workshop on 2 April. You will learn how to effectively work with investors and partners to grow your business – and then have a chance to pitch your business at the Forum on 3 April. The workshop and forum are offered free of charge to accepted business participants, but you must apply to attend at www.fish20.org/brisbane.

Calendar of events

DATE	EVENT	MORE INFORMATION
2019		
5-6 March	ABARES Outlook Conference	Canberra
8 March	International Women's Day	www.internationalwomensday.com
7-11 March	Aquaculture 2019, New Orleans	www.marevent.com/AC19_NEWORLEANS.html
9-10 March	Port Phillip Mussel and Jazz Festival Street Party	https://southmelbournemarket.com.au/event/port-phillip-mussel-jazz-festival-2019
17-19 March	Seafood Expo North America, Boston	www.seafoodexpo.com/north-america
27 March	Māori Fisheries Conference 2019	teohu.conference.maori.nz
2-3 April	Fish 2.0 Regional Innovators Forum	www.fish20.org/brisbane
12-14 April	Wild Harvest Seafood Festival	Mallacoota
16-17 April	FRDC Board Meeting	02 6285 0400
26-27 April	East Gippsland Field Days, Bairnsdale, Victoria	www.egfielddays.com.au
3-6 May	Wynnum Fishing and Seafood Festival	www.ozfishmoretonbay.org
7-9 May	Seafood Expo Global, Brussels, 2019	www.seafoodexpo.com/global
27-30 May	APPEA 2019 Oil and Gas Conference	www.appeaconference.com.au



Australian Government
Australian Maritime Safety Authority

Report maritime incidents directly to AMSA in two simple steps

1. Submit an incident alert—as soon as practicable

This lets us know a serious event has occurred.
Form 18—Incident alert

2. Submit an incident report—within 72 hours

This gives us detailed information about the incident and mitigation measures.
Form 19—Incident report

Submit forms via amsa.gov.au or email completed forms to reports@amsa.gov.au

Types of incidents you need to report



- death or serious injury of a person
- loss of a person overboard
- an event that could impact the safety of a vessel or passengers on board or nearby
- loss of a vessel
- grounding, sinking, flooding or capsizing of a vessel
- significant damage to, or fouling of a vessel (eg fire or ghost nets)
- collisions and close-quarters situations
- structural failure of a vessel



 Call AMSA CONNECT **1800 627 484**



Visit amsa.gov.au/incident-reporting