FISH

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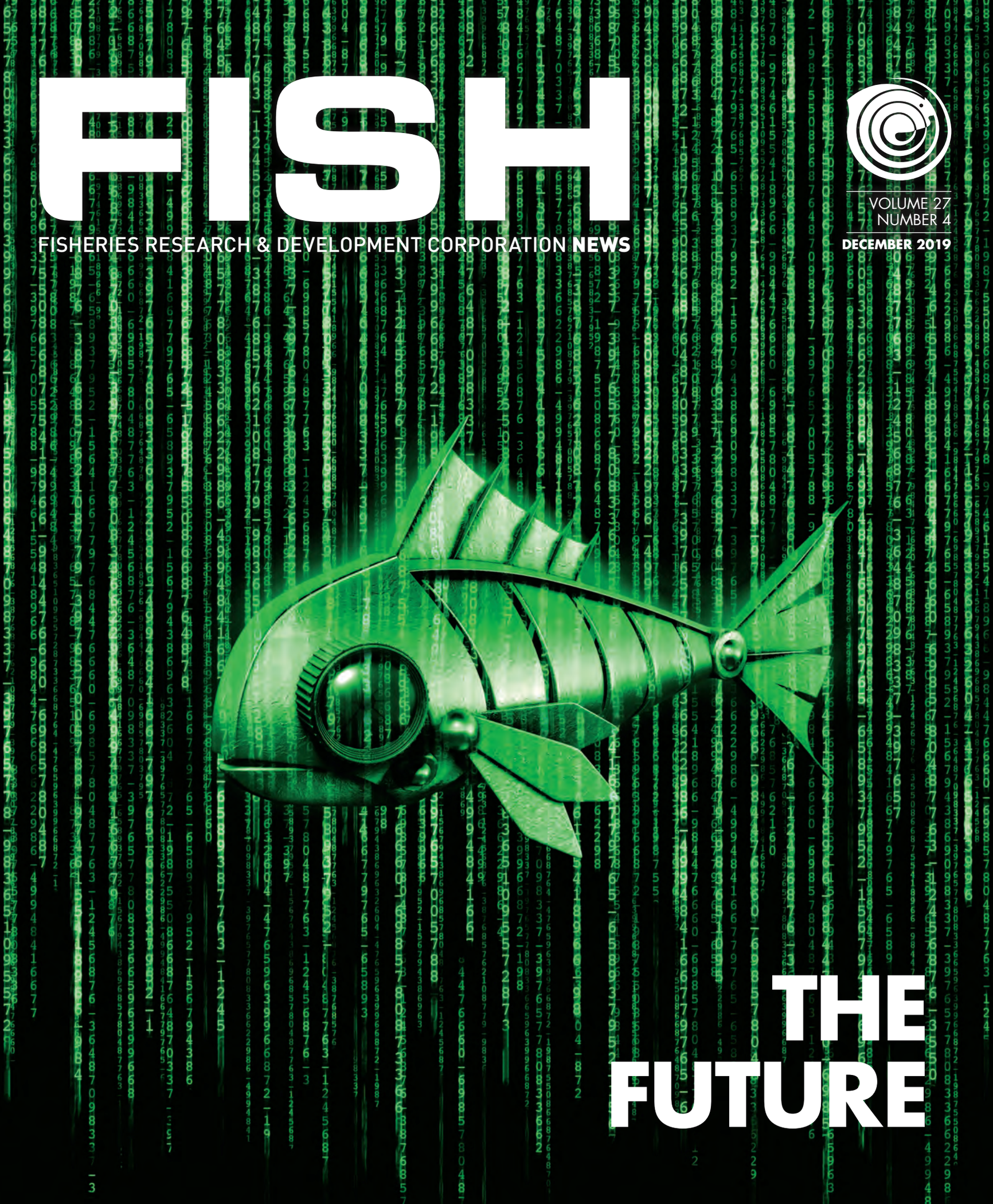

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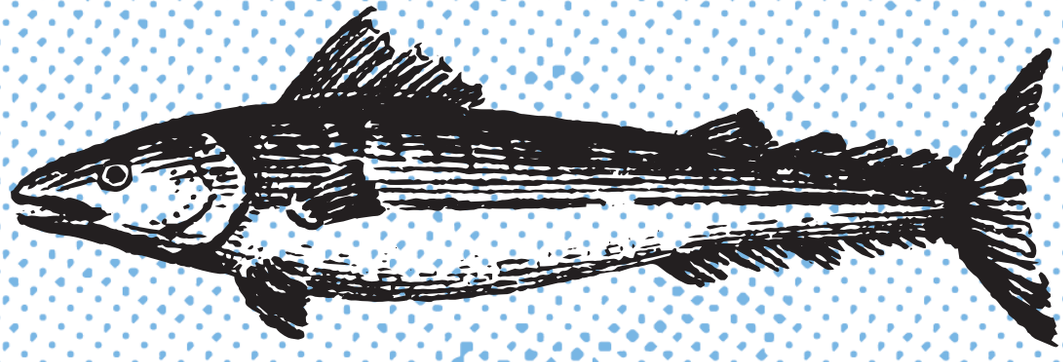
FRDC acknowledges the traditional custodians of the lands on which FISH magazine is produced, and pay our respects to their Elders past and present. We acknowledge the special relationship that Indigenous Australians have with their traditional lands and waters.

FUTURE

The future is coming and with it comes change. We will each plan, prepare and deal with it in our own way. This 'FUTURE FISH' edition is our way of taking stock, highlighting some issues and pondering what may happen and where we could go into the future.



Over the past decade, the readership of *FISH* has expanded; we estimate that more than 100,000 people read each edition, whether it be in print or in a digital format. During this time, we have endeavoured to cover important issues, but with such a diverse readership we recognise that not all issues are relevant to everyone.

However, in this special edition of *FISH*, we are focusing on something that impacts us all: the future.

The future is coming and with it comes change. We will each plan, prepare and deal with it in our own way. This 'FUTURE FISH' edition is our way of taking stock, highlighting some issues and pondering what may happen and where we could go into the future.

In fact, for the past year the FRDC has been focused on the future. This has been driven in part by the number of reviews and planning processes we have been involved with. These include the *Agricultural innovation – a national approach to grow Australia's future* report, the House of Representatives Standing Committee on Agriculture and Water Resources inquiry into growing a $100 billion agriculture sector, and the *Modernising the Research and Development Corporation system* review. And, of course, the development of the new FRDC five-year investment plan.

So, you could say the planning and content for this edition has been in the pipeline for a while. We hope to give a snapshot of the material we are looking at, the opinions being considered and the data that goes into developing the new plan.

As the executive editor for *FISH* magazine I have overseen many editions (60, for the record) and hundreds of articles. Some I have loved and others … well, let's say they were difficult children.

Whenever you write content that incorporates diverse views it becomes a challenge to ensure that you capture these accurately and without bias. Our starting point is to be agnostic and focus on the science. The end goal is to improve our knowledge, which then leads to improvement in what we do and how we do it.

This edition features opinion pieces from several industry leaders, offering their diverse personal perspectives on fishing and aquaculture. We do not normally run opinion pieces, instead sticking to the facts and staying within our remit. But, in looking to the future, we feel that sharing opinions is apt, as a way to spark fruitful conversations. I hope that people will read them in this spirit, even if they don't agree with everything our writers say.

Special mention must go to the communications team at the FRDC, in particular Elisabeth Howie and Annabel Boyer, as well to the production team at Coretext, Catherine Norwood and Fiona James.

I am proud of bringing this issue to life. Doing something new and writing broader-scoped, thought-provoking articles has been challenging and fun. I hope that you enjoy it and we welcome your feedback on what you liked and what you didn't.

Peter Horvat
Executive editor
FISH magazine
Email: peter.horvat@frdc.com.au

The science of making our own luck

In planning for the future of fisheries, the FRDC's Managing Director Patrick Hone says asking the right questions and embracing change will be crucial

By **Patrick Hone, Managing Director, FRDC**

Is Australia the 'lucky country'? Or do we make our luck?

As a scientist, my answer is there is no such thing as luck. There is planning, data and preparation, followed by good implementation. So, to succeed and make Australia 'lucky', we need answers. Therefore the questions become the critical piece.

The FRDC has started finding out what the key questions are. We have been out listening to stakeholders across the country. We have been undertaking research to identify what we need to focus on.

These questions will not only help inform the new Research, Development and Extension (RD&E) Plan, but also all of our stakeholders.

For 28 years the FRDC has been investing in RD&E to answer questions, solve problems and work to ensure a vibrant fishing and aquaculture community. Over this time there has been considerable change.

Aquaculture production technology has progressed so not only is it reliable, but it can also produce healthy, cost-effective seafood. At the forefront of fish farming has been the Atlantic Salmon sector.

This sector is closing in on a farm-gate gross value of production of $1 billion annually, and more growth looks extremely likely. This positive future lies not only with Atlantic Salmon, but also with many other farmed species.

Australia's First People have made great strides in ensuring they receive recognition for their stewardship of and cultural connection to aquatic resources. But there is still more to be done to improve outcomes and create better futures.

Photo: Unsplash

Angling as a pastime continues to grow, creating new opportunities for those who enjoy recreational fishing. This sector is embracing technology from complex artificial reef constructions, using anglers as citizen scientists who connect by digital platforms to rehabilitate aquatic habitats. But, like other stakeholders, the recreational fishing sector must continue to take on more of a stewardship role, listening to and addressing community concerns.

Increasing capacity

Commercial fishers have also responded to ensure that their practices continue to evolve to meet community values. This has not been easy. Increased community pressure has resulted in a decline in commercial fisher participation and catch. The paradox is that despite changes in community views, consumers' desire and need for wild-caught seafood has not diminished.

We need to encourage people of other ages and genders to take part in all sectors of fishing and aquaculture. This is already happening: for example, more women are taking on leadership roles, and Victorian and NSW fisheries agencies are working to increase the number of women and people from non-English speaking backgrounds participating in recreational fishing.

Building the capability in an ageing and declining workforce is also important to growing the sector, but this presents a range of issues. However, with the right investment and incentives to increase skills and capability, we can fast track and facilitate the adoption of new technology and develop a broader skillset within the industry. This will help to provide capacity within the industry to deal with increasingly diverse and complex issues, from managing regulatory burdens to developing new markets.

Pooling our resources

One question that has remained constant is 'whose fish is it?' This continues to be a major issue, with a common mindset being that the growth of one sector means taking something from another. The challenge is to grow together and to share the benefits without creating 'winners' and 'losers'. This will require cooperation.

We also need to consider how we respond collectively to the other big issues facing us all. For example, how can we address climate change so that aquatic ecosystems are conserved? Issues such as this are not solely the remit of fisheries and aquaculture.

There is clearly a need for cross-industry and whole of agriculture investments to be more strategic. Currently, Research and Development Corporations (RDCs) collaborate on a project-by-project basis and while this is often quite effective, there is an opportunity for RDCs to deliver greater returns to stakeholders through investments aligned to the big issues we all face.

My assessment is that the fishing and aquaculture sectors are not satisfied. They do not want to sit back and become forgotten. They want to embrace the changes that this century is bringing.

The challenges and opportunities for fishing and aquaculture are enormous. >

"Business as usual will not get us there ..."

Patrick Hone,
Managing Director,
FRDC

> ***Winning strategies are going to be more Scrabble than Monopoly.***
>
> Monica Jain, FISH 2.0

As outlined in the AgriFutures report, *Agriculture – a $100 billion sector by 2030?*, progress toward this target requires aligning and executing strategies that contribute to and improve enduring profitability for the whole industry.

Business as usual will not get us there and any strategy needs to be flexible to adapt across sectors and over time as circumstances dictate. For commercial seafood, we will have to increase value by 36 per cent to take the current GVP ($3.0 billion) to $4.24 billion by 2030 – just to stay on trend.

Change is a given. At the recent 2019 FISH 2.0 Global Innovators Forum, the program founder Monica Jain highlighted 10 changes she sees facing industry and consumers. These were:

- Aquaculture is becoming everywhere and will continue to grow, being everywhere.
- Data is the most valuable seafood product.
- We increasingly find treasure in trash.
- Winning strategies are going to be more Scrabble than Monopoly.
- Algae is going to be both our friend and enemy.
- Designer fish and shellfish babies are going to be normal.
- Fish have lost their rights to privacy.
- There are fewer mysteries to solve at our table.
- Middlemen who trade in seafood (commodity) are a dying breed.
- The sun is the friend, instead of the enemy, of seafood.

The question for the FRDC and its partners is, what are we going to do to ensure these changes serve all fishing and aquaculture sectors? We can hope for luck or serendipity.

Or, we can take on a leadership role to chart a course in the direction we collectively want to go.

Business as usual will also not solve the other wicked problems facing fishing and aquaculture. We require new ways to solve complex problems together.

Evolving perspectives

We can only speculate, based on data, what 2030 looks like for the fishing and aquaculture sectors. I hope that it continues to be an integral part of Australia's life from all perspectives: Indigenous, recreational and commercial.

This issue of *FISH* explores what we have heard as part of the consultation for the next FRDC RD&E Plan, due to be released mid-2020 (see story page 10). What I can say is that the conversations have all been very positive, but they are only the beginning.

As for the FRDC, it will need to evolve, by continuing to deliver long-term strategic investment in RD&E, but also by growing and delivering agile services that meet the needs of our customers.

We will become ambidextrous in delivering these services. On one hand, we need to maintain our research capacity, both for short-term tactical and long-term strategic issues, while on the other, we need to embrace new ways to partner and innovate. The FRDC also sees incredible value and need to work more collaboratively with all RDCs to address the complex challenges that are faced by all sectors nationally.

Front and centre of these challenges is ensuring healthy environments that support all the agriculture, fisheries and forestry sectors. Pooling the RDCs' resources is the logical way for all sectors to meet these challenges and make them opportunities.

Ultimately, we will all have to work smarter, connecting with stakeholders from both within and outside of fishing and aquaculture, to gather information that helps us all win. **F**

Illustration:
Gregory Baldwin

Scenarios help focus on future strategies

A new approach is needed to prepare Australia's fishing and seafood sector for a complex and technologically interconnected future

By **Matt Barwick** and **Gary Saliba**

Will past trends continue, or will the future of fishing and aquaculture be shaped by entirely different factors, with different outcomes?

Since the FRDC developed its first strategic plan in 1991, the world has become more complex. Technology has played a major part in this. The cost of computing has decreased massively and it has become more powerful. Further, the internet and interconnected smart systems have resulted in the widespread digitisation of information and a far more connected world. These technological changes have brought social and cultural flow-on effects that few could have predicted. Societal norms have changed and people can connect like never before.

The FRDC's current Research, Development and Extension (RD&E) Plan 2015–2020 is drawing to a close and, as we prepare the next RD&E plan, it's clear we need to think about new approaches to both anticipate the future needs of Australia's fishing and aquaculture sector leading up to 2025 and address the ongoing ones.

The FRDC has previously taken a classic 'priority setting' approach to developing its RD&E plans. For the 2015–2020 plan, that meant consulting across the broad range of FRDC stakeholders, conducting research to generate a quantified picture of the sector, and from there identifying priorities and goals for the five-year period.

For the next plan, stakeholder consultation remains crucial to the planning process and stakeholders can still let the FRDC know their thoughts by visiting www.frdc.com.au/Research/RDE-planning-and-priorities/FRDC-RDE-Plan-2020-2025. In addition, the FRDC is trying a few new approaches. One of these is working with futurist management consultancy Strategic Journeys to think about and map potential future scenarios, which are then explored in workshops.

Exploring the future

Scenario planning enables stakeholders to consider a range of possible futures, both desirable and undesirable. It helps them explore different potential outcomes, challenges their unconscious biases and encourages them to examine and test their assumptions about the future.

The FRDC has engaged a broad cross-section of leaders, entrepreneurs and innovators from across Australia's fishing and aquaculture community, including industry, to explore four possible scenarios of the future up until 2030. These scenarios will then help inform the 2020–2025 plan and alternative investment areas for RD&E. The four scenarios can loosely be described as:

- A future world characterised by confidence in information, knowledge and authority, in which these drivers work to create a unified and inclusive community.
- A future world driven by fear, in which authorities and the purveyors of information polarise and divide different sectors within the community.
- A future world in which key environmental impacts are known, measured and managed and decisions are informed by evidence.
- A future world in which key environmental impacts are largely unknown, unmeasured and unmanaged and decision-making is driven by populism.

The dynamics within each scenario described above shape how the scenario plays out.

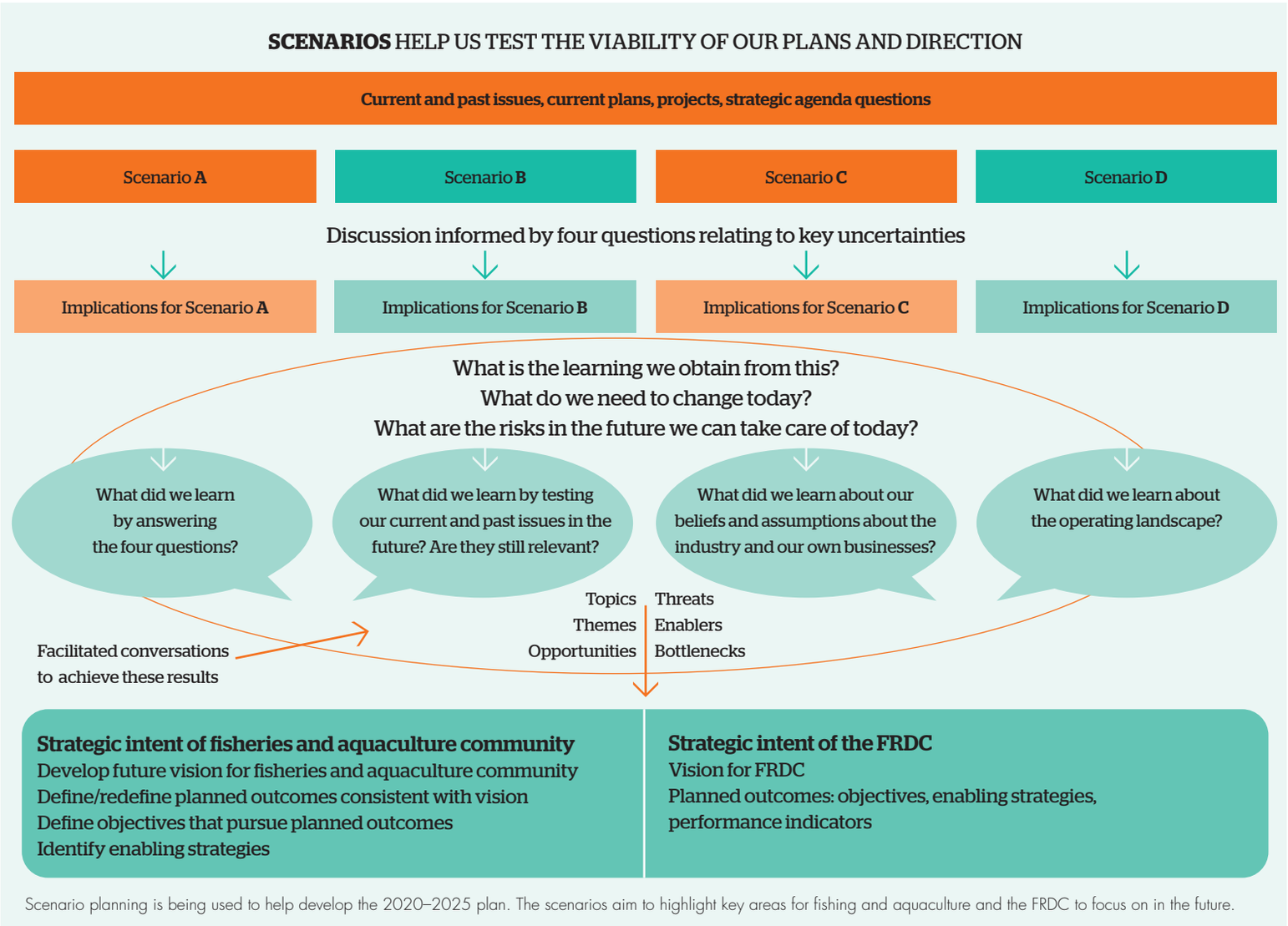
For example, by 2030 strong beliefs in the value of science might drive proactive adaptation to and mitigation of climate change. Alternatively, progress could be hampered by an inability to take evidence-based action.

Several of the scenarios describe deeply polarised politics which are fuelled by factors such as sensationalist media, or populism, in which celebrity is entwined with politics. Other potential futures feature more respectful, evidence-based political discourse.

The four scenarios also describe a number of possibilities for our aquatic systems – in some futures, they continue to be neglected and decline in health and productivity. Another scenario incorporates incentive programs to deliver economic advantage from rehabilitative efforts.

In one possible future, Australia's fishing and aquaculture community is highly regarded for the benefits it delivers to the Australian public and our fisheries management is upheld as an example of world's best practice. A less positive alternative sees Australia's fishing and aquaculture community endure radical disruption, loss of social licence, heavy regulation, contraction and marginalisation.

By presenting potential futures, these scenarios can help to establish what the industry needs to focus on, to either reach desired outcomes or avoid detrimental ones. The process



Scenario planning is being used to help develop the 2020–2025 plan. The scenarios aim to highlight key areas for fishing and aquaculture and the FRDC to focus on in the future.

provides a way to 'rehearse' for what might happen and seeks to present futures that embody some of the complexity of the real world. For this reason, each scenario presents a range of interconnected outcomes that transcend a simpler, more linear cause-and-effect approach. The aim is that any lessons identified from such a rehearsal can then be incorporated into the plan.

Some of the early themes emerging from the scenarios include the need to identify opportunities to continue to grow production and profit, while leaving a lighter environmental and social footprint.

Participants in the planning process have also identified a need for:

- greater capacity within the fishing and aquaculture community to influence decision-makers and leaders at all levels;
- readily accessible, robust data to inform resource-sharing decisions as competition for aquatic space and resources increases;
- effective investment in activities to care for the natural processes that underpin sustainable fisheries;
- the collection of robust and accurate data in key areas to demonstrate transparency and enable traceability;
- better relationships with customers, with other sectors and with each other; and
- leadership to set good strategic direction, enable difficult conversations and to make hard decisions.

The four scenarios have been presented at workshops around the country, to gather further feedback and insights. Participants have been quick to observe that some of the dynamics explored in the scenarios are already beginning to play out, including economic crisis, climate change and population growth, and their associated effects.

Other changes already affecting the fishing community are a steady reduction in the number of fishers, consolidation of ownership and societal changes, including those related to food choices, such as the rise of flexitarian or vegetarian diets.

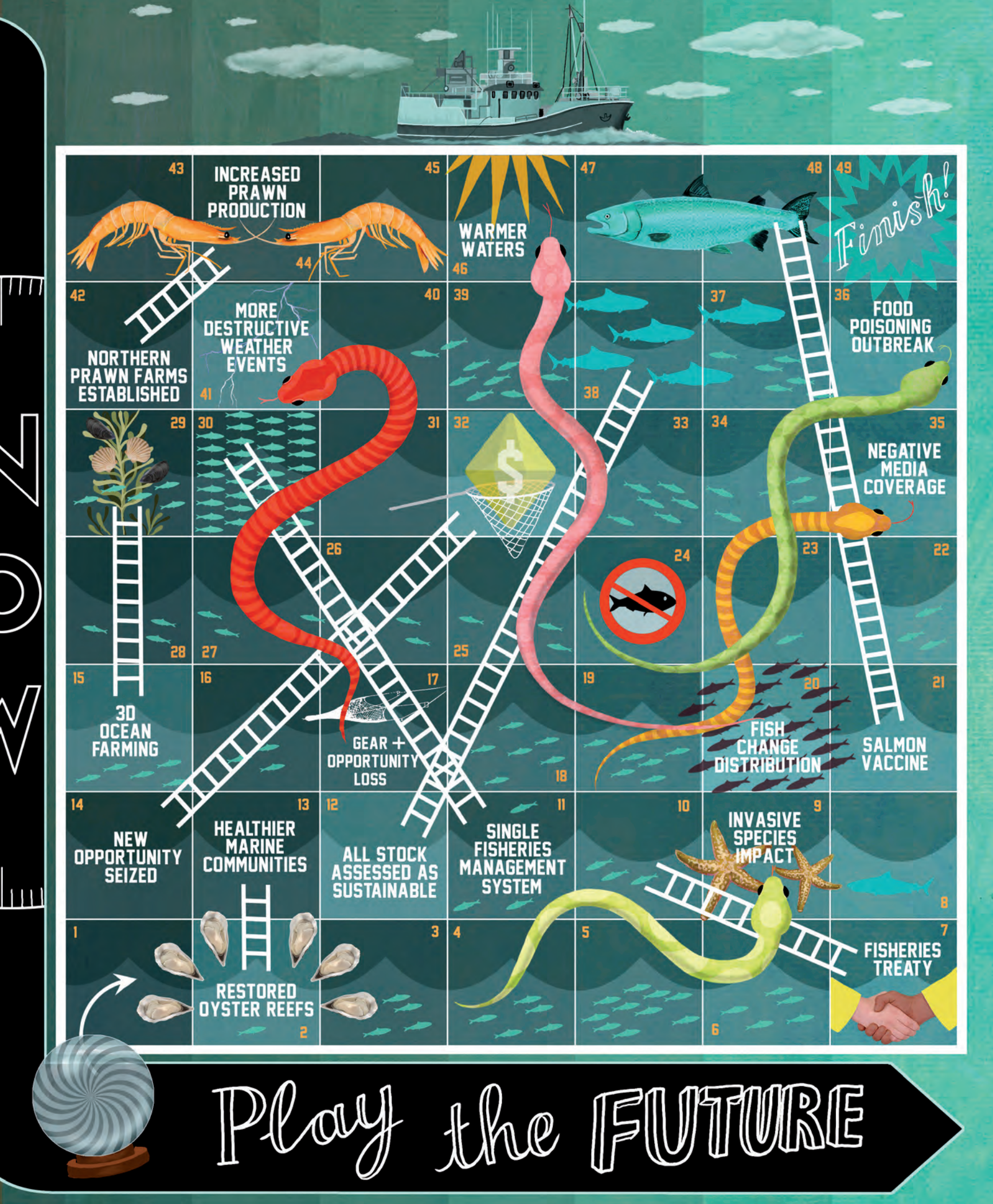
That these trends will continue appears to have been broadly accepted as a 'given', however, even amid the negatives, there are opportunities to be found and action that can be taken to respond and adapt, particularly if there is collective will and a coordinated plan to do so.

The results of these stakeholder workshops are being collated, analysed and considered by a number of stakeholder groups.

The analysis will help to articulate a shared vision, planned outcomes and objectives, which the FRDC will use as the basis for developing the 2020–2025 plan. The final plan will be released in mid-2020. F

Play the Past

Illustration: Sonia Kretschmar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Play the FUTURE

CAPACITY TO CREATE AN ENDURING EXPERIENCE

With four decades of experience in the fishing industry, CEO of Austral Fisheries David Carter says the wild harvest seafood sector needs to keep the long game in mind if it wants to remain relevant as a respected and responsible food provider

By **David Carter,** CEO Austral Fisheries Pty Ltd

Five-year planning is useful for a business, but gazing out to 30 years' time can help give context to that planning. Thirty years is less than the span of my career. From our position today, it is also when the global population is expected to reach 9.5 billion. And a lot needs to happen by then.

Fuelling up

As an industry, I think we need to aim for zero net fossil fuel usage. If we do not, I think it is going to be too hard to maintain a competitive market position and we will lose our social licence.

Right now at Austral, our focus is on making the best use of every litre of diesel we do burn. The next step is finding what is going to power our boats beyond diesel.

We have a new boat being built in Norway, the *Cape Arkona*, which has a hybrid capability that includes regenerative braking winches that top up power into a battery system. But we still have to burn diesel.

It is hard to see what the future of fuel is going to look like, but it has to change; we have to wean ourselves off fossil fuels. I do not really think battery power is going to work, but I have a quiet itch about hydrogen and how

we might be able to work with that. We have a few hydrogen-related projects on the go, and want to collaborate with people trying to make a difference in this space.

Fishing operations

I think there also needs to be greater use of autonomous systems in fishing, operating boats and handling catches. We need to catch fish more efficiently and cheaply, with more transparency in fishing and along the supply chain.

My idea for prawn fishing is to have an autonomous underwater vehicle that, using a vision system and machine learning, cruises around and gulps up prawns selectively: beautiful quality, no bycatch.

This idea is not so off the wall. With remote sensing, satellites and underwater glider systems, autonomous underwater vehicles already do all sorts of stuff. We have vision systems that allow us to count fish as they come over the rails and pick out species as the fish move along conveyor belts.

We can also build into this greater transparency for consumers by using blockchain technology along the supply chain. Customers increasingly want to know where their product is coming from. They want to understand its exact provenance and related information, such as about bycatch. We have done a lot of work reducing bycatch in the prawn fishery, but in 20 years current practices simply will not be up to scratch. We need to do better.

Autonomy, technology, traceability – they all come together to transform fishing operations.

Seafood customers

Keeping Australians favourably disposed to seafood is going to be harder, but is critical if we are to maintain access to resources. The narrative we build about our fisheries is going to be important.

It is hard to imagine that food security will be an issue for Australia. It is just not on our radar because we are a net exporter of food, although it clearly is an issue for smart and strategic countries like China.

We also have a generation of 20 year olds opting to be vegetarians for ethical reasons and people are generally eating less and less animal protein. There are new meatless meats and shrimpless shrimp and all the trickery that goes with that.

But, I think 30 years out, there will still be markets that are keen on having the real deal, a real piece of fish, as God intended. For me, that means an increasing focus on a premium experience – smaller portions at a higher price.

I like the idea of animal protein as a garnish to vegetables in a diet that is good for us and good for the planet. Wild seafood is a fantastic product, a high-quality protein with good oils and essential trace elements, no fresh water, no antibiotics, low emissions, all of which combine to make our bodies sing. And if you do eat animal protein, it is much better to eat wild seafood than red meat for both health and environmental reasons.

Climate moves

For many years, we have had a pretty good handle on the science about how we harvest and keep fisheries sustainable. But we have to be vigilant about the impacts of climate change. The oceans are changing and we need to think about possible shifts in the range of species available. This may result in some fisheries being winners and others losers.

At a corporate level, climate is now officially a 'foreseeable corporate risk'. Directors and executives who do not see it as such can be held responsible for their failure to respond.

Different parts of the industry have more fat in the system, more capacity to identify the risks, take action and survive these challenges.

There are going to be casualties, particularly smaller inshore fisheries, although that is not just about climate. Smaller businesses do not have the resources to mount a counter-argument against competing users in growing population centres. Governments are also making expedient decisions and chasing the recreational fishing vote.

Market opportunity

Climate is the threat, but we also see it as an opportunity to distinguish ourselves. For the many people who think that climate change is real and who want to do something about it, we give them a choice. We are saying: "This is important to us, and if it is important to you, support us with your spend".

If you can get the branding right and build a following, you are in with a chance. You need a brand, as well as trust and transparency. As a producer, it is an uncomfortable position to be in if you are relying on relationships with supermarkets to sell unbranded seafood.

We deal with importers all over the world and these customers recognise the value in long-term relationships. But supermarkets are very transactional in their approach; it is most often about the best price right now, not the relationship.

I think the demand for wild seafood will endure, but it is definitely under pressure.

Moving forward, making a buck will continue to be difficult – finding good people and keeping them safe, having markets sorted out, taming supermarkets, building a brand, building value, and explaining yourself to customers and stakeholders are all challenges we will face. None of that is going to get any easier. F

> ***"We need to catch fish more efficiently and cheaply, with more transparency in fishing and along the supply chain."***
>
> David Carter (pictured left)
> Photo: Brad Collis

DOUBLING UP ON WILD FISHERIES

Far from being a dwindling resource, Australia's wild fisheries have the capacity to provide double the volumes currently harvested

By **Catherine Norwood**

In recent years, Australia's wild harvest fisheries have averaged a yield of 166,000 tonnes, a decline of almost 30 per cent on our 'peak fish' production. That was in 2004-05, when we harvested 236,000 tonnes. While some continue to attribute the reduction in yields to dwindling fish stocks, there has been a substantial investment in fisheries research and management over more than a decade to ensure this is not the case.

More fish in the sea

In a recent FRDC-funded project, led by the CSIRO, researchers identified that current fished stocks, rebuilt to the baseline where necessary, could allow for double the current harvest, which would set a new peak for the industry.

The project team, led by David Smith and Rich Little, included fisheries scientists from each jurisdiction, who calculated the maximum sustainable yield (MSY) for 290 fish species and stocks (as some species have multiple stocks).

These species represented 84 per cent of the average national catch for the period (2014-15 to 2016-17).

This allowed the team to estimate what the biomass and sustainable harvest volume could be for each of these species. MSY was used as a consistent reference point for the calculations (not as a recommended target for fishing). In practice, some jurisdictions and species have different reference points, such as maximum economic yield (MEY).

The project used a three-year catch average as the basis for calculations, which also includes 27,000 tonnes of fish from stocks that were unable to be assessed as part of this project.

When researchers tallied the total MSY for the 290 species and stocks they were able to assess, it came to 345,000 tonnes compared to an actual catch of 139,000 tonnes of these species. That's an additional 206,000 tonnes, and a potential national catch of 371,500 tonnes (see 'Adding it up' right).

Small pelagic species such as Australian Sardine, mackerels and redbait were big contributors to the potential increase, although, in practice, the total allowable catch (TAC) set for these species is highly conservative. This reflects the role these species play in the ecosystem: they are the foundation of the food chain for many ocean species, including birds and mammals.

Recognising this, the researchers also recalculated the potential national catch using the current TACs for the small pelagic species rather than MSY, adding this to the MSY total for the other assessed species.

This reduced the potential national catch by 78,000 tonnes to 293,500 tonnes, still a substantial increase on the 166,000 tonnes caught in 2016-17.

The project did not take into account any changes to fish biomass that might result from climate change, nor the development of any new fisheries or harvesting of other products, such as seaweeds. It was also based on all fish stocks being above a reference point that achieves MSY, including some species that are not currently assessed as sustainable, such as Snapper (South Australia) and Blacklip Abalone (Central Western Zone, Tasmania), which will need to rebuild their populations.

>

ADDING IT UP

High-yield scenario

139,000 tonnes current catch of assessed stocks

\+ **27,000** tonnes current catch of additional stocks

= **166,000** tonnes 2016-17 national wild catch harvest

\+ **205,500** tonnes (total MSY estimates of all assessed species)

Potential national catch

= **371,500** tonnes

Medium-yield scenario

166,000 tonnes 2016-17 national wild catch harvest

\+ **127,500** tonnes (up to TAC for small pelagics, MSY other assessed species)

Potential national catch

= **293,500** tonnes

Catch incentives

With so many uncaught fish potentially available for harvest, the FRDC and its partners are also investing in other projects to identify barriers and increase the market demand and value for these species.

Market forces are widely recognised as one reason why Australia does not catch as many of the fish as it could; simply put, it costs more to catch them than fishers can earn for them.

The growing body of research investigating ways to unearth new value for currently 'lesser-known' species commonly recommends:

- changes to fishing practices to optimise catch quality;
- processing to create value-added products; and
- promotion to increase market awareness and consumer demand.

The FRDC's latest project on lesser-known species is being developed by Ridge Partners and looks at opportunities on the east coast, particularly those for NSW fishers. Project partners include the Professional Fishermen's Association of NSW and Sydney Fish Market.

Table 1: Commonwealth fisheries quota species with significant volumes of uncaught quota in 2017-18

Fishery	Species	Tonnes available	% TAC uncaught
SPF	Jack Mackerel (eastern)	15,847	76%
SPF	Jack Mackerel (western)	4282	100%
SPF	Australian Sardine	10,329	99%
SPF	Blue Mackerel (eastern)	9297	70%
SPF	Blue Mackerel (western)	3553	100%
SESSF	Blue Grenadier	7827	81%
SPF	Redbait (eastern)	3189	85%
ETBF	Albacore	1782	68%
ETBF	Yellowfin Tuna	1115	51%
SESSF	Alfonsino	1106	99%

SPF Small Pelagic Fishery, **SESSF** Southern and Eastern Scalefish and Shark Fishery, **ETBF** Eastern Tuna and Billfish Fishery

Source: Australian Fisheries Management Authority Catchwatch reports, 2018 end-of-year returns, www.afma.gov.au

Consultant Ewan Colquhoun has identified 10 priority species, in conjunction with industry partners. It was agreed that there was potential to increase the catch of these species and also opportunities to value-add to the catch. The species identified are Royal Red Prawn, Ribbonfish, Australian Sardine, Gould's Squid, Blue Mackerel, Silver Trevally, Yellowtail Scad, Sea Mullet, Luderick and Ocean Jacket.

He has also calculated the currently uncaught portion of quota and the potential increase in value that could be achieved from value-adding to an increased catch for these species. This was estimated at an additional 17,750 tonnes of catch, with a potential value-added return of $83.5 million.

The highest potential return comes from increasing the catch of Blue Mackerel, for which there is substantial uncaught quota (Table 1). For several other species, demonstrated value-added products also indicated improved potential returns from an increased catch.

Barriers to greater value

While the research is not yet complete, Ewan Colquhoun says it has identified a range of issues along the supply chain that prevent greater returns being realised.

Commodity approach: Seafood is the world's most traded commodity, but an undifferentiated commodity product approach prevents the recovery of greater value.

Quality: Fishing processes and equipment are often not adequate to maintain the quality of the catch, and lower-quality fish have reduced returns that make the catch financially unviable. There is a lack of incentives to encourage and reward efforts and maintain fish quality.

Quota obligations: The current quota management arrangements in Australian fisheries allow quota to be held in perpetuity. Current arrangements may not encourage new investment in improved fishing or market development for large volumes of uncaught quota.

Consumer preferences: Australian consumers have conservative tastes, consistently selecting a limited range of familiar seafood species.

Supply chain: Australian seafood supply chains are often long and complex, and are also consolidated in the hands of a few major players. This occurs in the wholesale market, in processed product distribution chains, and at a consumer level, via the major supermarkets.

Supermarket power: More than 60 per cent of consumers regularly shop for seafood at supermarkets, which have a preference for year-round consistent product offerings. The variability in the supply of wild seafood reduces supermarket acceptance of these products, and therefore limits consumer exposure.

Processing facilities: There are limited land-based processing facilities in Australia capable of handing large catches of species such as Blue Mackerel. Also, few Australian vessels have the necessary onboard processing capabilities to handle such catches and public sentiment has opposed larger, internationally owned processing vessels fishing in Australian waters.

To address these challenges and barriers, the FRDC has funded similar projects in other states, as there is interest nationally in making more of lesser-known species. The potential benefits from doing so include greater economic returns for fishers, and more seafood diversity and low-cost options for consumers. Spreading harvesting effort across a larger number of species, as opposed to targeting a narrow group of high-demand species, would also improve sustainability. F

Why catch more fish?

Balance our trade: Replace some of the 70 per cent of imported seafood with local fish.

Take responsibility for fishing impacts: We can influence what happens in our own fisheries.

Importing seafood also effectively exports our responsibility for the impacts of seafood production to other countries where management practices may not meet the same standards as those in Australian fisheries.

Provide food security: Help feed the projected global population of 10 billion in 2050. Food security is not high on Australia's national agenda, although this could change in coming decades as the world population increases at the same time that environmental and climate changes are reducing the productive capabilities of land-based food systems.

Reduced capacity, along with changing political alliances, could reduce our access to the imports we currently rely on.

Additional fishing of Australian resources may be needed to supply the domestic market. Organisations from other countries could also buy quota and fish our waters to feed their own populations.

Increase economic activity: Fishing already makes a substantial contribution to the Australian economy and supports many regional communities.

The combined value of fishing and seafood processing to the national economy in 2017-18 was $5.3 billion, with a farm-gate value of $3.2 billion, according to new research on the economic and social contributions of the industry.* The sector also employs more than 24,000 people directly and indirectly. Additional fishing activity could generate more activity and increase the return from our fisheries – a resource owned by the Australian people – to the Australian people.

*Australian Fisheries and Aquaculture Industry 2017/18: Economic and Social Contributions Summary, (FRDC 2017-210) conducted by the Institute of Marine and Antarctic Studies at the University of Tasmania, for the FRDC.

Top 5 east coast species to be targeted for increased catch and value adding

Royal Red Prawn

Uncaught quota	300 tonnes
Achievable beach price	$20/kg
Additional value	$6 million

Action needed: Snap freezing onboard at point of harvest to create a high-quality, high-value sashimi product of interest to Asian markets.

Australian Sardine

Uncaught quota	5000 tonnes
Achievable beach price	$3.40/kg
Additional value	$17 million

Action needed: Investment in processing and packing facilities; marketing of species for human consumption market.

Gould's Squid

Uncaught quota	700 tonnes
Achievable beach price	$3.50/kg
Additional value	$2.45 million

Action needed: Development of processing and consumer-ready products, which will be supported by the addition of Gould's Squid to list of seafood species eligible for import to China.

Blue Mackerel

Uncaught quota	8400 tonnes
Achievable beach price	$5/kg
Additional value	$42 million

Action needed: Onboard freezing and processing or investment in land-based processing to preserve fish quality; development of value-added products for human consumption; and promotion of the species as a good eating fish.

Silver Trevally

Uncaught quota	350 tonnes
Achievable beach price	$15/kg
Additional value	$5.25 million

Action needed: Seine or trap harvesting and improved onboard handling procedures with iced slurries to preserve quality for sashimi markets; careful handling through the supply chain; and further development of value-added consumer products.

* Source: FRDC Project 2016/224 Boosting fisher returns through smart value adding and greater use of underutilised species

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FRDC RESEARCH CODE: 2016-056, 2016-224

CULTURAL RECOGNITION ON THE AGENDA

Stan Lui at Kagar Reef, south east of Thursday Island
Photo: Allison Runck

Indigenous philosophies of sustainability and reciprocity could be integrated into the management of Australia's fisheries as a whole, says Stan Lui, chair of the FRDC's Indigenous Reference Group

By **Stan Lui, Chair, FRDC Indigenous Reference Group**

We are starting to see more consideration of Indigenous people and perspectives in the management of fisheries.

One of the major recent changes is about recognition of Indigenous and recreational fishing in the Commonwealth *Fisheries Management Act 1991*. This has changed the consultation that fisheries managers now need to do. As part of all their advisory groups and management committees, they now have to include an Indigenous and a recreational fishing representative.

Without the political will and ministerial assistance of Richard Colbeck and Anne Ruston [both of whom have held the position of Assistant Minister for Agriculture and Water Resources] the changes to the Act would not have been possible.

This is a good example of things moving in that direction. It would be a good outcome if all the states provided the same kind of representation for Indigenous fisheries.

The next logical step is to include Indigenous wellbeing in the processes that fisheries managers undertake to assess ecologically sustainable development (ESD) and make fisheries decisions.

Indigenous people have always been part of the Australian environment and we continue to practise our culture and traditions in harmony with nature. Optimum utilisation is not our motivating factor.

I would like to see this extended to the ESD and ecological risk management processes that fisheries managers use to set total allowable catches (TACs) and decide on gear and other restrictions as well. An allocation for cultural catches should be made at the same time that total allowable catches are set for the commercial fishery.

Indigenous bag and size limits, especially in the southern states, are basically the same as they are for recreational fishers. But cultural fishing, or traditional fishing, has a different purpose.

Indigenous fishing is usually based around cultural events and supplying food for gatherings such as funerals. For this kind of fishing, Indigenous people need more than a bag limit would provide, and this should be recognised in cultural allocations.

Indigenous fishing is usually based around cultural events and supplying food for gatherings such as funerals. For this kind of fishing, Indigenous people need more than a bag limit would provide, and this should be recognised in cultural allocations.

There would need to be some management procedures put in place.

I see that the recognised traditional owners of a particular area would be the custodians of the cultural allocation and they would need to provide permits and catch-recording documentation to Indigenous people to harvest fish beyond the standard bag limits, as part of that allocation, for a specific event.

Catch recording will be very important to ensure sustainability. It would not be an ad hoc breaking of bag limits. It would be for specific events.

Traditional owners coming from other areas would need to seek local permission to fish the cultural allocation, which would allow fishing to be regulated, but in the traditional way. This includes principles of reciprocation between different groups, and sustainable harvesting – leaving enough to ensure there will be fish for the future – and using traditional methods where that is appropriate.

This would also allow us to strengthen cultural connections; we would be able to take our kids down to the water and teach them the traditional way of harvesting and sharing the stories around a place, passing on traditional knowledge.

It would be a good thing if legislation and court decisions were not needed in order to recognise Indigenous rights and practices. No one wants to see more cases going to court.

But many discussions have been had over and over again without resolution. Whether or not it is a good thing for Indigenous people, the courts and legislation are proving the only way to provide clarity and security around these issues.

More broadly, looking forward, I see that having Indigenous recognition in the Australian Constitution, and an Indigenous voice advising the Commonwealth Parliament, would help fisheries. We would be able to help make policies and suggest Indigenous amendments to policy and legislation so that it all works together.

Recent policy and legislation changes have been a positive step, but there is still a long way to go. **F**

Ancient culture shaping new futures

By **Elisabeth Howie**

Age-old Indigenous methods of fishing and resource management are combining with modern science to tackle fisheries challenges and provide sustainable futures for local communities

On the western coast of Cape York, Queensland, a small team of land and sea rangers look after 183,000 hectares in the Aboriginal Shire of Mapoon, including 70 kilometres of coastline and three main river catchments.

On any given day, Mapoon rangers can be found on country removing debris from rivers and beaches; patrolling for illegal activities; monitoring wetlands and seagrass, and even directing rigorous research to enhance the survival of various turtle species, including the endangered Olive Ridley Turtle.

The Mapoon rangers represent one of many similar groups around Australia working to restore ecosystem health, protect vulnerable species and help manage Australia's aquatic landscapes.

Ranger programs, and work being done within Indigenous Protected Areas, are revealing innovative ways to combine the strength of Indigenous traditional knowledge with modern science to meet the challenges of changing environments.

As part of the oldest continuing cultures on the planet, many Aboriginal and Torres Strait Islander communities have a long history of fishing and aquatic resource management. And in today's world, they are combining this knowledge with new initiatives, developing their fishery resources to enhance economic, cultural, environmental and social wellbeing.

Enterprises with a range of different business and governance models are providing benefits for Aboriginal and Torres Strait Islander people and empowering them to create a future for themselves that is both progressive and respectful of each region's values and authenticity.

Above
Channel with reconstructed stake, branch and weir.
Photos: Tyson Lovett-Murray, Gunditj Mirring Traditional Owners Aboriginal Corporation

Cultural tourism at Budj Bim

More than 6000 years ago, Gunditjmara people in south-west Victoria worked together to engineer one of Australia's oldest, largest and most culturally significant aquaculture systems, designed for the trapping and farming of kooyang – the short-finned eel (*Anguilla australis*).

The system they created was so productive that it allowed for year-round food harvesting and provided a significant economic and social foundation for Gunditjmara society.

Denis Rose, Gunditjmara elder and knowledge and estate manager of Gunditj Mirring Traditional Owners Aboriginal Corporation, says that the Gunditjmara people's continued management of the Budj Bim cultural landscape has enabled the community to sustain their traditional practices and pride in looking after country.

Increased opportunity

Budj Bim's recent UNESCO World Heritage recognition has brought a number of increased economic and tourism benefits with it, including $13 million funding from the Victorian Government to help implement the Budj Bim Master Plan.

The master plan was created with the aim of strengthening the region as a world-class destination, sharing its cultural landscape with the world whilst supporting the Gunditjmara people in achieving self-determination.

"It is essentially a tourism enterprise," says Denis Rose. "But also one that is environmentally sustainable and has important cultural education values."

The three-stage plan outlines visitor targets for the region and sets a goal of more than 150,000 visitors a year in the next 10 to 25 years. It also recognises the need to manage tourism sustainably so that visitor growth will not have a negative impact on the region.

The plan includes creating better boardwalks, signage and access to some of the 3000 hectares of Gunditjmara-owned property within the Budj Bim landscape. For example, a pedestrian and light vehicle bridge will allow improved access to the landscape's largely inaccessible Muldoon aquaculture system.

Plans for construction of a traditional eel aquaculture facility have also been drawn up, with work expected to begin in 2020. The facility will support the development of eel products for sale and provide an educational experience for visitors to learn more about Gunditjmara people's traditional practices and culture.

"In particular we'll be looking at selling eel products and having tastings of eels – eel pâté, smoked eel, fried eel," says Denis Rose.

Two-way knowledge sharing

He says the Gunditj Mirring Aboriginal Corporation and its community are dedicated to increasing their own knowledge of the short-finned eel, as well as other species found in the Budj Bim landscape.

In collaboration with scientists at the Arthur Rylah Institute, Budj Bim rangers have been supporting the satellite tagging of eels to better understand their movements through different landscapes.

The innovative technology will help to identify eel migration routes, along with spawning areas and differing environmental conditions during their migration. Early results have shown tagged eels located thousands of kilometres north, on their way to presumed spawning grounds in the Coral Sea.

This three-year research project involving Victoria's Department of Environment, Land, Water and Planning (DELWP), the Gunditjmara Traditional Owners and the Glenelg Hopkins Catchment Management Authority, offers a valuable knowledge exchange opportunity. DELWP staff are taking in traditional eel husbandry knowledge, while traditional owners learn about modern surveying and tracking methods.

Climate challenges

Denis Rose says climate change will be a significant challenge for the Budj Bim landscape, in particular for its water systems and wetlands.

"We're doing a lot of work at the moment with hydrologists and the local water authorities to get a better understanding of what the water is doing and planning for more resilience of our systems. It is a tough country, it is lava flow, and it will survive," he says.

"Our job is to bring it back to health as best we can. And that includes the health of the plants, the animals and the people."

> ***"Our job is to bring it back to health as best we can. And that includes the health of the plants, the animals and the people."***
>
> Denis Rose, Gunditjmara elder

More information:
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Right
Lake Condah, Budj Bim.

A voice for Mabuiag fishers

On the small island of Mabuiag in the Torres Strait, Flora Warrior – traditional owner, community advocate and mentor – volunteers much of her time to support the development of the local seafood industry, mostly Tropical Rock Lobster, for the Goemulgal people.

She says initially she found herself acting as a translator for local fishers, then became an advocate for them. She was speaking on their behalf with government agencies and businesses, companies and suppliers; she was also explaining supply chain and management processes to fishers, and directing them to training and development opportunities.

"It all began with one fisher turning up [to consult with me]," she says. "Followed by another and another, until the word had spread and I realised that there were much bigger issues at stake here."

She says that Mabuiag fishers find themselves at the poor end of the supply chain and her community has been asking itself some vital questions regarding the future of its local seafood economy.

"How do we find our rightful place in the broader industry? How do we maximise opportunities so that the benefits flow back to the community? And how do we get the next generation involved in the seafood sector?"

During her business studies at James Cook University in Cairns, she explored the possibility of developing a fisheries social enterprise to improve the economic prospects and wellbeing of Mabuiag's traditional owners and community.

Flora Warrior says she wants to help Mabuiag's fishers realise their worth and value to the seafood sector as a whole. And not just as fishers, but as Indigenous fishers.

The idea focused on the direct global export of Tropical Rock Lobster to foreign markets, and she undertook a university project to develop a social business structure that supported local suppliers and fishers, and tackled economic challenges while reflecting the community's value system.

Fast forward a few years and Flora Warrior is using her skills to improve local governance structures in the fishing industry to ensure Mabuiag's sustainability.

She says she is optimistic about her community's aspirations, which include developing its own processing facilities so that Mabuiag can have a stronger position in the seafood market. However, sourcing capital for a facility that meets stringent food quality standards for international trade remains a challenge.

"As a very remote Indigenous community, we are often out of sight and out of mind for many stakeholders," she says.

Johnny Malakula Kris, Mabuiag Island fisher and community representative, with Flora Warrior, Mabuiag Island fisher advocate who won the 2019 National Seafood Award for People Development.

"We don't have a post office, a high school, a bank, or infrastructure and all of the regular things that other towns have, and our [telecommunications] connectivity is really poor."

Working from her kitchen table, she has also been instrumental in establishing a micro-finance program for low-income families to bring white goods and minor assets into their homes.

The program has been extended to allow fishers to purchase equipment, such as flippers, wet suits and diving masks, so that they can go out and dive with the other fishers. "It's only a small amount," she says. "But for a lot of families, it has been a life saver."

Flora Warrior says she wants to help Mabuiag's fishers realise their worth and value to the seafood sector as a whole. And not just as fishers, but as Indigenous fishers.

"My participation in the National Seafood Industry Leadership Program in 2017 had a substantial impact on me," she says. "I realised how much my people had missed out on, and now I pass that knowledge and experience along to my community."

"Though I'm not a fisher myself, I am supporting the development of the sector – creating awareness and understanding around how the wider industry operates," she says.

"And today, we are trying to find a voice and a space for ourselves in the greater economy, and make our own decisions in the process." F

Flora Warrior was the winner of the 2019 National Seafood Award for People Development.

Indigenous RD&E Priorities for Fishing and Aquaculture, developed by the FRDC's Indigenous Reference Group

- Primacy for Indigenous people
- Acknowledgement of Indigenous cultural practices
- Self-determination of Indigenous rights to use and manage cultural assets and resources
- Economic development opportunities arising from Indigenous people's cultural assets and associated rights
- Capacity-building opportunities for Indigenous people are enhanced

World Fisheries Congress 2020: Creating a vision for the world's fisheries

From Indigenous fisheries to the latest technologies, the World Fisheries Congress in Adelaide will bring together diverse perspectives in research and practice

From 11 to 15 October 2020, leading fisheries experts will meet in Adelaide for one of the largest international fisheries conferences, World Fisheries Congress 2020 (WFC2020).

WFC2020 will bring together research, industry and management across marine and freshwater fisheries worldwide, under the overarching theme 'Sharing our oceans and rivers – a vision for the world's fisheries'.

It's a pivotal opportunity to help shape the future of our fisheries, says WFC2020 chair Gavin Begg.

"Over the past two decades, we have seen significant progress in the sophistication and complexity of fisheries management measures when a science-based approach is adopted," he says. "WFC2020 will provide an important platform for sharing international perspectives on the sustainability, conservation and management issues we are tackling globally, helping to create a vision for the future of our fisheries."

The role of technology in the future of fisheries will also be a key issue tackled at WFC2020, says Gavin Begg, who is also the research director, Aquatic Sciences, at the South Australian Research and Development Institute (the research arm of Primary Industries and Regions SA).

"Advances in technology have seen its use become increasingly popular in the study of environments and species, which has the potential to transform our understanding of aquatic systems," he says.

"Sessions at the WFC2020 will explore the range of new technologies and interdisciplinary partnerships that are paving the way to next-generation data advances.

"This includes applications of robotics in data collection and monitoring, through the use of remotely operated vehicles (ROVs), autonomous unmanned vehicles (AUVs), drones, sailing drones and acoustics, as well as machine learning, artificial intelligence (AI) and blockchain technologies."

Advances in genomics will also be part of the discussion, with the Fisheries Society of the British Isles (FSBI) sponsoring a session exploring novel applications of genetics to address global fisheries issues.

The session will cover the application of metabarcoding for informing food webs or to identify processed fisheries discards; eDNA for targeted species detection; and directly using genetics for stock estimation with novel methods such as close-kin analysis.

WFC2020 provides a global platform to discuss major issues facing world fisheries.

Registrations for WFC2020 will open in February 2020.

To find out more about the congress and to register for updates, visit wfc2020.com.au

WFC2020 call for abstracts open

The WFC2020 call for abstracts is now open.

Abstract submissions are welcome in all areas related to global fisheries issues and key developments needed to ensure a sustainable future for our oceans, lakes, estuaries and rivers, including commercial, recreational and Indigenous fishing communities.

Submissions can fall under one of the following four key themes:

- **sustainable fisheries (assessment, regulation, enforcement);**
- **fish and aquatic ecosystems (biodiversity, conservation, ecosystem function, integrated management);**
- **fisheries and society (contributions to sustainable development); and**
- **the future of fish and fisheries (innovations in fisheries).**

WFC2020 provides a valuable opportunity to present your work to a global audience.

Abstracts must be submitted via the online submission portal and must follow the WFC2020 Abstract Guidelines. Submissions close 31 January 2020. **For full details, visit wfc2020.com.au/callforabstracts**

WORLD FISHERIES CONGRESS
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Rapid evolution is the solution

Recreational fishers have an important role to play in increasing the abundance and resilience of our fish stocks, says Andrew Roland, leader of Western Australia's peak recfish organisation

By **Andrew Roland**, **CEO, Recfishwest**

Changing environments, populations, technology and, increasingly, community values are all rapidly impacting on the fishing landscape. Such changes present huge challenges for the future of recreational fishing, but also opportunities. As a sector we need to become more agile, savvy and tenacious than ever to meet these challenges.

By providing innovative solutions such as stock enhancement, habitat restoration and artificial reef systems, we can help aquatic resource management evolve and future-proof against many of the challenges.

Adding stock to the resource

Fish stocking has often been regarded as a last resort to rebuild stocks that have crashed, but it can also be a valuable management tool that helps the sector meet community expectations about how fish stocks should be managed. A strategic stocking program can help smooth variation in fish recruitment, ensuring stable and growing fish populations. In turn, this allows for consistent and stable fishing experiences. In years of good recruitment, no stocking may be needed; in years when environmental conditions suggest recruitment may be poor, stocking can

take a leading role in a management strategy. The benefits of stocking have long been evident in 'put and take' freshwater fisheries around the world. However, there is no reason why stocking programs cannot be applied to a broader range of estuarine and marine species.

Recfishwest's 'Snapper Guardians' program is a good example of how approaching fish stocking differently can result in greater community engagement and stewardship of important fish stocks, changed community perceptions and improved fishing experiences.

Habitat enhancement benefits

By constructing artificial reefs we can create highly productive habitats and new fishing oases. This strategy is informed by science: artificial reefs have been shown to be more productive than natural reef systems and the ability to build reefs in specific locations to suit specific species makes them a vital fisheries management tool. When done well, purpose-built reef systems can benefit the community, industry, government, tourism, the environment and critically endangered fish stocks.

Increasingly, the energy sector is also showing an interest in enhancing habitats. Obsolete oil and gas industry infrastructure is being repurposed as reefs, for example in the Mexico Gulf. Giving these structures new lives as artificial reefs benefits the community enormously and should be embraced.

These types of projects, together with our sector's support of initiatives such as shellfish reef and seagrass restoration, not only provide fishery benefits but also improve our sector's environmental credentials. This credibility will be increasingly important if we want to do what we love into the future, in the face of shifting societal norms about animal welfare and the acceptability of fishing.

Beyond sustainability

The benefits of recreational fishing to people's wellbeing are enormous. In an ever more urbanised society, recreational fishing experiences give people the opportunity to connect with the natural world, tap into their primal reward systems and engage with others. It is not just about catching a feed. This connection to nature means recreational fishers' attitudes are changing. Consciousness of environmental and conservation issues within the recreational fishing community continues to grow.

The economic dividends of recreational fishing are also substantial: recreational fishers in WA, for example, directly spend $2.4 billion a year on fishing. Despite their economic and social importance, our fisheries have traditionally been managed using tools that focus on exploiting fish stocks to the edge of sustainability. Sustainability should be the starting point for fisheries management rather than the end goal.

It is critical we don't just settle for sustainable fisheries – we want abundant fisheries. User groups need to work more closely together to achieve outcomes that lead to abundant fisheries. When we get bogged down in inter-sectoral stand-offs the resource suffers first, then all of us do.

There is also a pressing need to improve procedures and tools within the existing fisheries management system in Australia. We need to extend management plans and harvest strategies beyond the traditional concepts of a fishery's biology and commercial fishing economics. Such concepts are well understood and relatively easily applied to deliver positive outcomes against sustainability and commercial fishing economic targets; however, the same cannot be said in their application for recreational fisheries.

In most recreational fisheries, the data relied on under traditional management systems is the wrong type or it simply does not exist. Moreover, it is generally unclear what data should be collected to measure fishing experiences or how to best apply the limited data currently collected. We need to create a management system that is less subjective, more transparent, more inclusive, more reactive and less *ad hoc*.

Turning value into valuable

One of the biggest challenges is a general lack of understanding as to what constitutes a quality recreational fishing experience. For some, catching Yellowfin Whiting on micro-poppers in south-west estuaries is what gets them going; for others, catching, tagging and releasing mighty marlin out wide on fish aggregating devices (FADs) is the ultimate. And others enjoy simply soaking a bait off the beach and maybe catching a herring or two.

We need a cultural shift in the mindsets within fisheries regulatory agencies if we are to truly optimise social outcomes from fishing activities. Understanding, quantifying and clearly articulating what recreational fishers value most and building this into management objectives is the critical first step.

To evolve in this direction, fisheries management needs to draw much more heavily on the expertise of social scientists, economists and the recreational fishing sector itself. As we establish clear social objectives, we will need to develop new tools to complement traditional management practices. This evolution will take time, it will require leadership and patience, and it will not be perfect the first time. However, we must start now if we are to effectively meet the desired outcomes of recreational fishers and maximise the benefits of recreational fishing into the future.

We live in a fast-paced world that is speeding up all the time. We need to not just meet these challenges and opportunities, but get ahead of them. We need to work smart and focus on solutions that benefit our sector, the community and the environment in the weeks, months and years to come. I, for one, relish that responsibility and challenge – bring it on! F

"We need a cultural shift in the mindsets within fisheries regulatory agencies if we are to truly optimise social outcomes from fishing activities. Understanding, quantifying and clearly articulating what recreational fishers value most and building this into management objectives is the critical first step."

Andrew Roland, Recfishwest CEO, pictured at Whitfords Nodes Beach, WA. Photo: Craig Wells

The changing face of recreational fishing

Initiatives that target women and help build their confidence with the rod and reel are part of efforts to make recreational fishing more inclusive and to create a larger and more diverse community of participants

By **Bianca Nogrady**

Recreational fishing has long been the domain of men, in modern Australia at least. So, when Nadia Taylor participated in an all-female fishing tournament, she felt a greater sense of self-confidence and belonging in the recreational fishing community than she had in the past.

The tournament was a testing ground for the skills she has learned and the culmination of her apprenticeship with the Barra'Prentice initiative – a mentoring program for women recreational fishers.

The Barra'Prentice program, run by Jo Starling and Vicki Lear, takes one woman each year as an apprentice, trains them in everything from knots and casting to hooking up a boat trailer and reversing down a boat ramp, then tests them in the all-female Secret Women's Business Barra Challenge fishing competition in the Northern Territory.

The program began because Jo Starling realised that so many women, like her, were keen on recreational fishing but didn't want to have to rely on their partners to teach them. Jo Starling was fortunate that two of her sisters-in-law, both experienced recreational fishers, took her under their wing and taught her the ropes. That inspired her to want to do the same for other women, and so, Barra'Prentice was born.

The feedback from the six women who have graduated from the program over the past five years, including Nadia Taylor, has been overwhelmingly positive.

"What they get out of it is the self-belief that comes from becoming proficient at something that they always thought they'd just be a novice at and a tag-along," Jo Starling says. "They end up going home and teaching their husbands knots, and taking the kids fishing when husband's away."

The Barra'Prentice program is one of a growing number of initiatives working to broaden the appeal and accessibility of recreational fishing beyond the middle-aged male stereotype.

"It's all about encouraging as many people to fish as possible," says Belinda Yim, from the Victorian Fishing Authority. "Fishing is very popular amongst the male population already, but we're missing the women and the kids. If we can attract the women, then more than likely they'll bring their kids along too."

> ***"It was so nice to see boats with women out. I felt like I belonged."***
>
> Barra'Prentice program graduate Nadia Taylor

Women's network builds confidence

The Victorian Fisheries Authority is working towards this goal with its Women in Recreational Fishing – WIRF – network, which is building and nurturing women recreational fishers around the country. That project came out of a 2017 survey that aimed to understand why women fish and what could be done to encourage more women into recreational fishing.

"One of the main findings from it was women wanted a comfortable space to be able to ask questions and share their fishing story," Belinda Yim says.

The first response to that need was to create a WIRF Facebook group, which proved so popular that it soon expanded out from cyberspace into a series of events and initiatives targeted at women interested in recreational fishing. There are the 'Ladies' Nights In' events, where the program has partnered with tackle shops to run workshops for women.

"Some women feel a little bit anxious walking into a tackle store, so we're holding events there – running talk nights on whatever topic they really want to learn about, whether it's tying knots or getting tips on what's biting at the time," Belinda Yim says.

It's not just about getting more women out on the water; the WIRF initiative wants them to take leadership roles as well. In 2018, they sent a group of female recreational fishers along to a major trade show to meet some of the big movers and shakers in recreational fishing, from celebrity fishers and FRDC representatives to CEOs of companies such as fishing equipment manufacturer Shimano. The program now has 16 WIRF leaders, who are everyday women paving the way for more women in recreational fishing.

The network is growing rapidly. It already has around 1600 members and hopes to grow that to 3000 by the end of 2020.

Nadia Taylor shares in the joy of the catch, an experience being shared more widely through training programs designed to bring more diverse members into the recreational fishing fold.

Photo: Jo Starling

Increased diversity

Dallas D'Silva, director of fisheries policy, science and management at the Victorian Fisheries Authority, says the authority is keen to improve diversity across the board in recreational fishing.

"Historically we've had a certain demographic of rec fisher represented on those committees – generally Anglo-Saxon males above 50, for example," Dallas D'Silva says. "Now with the work we're doing with the Chinese community, multicultural community, women in rec fishing, the Aboriginal community, we're getting a much bigger group that's more diverse."

That work includes special fishing forums with the Victoria Chinese Angling Association to raise awareness of fishing regulations among Chinese fishers, and forums with the Burmese Karen community.

"These have been a great success in building positive relationships and networks with parts of the multicultural community," Dallas D'Silva says.

The Victorian Government's Target One Million campaign is a push to grow recreational fishing and get more people fishing more often, especially children, women, and people from diverse backgrounds.

Funding from recreational fishing licence fees supports programs such as the stocking of lakes ahead of school holidays, to attract families for recreational fishing. The organisation issues a media release ahead of school holidays to let people know which lakes have been stocked and they get plenty of enquiries from eager fishing families.

It is an acknowledgement of how much recreational fishing contributes not only to the health and wellbeing of those who fish, but to the communities they fish in.

"That's recognising how important rec fishing is to the visitor economy and tourism industries and flow-on businesses, particularly in regional Victoria," Dallas D'Silva says.

The make-up of committees and advisory bodies for recreational fishing is also changing to better reflect Australia's diverse recreational fishing communities. Evidence and experience show that more diverse representation leads to better policy outcomes and decision-making.

Owen Li, executive officer of the Recreational Fishing Research Subprogram at the FRDC, says the increasing diversity has implications for communication about recreational fishing practices and regulations. "If you want to maximise the ability to reach certain cultural groups, the messaging needs to adapt," he says.

He says Asian and Pacific communities, in particular, have a strong attachment to seafood because it is a huge part of their culture and identity. "In Chinese culture, the harvest of seafood from a wild environment is a gift to the family and a highly prized commodity." F

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FISH HABITAT INITIATIVES

Recreational fishing is going through a change; not just in its diversity, but also in its goals. All around the country, recreational fishers are putting down their rods and reels, and taking up the cause of habitat restoration.

The organisation behind this movement is OzFish, a national not-for-profit that is engaging recreational fishers in hands-on restoration work in their favourite fishing habitats. "We're basically mobilising that army of fishers to get out there and make positive change for fish," says Cassie Price, director of habitat programs at OzFish.

This includes harvesting seagrass seeds and using them to restore the seagrass meadows in Cockburn Sound in WA, and collecting discarded oyster shells from restaurants and wholesalers to rebuild oyster reefs in Moreton Bay in Queensland, to name just a couple of projects underway.

There are also large-scale projects using heavy machinery to return big dead tree trunks, or snags, back to the Murray River on the NSW–Victoria border as habitat for the Murray Cod and other threatened native fish species.

While OzFish has coordinated these projects, the initiative and drive come from the members of the recreational fishing community themselves, who form OzFish 'chapters' to tackle issues in their local waterways. OzFish now has 33 chapters around the country, with a presence in every state and territory except the ACT, and two Indigenous chapters. And, according to Cassie Price, it is growing "exponentially".

"There are some huge concerns out there in the community about declines in the health of a lot of their fishing spots and lack of fish to catch, and not a lot of knowing what to do about it," Cassie Price says. "Fishers come to us with a problem, we work together to find a solution and then make it happen with them."

As a result, OzFish partnered with the FRDC and the Fish Habitat Network to launch the National Fish Habitat Strategy last year, to take a more coordinated approach to habitat restoration.

"How do we mobilise everybody in the same direction and get that good science out to everyone?" asks Cassie Price. The strategy identifies opportunities to seek support and funding from local, state and federal governments, and highlights opportunities such as developing citizen science initiatives and carrying out a National Fish Habitat Assessment.

By better understanding waterways and wildlife, fishers are acting to ensure there will be fish in the future. For instance, they are engaging in more sustainable fishing practices such as catch-and-release. They are also taking responsibility for fish in crisis areas like the Darling River, helping to install aerators to make fish refuges and reducing fishing where fish populations might be under stress.

"We now have groups of fishers all over Australia taking a responsible stand; they are devoting thousands of hours to better habitat outcomes," Cassie Price says. F

More information
www.ozfish.org.au
FRDC RESEARCH
CODE: 2015-501

Sydney Fish Market redevelopment

Artist's rendering of the proposed new Sydney Fish Market. Image: NSW Government

By **Catherine Norwood**

The redevelopment of Sydney Fish Market (SFM) has been more than five years in the making, finally receiving the funding green light in September this year.

The NSW Government has approved $750 million for a new facility at Blackwattle Bay, a site adjacent to the market's current location. Works are expected to begin in late 2020, with the new market to open in 2024.

The redevelopment will create new value for the seafood industry, Sydney residents and a growing number of national and international tourists.

Designed for seafood

The new SFM will provide the seafood industry with the latest technology, to ensure fishers and fishmongers can maintain the quality of their seafood and trade it as efficiently as possible. Each year the market auctions about 13,500 tonnes of wholesale seafood.

The distinctive design for the SFM redevelopment comes from Danish architects 3XN, in partnership with Sydney firms BVN and Aspect Studios. It includes a wave-shaped, scale-patterned roof that pays homage to the fishing industry. Another feature will be a public viewing area for the wholesale auctions to give visitors a deeper understanding of the seafood supply chain.

As the Southern Hemisphere's largest fish market, SFM is a major national tourist destination that already attracts about three million visits a year. With expanded capacity at the new site, visitor numbers could double to six million a year.

Community connections

The new design will allow more people to experience the quality and diversity of Australian seafood and will showcase sustainable fishing practices and the hard work of fishers. It will also offer inspiration to visitors, encouraging them to visit the coastal towns that are the source of the seafood on offer.

The new SFM is part of a more extensive redevelopment of Pyrmont harbourside area, including more public space, more dining options, boardwalks and a ferry pier – all designed to create stronger connections with the local community.

Overseeing the redevelopment will be SFM's newly appointed CEO, Greg Dyer, who takes over from retiring general manager Bryan Skepper. Greg Dyer comes to SFM after four years as CEO of the City of Parramatta Council, where he instigated the $2 billion Parramatta Square urban renewal project.

"Sydney Fish Market is an iconic destination for Sydney, with an incredible history tied to the city's growth and its culinary diversity. I am genuinely excited about the opportunity to take the helm at a pivotal time in the organisation's history," he says.

Bryan Skepper officially retired in September 2019 after a 44-year career with the market, although he is continuing in a part-time advisory role in the lead-up to the redevelopment.

The redevelopment design aligns with SFM's purpose: to unite people and the sea. "Championing the reputation of the industry is very much a part of this," Greg Dyer says.

As well as the physical connection to the water at the site, SFM will also promote connections in terms of seafood supply and knowledge about the marine environment, sustainability and fisheries management. In addition to the more visible auction area, an interpretive centre is being planned to tell the stories and show the history of the seafood industry to visitors. **F**

More information: www.infrastructure.nsw.gov.au/projects-nsw/blackwattle-bay

Photo: Indian Ocean Fresh

THE UP-AND-UP OF AUSTRALIAN AQUACULTURE

Growth expectations

Aquaculture will bring technological advances and evolving workforce opportunities as the sector develops new species for farming, says leading Atlantic Salmon producer Frances Bender

By **Frances Bender,** Executive Director and co-founder, Huon Aquaculture

The future landscape of aquaculture, particularly in Australia, offers some exciting opportunities. Aquaculture is the way of the future. We have a growing world population, a global decline in wild fish stocks and an enormous amount of ocean.

The only way we can feed this growing population is through aquaculture. I see enormous opportunities and I see Australia having a bigger role than we do currently.

There are opportunities with emerging species and for operations in new regions that are more remote. These will come with their own infrastructure and labour issues, but I think emerging species are a real opportunity for us.

There are gaps in our knowledge about new species. There is still so much we have to learn about salmon, although we've been farming it for decades.

However, today there are good support mechanisms for aquaculture in Australia that salmon aquaculture didn't have when it started. There is scientific knowledge, researchers on the ground, new technologies and institutions. These are now all available to support new species.

Community perceptions

I believe community perceptions and the lack of understanding about aquaculture is a major issue. People think we are raping and pillaging the environment, when the complete opposite is true. If we do not manage the environment that we are farming in, we do not have a business. There are genuine issues with some species and in other countries, but that is certainly not the case in Australia.

We have strong regulation of labour forces, workplace health and safety, veterinary medications and environmental management. The standard we are expected to achieve in Australia is very high.

Yet more than 60 per cent of the seafood we eat in Australia is imported, from countries without our stringent regulatory practices.

We have an exceptionally strong story to tell, not only about this regulatory environment, but also about our robust research and development and world-class science. But we need to tell it better.

Careers

Dear to my heart is the opportunity that aquaculture provides to keep regional communities alive and thriving, by creating a critical mass of highly skilled workers and employed families. That should never be underestimated.

Even though securing workers can be challenging, a career in aquaculture is attractive. It can give people an opportunity to travel and work around the world.

It can also put people at the forefront of technological changes. For example, at Huon, we recently won a national IT award for our remote feeding system, which uses artificial intelligence. The system – controlled from our headquarters in Collins Street, Hobart – trains itself as it feeds our fish in the waters off southern and eastern Tasmania. That system was developed in Tasmania.

In addition to increasing efficiency and safety, new technologies like this mean that jobs that used to involve hard physical work are now more available to women and people with physical disabilities. That is a major step forward.

The development of that technology has happened here, in Tasmania, and the rest of the world has nothing like it. Sometimes people look at the remoteness of Australia, and of Tasmania in particular, as a disadvantage and in some ways it is, but it also means we have to be innovative. It has driven us to be different and think for ourselves.

Anticipating change

We are constantly taking action to anticipate change. The way we are farming now is completely different from the way we were farming five years ago. We are one of the first Atlantic Salmon aquaculture companies in the world to go offshore, into rough waters.

The future for the salmon industry, in particular, is offshore and that is an international trend.

The future is also onshore: growing fish for longer in freshwater on land. These changes in the way we grow fish come with their own technological, cost, and welfare and environmental challenges that require investment in expensive equipment to address.

Our company has spent $500 million on capital in the past five years in Tasmania. Aquaculture is a very capital-intensive business. It is also a long-term investment.

We have a three-year production cycle, and our planning and investment cycle is five years plus. So, a new grow-out facility costing $40 to $50 million might take five years to produce anything.

And there are threats to getting access to capital.

> ***"The only way we can feed this growing population is through aquaculture. I see enormous opportunities, and I see Australia having a bigger role than we do currently."***
>
> Frances Bender
> Photo: Huon Aquaculture

One of these is speculative financiers who can show productivity on a spreadsheet but do not actually produce anything. They can do a lot of damage to the reputation of the industry: people get burnt, and when the next business comes along with a better, more realistic plan, it is harder for them to get a start.

Government regulation could help prevent people who are not really interested in growing good, safe food from getting involved in the industry, but there needs to be a balance between regulation and access to capital.

Biosecurity

Biosecurity is another consideration for aquaculture. We need to be very, very vigilant in following our protocols in ports, when fishing and on farms, both aquatic and terrestrial. We should learn biosecurity lessons from overseas and not compromise on the biosecurity of any of the food we produce.

Australia has a unique position geographically; our biosecurity and lack of disease is an intergenerational asset. It is not ours to give away in the name of free trade.

Other influences

There are many other influences the industry needs to keep in mind, for example, politics. Australia is a small player in a big pond, so we need to be conscious of political decisions, trade sanctions and free trade decisions that might affect us.

Climate change is another influence. Our business is very aware of climate change, so we have been working on projects in the background such as adopting different technologies and going offshore where the water is cooler, and conducting selective breeding to cope with warmer water conditions.

Support for companies and scientists to work with governments is also key. I think there is regulatory support and enthusiasm for emerging species, but there needs to be a good, transparent mechanism for governments to work with the industry to develop business opportunities and emerging species.

Governments want gross domestic product and employment, and businesses want to be profitable. All of this is possible and the result is that Australian consumers get to eat more Australian seafood. **F**

Australian aquaculture is coming of age with increasing scale and diversity

By **Catherine Norwood**

Aquaculture production worldwide has been growing at a rate of almost eight per cent a year for the past decade – growth that is expected to continue at a similar rate for many years to come, to support the world's increasing food protein needs.

In Australia, growth has been less rapid, averaging about 4.3 per cent a year for the decade to 2017-18, but is still rising with increasing demand for seafood and the influence of food media, such as *MasterChef*. Popular programs like this have increased consumer awareness of seafood provenance, sustainability, quality and traceability – all strengths of aquaculture.

While the sector accounted for 36 per cent of Australia's total seafood production in 2017-18, this represented 44 per cent of the value: 97,406 tonnes worth $1.41 billion from the total seafood production of 271,133 tonnes worth $3.2 billion.

It is clear that aquaculture will continue to be the driving force for growth in Australian seafood and has been a significant focus for the FRDC, forming a large part of its submission to the $100 billion Australian agriculture inquiry. In developing its submission, the FRDC also developed a data analysis tool to predict future GVP volume.

While this article builds on the two previous aquaculture forecasts the FRDC has written, it only focuses on the major sectors. Over the next 10 years, development is also likely to occur for new and emerging species including seaweed, Cobia, Queensland Grouper and tropical oysters.

Atlantic Salmon

Tasmania's Atlantic Salmon industry comprises three companies – Huon Aquaculture, Tassal and Petuna Seafoods. The industry is Australia's most valuable seafood sector – wild or farmed – with 58,000 tonnes produced in 2018-19, worth $833 million.

Having doubled production during the past decade, the industry has exceeded its own expectations. Last year it revised its 2030 target from $1 billion in value to $2 billion.

In fact, extensive marketing and product development by these companies have seen Atlantic Salmon become Australia's most popular seafood. Stringent biosecurity measures protecting Tasmania's salmon industry from external and internal disease threats have enabled them to reliably supply a high-quality product to domestic and international markets.

The Tasmanian Government continues to provide support for the industry, which is the largest agri-food contributor to the state's economy. In 2017 the government released the *Sustainable Industry Growth Plan for the Salmon Industry* as part of major management reforms, streamlining processes and introducing additional steps to provide greater public and industry certainty.

This includes detailed mapping of areas suitable for expansion, as well as 'no go' zones, and also a commitment to deeper ocean sites, potentially outside state waters. The United Nations Food and Agriculture Organization believes that deep-ocean aquaculture, producing both plant and animal food products, will be a major global food resource for the future.

The Australian Government, which manages Commonwealth waters outside three nautical miles, outlined the need for legislative reform in its *National Aquaculture Strategy*. This is likely to include an amendment to the Commonwealth *Fisheries Management Act 1991* to allow individual jurisdictions to extend their existing aquaculture regulations to adjoining Commonwealth waters.

In preparation for aquaculture in offshore waters, the Atlantic Salmon industry (both here and overseas) is working to develop pens specially designed for high-energy wind and wave conditions of exposed ocean sites.

Prawns

Prawn farming has had a turbulent couple of years with the outbreak of White Spot Disease in 2016. The outbreak severely impacted the farms located in southern Queensland and resulted in a drop in production for the sector from 2016 to 2018, to about 4500 tonnes a year.

Over the next two to three years, as farms impacted by White Spot resume production, this volume is expected to double to about 10,000 tonnes. Further, larger increases are forecast out to 2025.

The disease outbreak has seen biosecurity and on-farm management become a major focus of efforts for prawn farmers (as it has for other aquaculture producers). However, it has not curbed the sector's enthusiasm, with many businesses looking to scale up and increase production.

Among those are Atlantic Salmon producer Tassal, which is diversifying its portfolio to include prawn farming. In 2018, it acquired the Fortune Group, which includes prawn farms in Yamba, New South Wales, and in Proserpine and Mission Beach, Queensland.

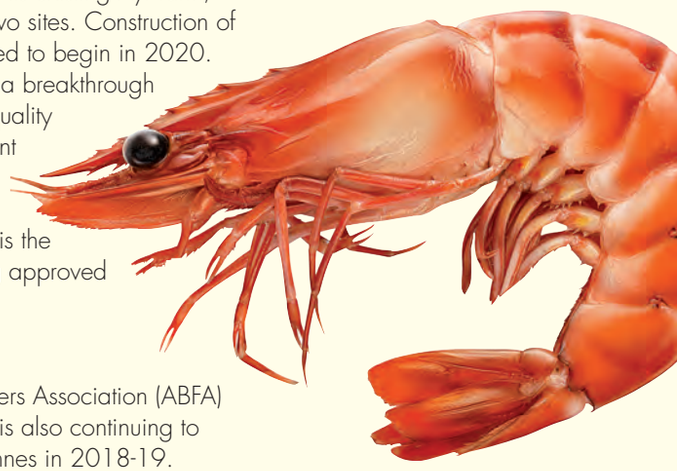
The company is planning a major expansion at Proserpine, on the Gregory River, with a target of 20,000 tonnes of black tiger prawns a year. The expansion is expected to include a hatchery, up to 400 hectares of new ponds and a processing plant. Investment in the expansion over the next five to six years is estimated at almost $70 million, in addition to the $31.9 million spent on the acquisition.

However, it is the Seafarms Group's Project Sea Dragon that is expected to prove a game changer for Australian aquaculture. Production is scheduled to come online in 2025, with a full-scale target of 150,000 tonnes of Black Tiger Prawns for export markets.

The $2 billion project involves five sites: Exmouth and Kununurra in Western Australia; and Legune Station, Darwin and Gunn Point in the Northern Territory. Production will be based at Legune Station, with 1120 hectares of grow-out ponds planned (see *FISH* June 2019).

The second generation of founder stock is currently being bred at the company's Exmouth quarantine centre and test ponds have been constructed at Legune Station, ahead of earthworks. Broodstock are expected to be managed at breeding facilities in Darwin, while the project's hatchery is based at Gunn Point, east of Darwin. Pacific Bio is also expanding production. After many years in the planning phase, it has approval for 259 hectares of new farming at Guthalungra in northern Queensland. This expansion will take the company's production from 1000 tonnes at its existing Ayr farm, up to 4000 tonnes across the two sites. Construction of ponds at Guthalungra is expected to begin in 2020.

This expansion has provided a breakthrough in meeting the stringent water quality targets for developments adjacent to the Great Barrier Reef, using seaweed production to absorb nutrients from the pond water. It is the first expansion of prawn farming approved in Queensland since 2001.



Barramundi

The Australian Barramundi Farmers Association (ABFA) says production by its members is also continuing to increase and reached 9000 tonnes in 2018-19.

National statistics to date have not reflected the full extent of production, as data from two of Australia's largest operators – Humpty Doo Barramundi in the NT and MainStream Aquaculture in Victoria – has been excluded under commercial-in-confidence provisions.

With a small number of operators in their respective states, published figures would reveal their competitive position in the market. The official national production in 2017-18 was 5668 tonnes, excluding these operators. Industry data from the ABFA, which included them, put production in the same year at 6700 tonnes.

However, Humpty Doo Barramundi and MainStream Aquaculture have now agreed to provide their production figures as part of efforts to lift the sector's profile. MainStream Aquaculture managing director Boris Musa says without this data, Barramundi's contribution to the aquaculture sector has been under-represented. He expects the additional reporting will raise the importance of the industry, which continues to have significant concerns about country-of-origin labelling, and is seeking improved biosecurity to protect both aquaculture and wild fisheries.

Imported Barramundi represents up to 70 per cent of the *Lates calcarifer* species sold within Australia. However, many consumers are unaware of this as the NT is the only jurisdiction that requires country-of-origin labelling in food service outlets such as restaurants and hotels, where Barramundi is a popular menu item.

The ABFA is anticipating a major increase in production in the next five years, with a production target of 25,000 tonnes by 2025. Investment in the infrastructure to achieve this is already underway.

MainStream Aquaculture will increase current fish production capacity from 2000 tonnes to more than 4000 tonnes within the next three years.

MainStream Aquaculture will increase current fish production capacity from 2000 tonnes to more than 4000 tonnes within the next three years. In addition to operating the world's largest Barramundi hatchery supplying domestic and international markets, the company also produces 1000 tonnes of fish in spring water at its Werribee facilities in Victoria. Following its merger with Pejo Enterprises in October 2018, it has another 1000 tonnes of production in Queensland.

This includes salt water production ponds at Innisfail, which are being expanded to produce 3000 tonnes. These fish will also form the basis of an expanded value-added product range that will include hot and cold smoked Barramundi.

MainStream Aquaculture also has a feasibility study underway into a new recirculating aquaculture system facility at Maryvale, Victoria, to operate in conjunction with an Australian Paper mill, which will be the source of the water. The feasibility study and business plan are expected to be complete by mid-2020. The proposed production capacity of the development is up to 3500 tonnes in the first phase, and potentially up to 10,000 tonnes overall.

In the NT, the family-owned Humpty Doo Barramundi is Australia's largest producer and in 2017 doubled its production to 3000 tonnes. Construction of additional facilities is underway to double production again, to 6000 tonnes in 2020. This is part of a $57 million expansion, which includes government support through a $28.7 million Northern Australia Infrastructure Facility loan. Stages two and three will be undertaken as market growth, including exports, allows, and the completed project is expected to take production capacity to beyond 10,000 tonnes.

In WA, Barramundi Asia has been slowly expanding at Cone Bay over the past year, after buying Marine Produce Australia (MPA) in 2018. MPA has a marine lease in the Kimberley Aquaculture Development Zone permitting production of up 15,000 tonnes a year, although production levels are currently about 1200 tonnes, increasing to 1800 tonnes in 2020.

Managing director of Barramundi Asia Joep Staarman says the Australian purchase is about diversifying the company's production base, which includes 6000 tonnes in Singapore and a new development in Brunei that will begin production in 2020, with a final capacity of 40,000 tonnes. It is keen to protect the Cone Bay marine environment and will seek to expand production using several different locations across the Kimberley zone, rather than concentrating farming in one location. He anticipates full-scale production of 15,000 tonnes at the Australian site by 2030.

Clean Seas has invested in its SensoryFresh -95 degrees Celsius freezing technology to develop a premium frozen product, using liquid nitrogen rapid freezing to optimise the freshness of the fish while maintaining the convenience of frozen supply.

Yellowtail Kingfish

Yellowtail Kingfish (YTK) farming has been evolving slowly in Australia for two decades, but the recently completed $7.3 million Kingfish for Profit (K4P) research collaboration, funded by the Department of Agriculture and the FRDC, has helped to give production new impetus.

Fish producers, researchers and feed manufacturers came together in the three-year project, which has produced new findings on feed formulations, fish growth and water temperature that will help bring fish to market more efficiently and sustainably.

In 2016 YTK production was estimated at 1200 tonnes, and came almost solely from Clean Seas in South Australia. The company had doubled production by 2018 to 2500 tonnes and expects to increase this to between 3000 and 5000 tonnes by 2025, having added additional cages to its Fitzgerald Bay lease near Whyalla last year.

Clean Seas markets its Spencer Gulf Hiramasa Kingfish as a premium cold water product and has developed a strong customer base, particularly in the high-end European food service sector.

In expanding production, the company says it will also target North American and Asian markets, where more than 75 per cent of kingfish sold is frozen. It has invested in its SensoryFresh –95 degrees Celsius freezing technology to develop a premium frozen product, using liquid nitrogen rapid freezing to optimise the freshness of the fish while maintaining the convenience of frozen supply.

Tasmanian Atlantic Salmon producer Huon Aquaculture was a major participant in the K4P project with NSW Department of Primary Industries, through its research lease at Port Stephens. Despite gaining significant insight into YTK production, it has put on hold its NSW operations and now has plans to begin farming at a similar latitude at the Abrolhos Islands near Geraldton, WA where it has a 2200 hectare aquaculture lease. At this stage Huon has not set a timeline or production target for the WA site.

TABLE 1: Australian aquaculture production and projections

Species	2006-07 tonnes	2017-18 tonnes	Comments	2021-22 projections (t)
FISH				
Salmonids (Atlantic Salmon, trout)	25,253	61,413	Offshore farming is being established and will increase production, a counter to warming inshore waters, which reduce production.	75,000 - 80,000
Southern Bluefin Tuna	7486	8000	No major increase likely; a slight increase in quota might allow more fish to be ranched.	9000
Barramundi	2590	5668*	New farms and expansions on existing farms to increase production. *Does not include production from Northern Territory or Victoria.	12,000
Yellowtail Kingfish (YTK)	N/A	N/A	Existing and new aquaculture leases in WA expected to increase YTK production in coming years. SA also ramping up production.	5000
Murray Cod	N/A	266*	Production based in NSW and Victoria. *Figure based on NSW production.	3000
Other species	772	3183	Totals include Silver Perch, Cobia, Queensland Grouper.	2000
CRUSTACEANS				
Prawns	3284	4205	Expansions of prawn farms in the north are expected to increase production.	10,000
Other species	299	166	Stable but low production of yabbies, marron and Redclaw. New Moreton Bay Bug production underway.	250
MOLLUSCS				
Edible Oysters	14,299	8824	Pacific Oyster production recovering from POMS in Tasmania. R&D underway for tropical Blacklip Oysters.	15,000
Blue Mussels	3145	3781		5000
Abalone	468	1027		1800
Pearl oyster	N/A	N/A	No figures provided because of limited commercial operators.	N/A
MISCELLANEOUS				
Other	N/A	873		5000
Seaweed	N/A	N/A	Emerging aquaculture production.	5000
TOTAL	**57,596**	**97,406**		**148,050 - 153,050**

Source: FRDC and ABARES

Meanwhile, Indian Ocean Fresh Australia has been operating from Geraldton for more than a decade, refining YTK aquaculture in warmer waters. It also has an 800 hectare marine lease at the Abrolhos Islands and has been slowly but steadily scaling up commercial production over the past five years. Director Erica Starling says she focuses on fresh, whole fish for the domestic restaurant trade, with plans to expand exports into Asia.

Challenges in the west include securing both fingerlings and quality feed, and continued development of expertise is needed to optimise fish growth in local conditions. Hatchery services are currently provided by a government-operated facility in Fremantle and will soon be supplemented by a $7 million nursery the WA Government plans to build at Geraldton to assist YTK production expansion.

While predictions for the species' potential production have been large – upwards of 60,000 tonnes across Australia – production is more realistically expected to remain at much lower levels in the near future, with producers targeting the premium food service sector markets in Australia and overseas.

The limited number of producers means that YTK is also not included in national fisheries statistics, although estimates for 2019 are for more than 4000 tonnes. F

Make way for farmed bugs and lobsters

By **Catherine Norwood**

At Toomulla Beach near Townsville, in Queensland's north, a former prawn farm is being given new life, farming two crustacean species that are emerging onto the Australian aquaculture scene: Moreton Bay Bugs (*Thenus australiensis*) and Ornate Tropical Rock Lobsters (*Panulirus ornatus*). While it will not be Australia's only Moreton Bay Bug farm, it will be a world first for Tropical Rock Lobster aquaculture.

Tasmanian company Ornatas is behind the effort to build a new aquaculture industry for these species in Australia, with hatchery and grow-out facilities in Tasmania and Queensland, respectively.

CEO Scott Parkinson says he expects the first farmed Tropical Rock Lobsters will be marketed to Australian consumers and exported to the lucrative China market by 2022. He says the company plans to produce approximately 150 tonnes of the iconic Morton Bay Bug within five years and 800 tonnes of the highly prized Tropical Rock Lobster by 2029.

Ornatus has been a long-term partner with the University of Tasmania (UTAS) in the research and development of both Moreton Bay Bugs and the Ornate Tropical Rock Lobster.

Greg Smith is leading the research team at the Institute for Marine and Antarctic Studies, which is part of UTAS, as director of the ARC Research Hub for Commercial Development of Rock Lobster Culture Systems.

This hub received a second round of funding from the Australian Research Council (ARC) – a $5 million grant over five years from 2020 – to develop commercial rearing techniques for the two species, which expands on the success of breeding and hatchery techniques. Ornatas, as industry partner, will support the program with $5 million cash and in-kind support from its Tasmanian and Queensland facilities.

Greg Smith says research into lobster aquaculture has evolved at UTAS over more than 15 years, with early work funded by the FRDC. Progress has included completing the full life cycle of broodstock through to the egg, larval and adult stages, and breeding from the offspring of the Southern Rock Lobster (*Jasus edwardsii)* and Eastern Rock Lobster (*Sagmariasus verreauxi*), as well the Ornate Tropical Rock Lobster and Moreton Bay Bugs.

Australia's rock lobsters are grouped internationally as spiny lobsters, as opposed to the northern hemisphere clawed lobsters. Moreton Bay Bugs are part of the slipper lobster grouping, along with other Australian reef and mud bugs, including Balmain Bugs.

While the Eastern and Southern Rock Lobster have a seven and 12-month larval phase, respectively, and take five to seven years to reach market size, the grow-out time for the Ornate Tropical Rock Lobster and Moreton Bay Bug is much shorter. This makes them more commercially viable as an aquaculture species.

Tropical Rock Lobster larvae spend three to four months in the hatchery and grow to a one-kilogram market size in another 18 months. Bug larvae spend three weeks in the hatchery and grow to a 200-gram market size in six to nine months – a similar time frame to prawns. The next phase of research for these two species will focus on optimising the rearing of juveniles for market using onshore grow-out facilities, initially using raceway systems, and selection of the best-performing animals.

"We need to work out the best way to transport juveniles from the hatchery to grow-out facilities, and their feed requirements. There are no feed formulations for these species. Elsewhere they use trash fish, but that won't fly in Australia," Greg Smith says.

"We will also evaluate the potential social and economic impacts of production and the development of a new aquaculture industry for Australia."

While production is expected to begin in Queensland within months, Ornatas will also invest in a purpose-built, pilot-scale lobster hatchery co-located at the IMAS Taroona research facility. F

Above
Moreton Bay Bugs can be grown to market size in about the same length of time as prawns.
Photo: ARC Research Hub for Commercial Development of Rock Lobster Culture Systems

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Seaweeds beckon tomorrow's farmers

Beyond the populism of vegan superfoods, plastics alternatives and climate solutions, there is gathering research interest and financial support for seaweeds which could underpin a new plant-focused approach to aquaculture in Australia

By **Catherine Norwood**

In Australia, seaweed aquaculture is a nascent industry, although one for which momentum is growing, with new research into native species, propagation techniques and functional properties. Long-term ambitions are large and growing. There is the potential for a billion-dollar industry providing thousands of jobs – many in regional communities – and a range of increasingly important ecosystem services along with new food and industrial products.

Global impacts

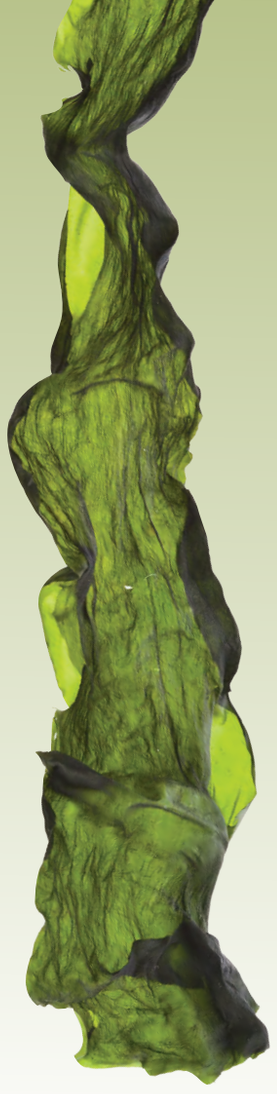
Figures from the United Nations Food and Agriculture Organization (FAO) indicate that cultivated seaweed production in 2015 amounted to 30 million tonnes globally. This was led by China (13.9 million tonnes), Indonesia (11.3 million tonnes), the Philippines (1.5 million tonnes) and South Korea (1.2 million tonnes).

China currently has more than 1250 square kilometres of farmed seaweeds that are grown for the products they provide, including foods and industrial food and chemical ingredients, but just as important is their ability to improve water quality in areas affected by high nutrient and low oxygen levels, and increased acidity. One recent research project estimated that China's farmed seaweeds remove 75,000 tonnes of nitrogen and 9500 tonnes of phosphorus from the country's coastal waters each year.

The ability of seaweeds to help mitigate climate change by absorbing carbon is gaining considerable attention and is the focus of many new research projects. Leading Australian scientist and conservationist Tim Flannery is an advocate of seaweeds and what they can deliver for humans and the environment. In his 2017 book *Sunlight and seaweed – an argument for how to feed, power and clean up the world* he outlines how large-scale seaweed cultivation could reduce levels of atmospheric carbon to fix current climate issues.

To sequester carbon requires growing it (capturing the carbon), then harvesting the seaweed or allowing it to sink and accumulate on the ocean floor (locking it up), effectively burying stored carbon. While it is known that carbon captured by seaweeds can be sequestered in oceanic sinks, there are still unknowns in the sequestration process, in particular what happens to the seaweed when it sinks. Continued research to answer key questions will be needed if seaweed is to establish its carbon-accounting credentials, allowing for the creation of blue carbon offsets. >

Photo: Shutterstock



Tackling methane

There are many seaweeds with existing markets and cultivation practices in other countries that are also native to Australia, such as Giant Kelp (*Macrocystis* species) and various species of *Gracilaria*. But Australia also has hundreds of unique species that may yet yield novel and highly valuable properties.

At the CSIRO, livestock systems scientist Rob Kinley and his team have identified the species properties of the native *Asparagopsis*, a red seaweed which contains chemicals that inhibit fermentation within the gut of cattle. When fed as a supplement to cattle it can reduce their methane emissions by 90 per cent or more.

In greenhouse gas terms, methane (CH4) is 28 times more detrimental than carbon dioxide (CO2) and emissions from livestock account for up to 12 per cent of Australia's total greenhouse gas emissions (and up to 50 per cent in New Zealand). These emissions also represent lost energy from feed of between two and 10 per cent. So as well as greatly reducing methane emissions, the use of *Asparagopsis* supplements within cattle feeds could also improve farm productivity.

While there is currently no commercial production of *Asparagopsis* in Australia, the CSIRO, Meat & Livestock Australia and James Cook University have jointly patented its use as a feed supplement, which they are commercialising as FutureFeed™, for ruminant livestock such as cattle and sheep.

Scale of production

Rob Kinley says he is now researching the minimum amount of seaweed needed in livestock diets to eliminate methane emissions. As a starting point, based on supplements for 10 per cent of the national dairy herd and feedlot cattle, he estimates 85,000 tonnes of *Asparagopsis* (wet weight) a year would be needed, requiring about 425 hectares of seaweed farms.

To meet this need, a number of commercial companies, some in collaborations with research organisations, have recently begun to explore the culture of this species onshore and in-sea in Australia, as well as overseas. One of these is CH4 Global, a team of international innovation and investment experts committed to developing sustainable *Asparagopsis* production to address climate change.

In South Australia, general manager of aquaculture for Primary Industries and Regions South Australia (PIRSA), Adam Main, says the state is in discussions with CH4 at a government level to identify potential sites to farm the species. He says 70 hectares will initially be made available for trials, with 1000 hectares or more zoned for seaweed in the longer term. While Port Lincoln is an area of primary interest, PIRSA is also working with the Narungga Nation Aboriginal Corporation on the Yorke Peninsula about its possible involvement in seaweed initiatives.

Previous research by the South Australian Research and Development Institute has already identified several other species with potential for cultivation, some possibly as part of multi-trophic aquaculture with finned fish culture. Adam Main says further work will be done to progress these species too.

In Adelaide, Flinders University is also leading a bid to establish a Marine Bio-products and Biotechnology Cooperative Research Centre (CRC). This CRC would focus on identifying and developing bioproducts from marine resources such as microalgae and macroalgae, for uses including human functional foods, and nutrition and animal feeds. It intends to address the whole production chain, including production, processing and product aspects.

Land-based farming

It is human, rather than animal health, that has been the focus of seaweed aquaculture from one of Australia's pioneers in this space, Pia Winberg, who established land-based production of species of sea lettuce, *Ulva*, in the NSW Shoalhaven in 2014. Pia Winberg's

A seaweed primer

Seaweed is part of the algae family, which is found around the world in many thousands of forms, ranging from microscopic species to giant underwater forests towering five storeys above the ocean floor.

Algae is the general term applied to types of aquatic plants, although they aren't really plants in a botanical sense, in that they don't have roots and leaves and other plant features; their cell structure is comparatively simple. Algae is found in oceans, rivers, lakes and other water bodies. Most forms use photosynthesis to convert energy from sunlight in order to grow, as land-based plants do, although some can grow in the dark using sugar or starch for energy.

The **microalgae** members of the family are single-cell organisms, the largest of which might be 0.5 millimetres. There are green, brown and red microalgae species, as well as cyanobacteria, which is similar to bacteria, commonly known as 'blue-green algae'.

Seaweed is a common term for **macroalgae**, the larger members of the algae family. There are three main types of seaweed: green, red and brown. Australia has thousands of different species. Of the 1000 kinds identified in southern Australia, about 60 per cent are endemic, found only in this part of the world.

Kelps (Laminariales) are a particular group of large brown seaweeds. Giant Kelp (*Macrocystis* sp.) can grow into substantial underwater forests up to 20 metres high, such as those found off the eastern coast of Tasmania. During the past decade the Tasmanian kelp forests have largely disappeared as a result of warm water from the East Australian Current moving further south along the Tasmanian coastline.

Top left
A puffy pink seaweed that can stop cows from burping out methane is being primed for mass farming by University of the Sunshine Coast researchers. The University's Seaweed Research Group leader Associate Professor Nick Paul says that if Australia could grow enough of the seaweed for every cow in Australia, the country could cut its greenhouse gas emissions by 10 per cent.

Left
The seaweed team.
Photos: USC

Top right
Pia Winberg, who established land-based production of seaweed in the NSW Shoalhaven in 2014.
Photo: Blue BioTech Shoalhaven

company, Venus Shell Systems, has a strong research and development focus, which builds on her previous research, including a report for AgriFutures on cultivating Australian seaweeds for health and nutritional markets. Tapping into the strong consumer trends in nutrition and gut health, her business is expanding quickly, with increased processing and farming capacity.

A seaweed pasta is part of her PhycoPRO™ branded foods and supplements range of seaweed products for food, digestive and skin health applications. It's entirely feasible, Pia Winberg says, that 10 per cent of the wheat flour used to make pasta in Australia could be replaced with seaweed, increasing the nutritional benefits of the product.

This year her business Venus Shell Systems will produce 40 tonnes, which equates to four tonnes of dried seaweed. Small beginnings, but Pia Winberg has much bigger goals. By 2021 she expects to grow 100 tonnes of seaweed, using a series of raised ponds across one hectare of the current site. With five >

Australian species
Widely recognised species native to Australia include:
Brown:
- common or golden kelp (*Ecklonia radiata)*
- lobster or crayweed (*Phyllospora comosa*)
- Neptune's necklace (*Hormosira banksii*)
Green:
- sea lettuce or greenweed (*Ulva* sp.)
- seagrapes (*Caulerpa* sp.)
Red:
- Nori (*Porphyra* or *Pyropia* spp.)

Exotic seaweeds
Among the most widely known exotic species is Wakame (*Undaria pinnatifida*), which has been found in Victorian and Tasmania waters. It has been declared an invasive species in these states.

Seagrasses
Seagrasses are aquatic flowering plants that have roots and leaves. They have a vascular system – specific plant tissues responsible for the distribution of nutrients – unlike seaweeds, which have a holdfast that connects them to the ocean floor and which distributes nutrients by diffusion.

The Marine Education Society of Australasia has detailed 33 species of seagrass found in Australia, including short eelgrass (*Zostera muelleri*), ribbonweed (*Zostera capricorni*), sea nymph (*Amphibolis antarctica*) and paddleweed (*Halophila australis*). It estimates that there are 51,000 square kilometres of seagrass meadows in intertidal environments. **(www.mesa.edu.au)**

Above
Pacific Bio's production manager – macro algae, Chris Praeger, monitors raceways where sea lettuce is being used to treat water from prawn ponds.
Photo: Andrew Rankin

hectares at this location, the business has the potential to produce up to 500 tonnes of seaweed a year in the Shoalhaven, and is also investigating five new sites around the country.

Multi-trophic aquaculture

Since 2016, Tasmanian Atlantic Salmon producer Tassal has been investigating ocean-based, integrated, multi-trophic aquaculture – a combination of fish, shellfish and seaweed that some call 3D mariculture. The research initially included Camerons Shellfish and Seaweeds Tasmania, but from late 2017 it continued in conjunction with Spring Bay Seafoods, the Institute for Marine and Antarctic Studies (IMAS) at the University of Tasmania and Deakin University, with FRDC funding.

These parties secured a CRC project grant this year to scale up the work over the next three years, with $5.5 million combined funding from the grant and all participants. Hatchery and grow-out methodologies have been developed for local kelp species with the aim of initiating a seaweed-based industry that will generate environmental benefits.

Australia also has its own philanthropic, climate-driven seaweed initiative underway in Storm Bay, in southern Tasmania. Partly crowd funded, the project is a collaboration involving the producers of the climate change movie *2040*, the Climate Foundation, University of Tasmania and The Intrepid Foundation.

The project raised $350,000 earlier in 2019 for research into the propagation of native Giant Kelps. These species, which once formed extensive underwater forests along Tasmania's eastern coastline, have largely disappeared during the past decade as a result of warm water from the East Australian Current extending further and further south. In phase two of the project, another $250,000 is being raised to establish an offshore pilot platform in Storm Bay to regrow these kelps.

Huon Aquaculture is also collaborating with the Climate Foundation and Giant Kelp trials, helping Tasmanian researcher Cayne Layton from IMAS with planting of kelp seedlings at its two lease sites in Storm Bay in October.

Water quality

Queensland initiatives include the use of the sea lettuce *Ulva ohnoi* as part of water remediation processes at Pacific Bio's prawn farm in Ayr. The seaweed draws on the nutrients in the discharged prawn pond water for its own growth, which results in lower nutrient emissions in the water.

This process has been developed in conjunction with James Cook University. Pilot trials at Ayr provided crucial proof-of-concept for zero net nutrient emissions in the treated water, paving the way for the approval

of new prawn ponds at the company's Guthalungra site further south, adjacent to the Great Barrier Reef.

James Cook University professor and chief technical officer for Pacific Bio, Rocky de Nys, has been closely involved in the project development and says that even prior to the Guthalungra expansion being completed, seaweed production at Ayr has been so successful that Pacific Bio is already expanding production.

It will increase the seaweed production area from 0.5 hectares to 2.5 hectares within the year, with seaweed yields increasing from 200 tonnes in 2019 to more than 1000 tonnes by 2022. He says the seaweed is in demand as the ingredient for PlantJuice™, developed by Pacific Bio, a high-performing plant biostimulant used predominantly by local sugar cane farmers. The seaweed is also being used in aquaculture feeds.

Options to diversify

Further south in Queensland, Sandy and Wade McFadgen at Moreton Bay Rock Oysters have secured a variation to their 48 hectare oyster lease in the Moreton Bay Marine Park to farm any of the 20 or so seaweeds native to the local area. Wade McFadgen says they will be providing a test case for production in the bay, as part of an FRDC-funded research project.

Wade McFadgen believes seaweeds offer an opportunity for local oyster producers in the bay to diversify production and generate new income. "We'll need research and development into possible uses, whether that's for food or pharmaceuticals, or something else. To make it successful we'll also need volume and markets, and that may take a while to develop."

Trials will kick off in 2020 to identify the best-performing seaweeds at the location and any potential ramifications from farming. Leading candidates for production include edible seaweeds such as sea lettuce, red seaweeds for agar-agar and carrageenan gels, and brown seaweeds for health applications.

Nick Paul and Alexandra Campbell at the University of the Sunshine Coast (USC) are working closely with the McFadgens in their initial trials, and will also help assess the potential of seaweeds to offset nutrients washed into the bay.

The research team is developing propagation techniques for sea-based culture for a range of species, including *Asparagopsis*, and will document the environmental benefits of seaweed farming.

Nick Paul has also worked extensively in Indonesia, where he says production ranges in scale from smallholder farming families to huge industrial operations. In Australia, he believes combining production with existing aquaculture enterprises makes sense as a way to help establish a local industry.

The Australian Seaweed Institute (ASI) also has a development proposal underway for Moreton Bay, with a larger vision for 60 hectares of seaweed mariculture, producing up to 5000 wet tonnes a year. CEO Jo Kelly is enthusiastic about the potential for a national seaweed industry to provide jobs in regional areas, while the crop itself provides ecosystems services that support a low carbon economy.

She says the Queensland Government is supportive of seaweed aquaculture. "It's a no-brainer to invest in an industry that improves the health of bays, oceans and reefs, provides jobs in regional areas and produces high-value products for the domestic and international markets. The time is right to bring regulators, researchers and industry players together to get serious about mobilising investment needed to grow seaweed to a billion-dollar industry."

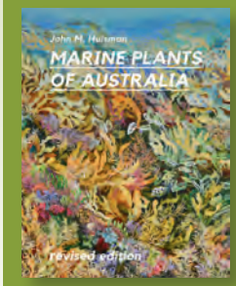
In an independent initiative in Western Australia, Ashley Sutton has been conducting trials at the Abrolhos Islands for the past year, selecting three of the initial seven species trialled for further development.

For Ashley Sutton, a former interior designer for hotels and hospitality venues in Asia, the move to seaweed farming represents a return to his roots – he grew up in Fremantle and has family members in the commercial fishing sector. But it is also a move with the future in mind, given the many benefits and diverse markets for seaweed products.

He has a 10-hectare marine lease at the Abrolhos Islands and hopes to begin commercial production within the next 12 months. He says the final decision on which species to grow and target markets will depend on which of the three shows the best growth rates during the next six months. **F**

The new Australian Standard for Aquatic Plant Names in development is designed to support a new seaweed production industry by providing all parties to the seaweed production and supply chain with an agreed, common language when discussing and marketing different species.

More information
www.seafoodstandards.com.au



Marine plants of Australia

With a growing interest in seaweeds and potential applications in food, industrial and environmental systems, the December 2019 release of the latest edition of *Marine plants of Australia* is timely. It is the work of one of Australia's leading seaweed taxonomists, John Huisman. This second edition illustrates over 600 species of Australia's underwater plant life, mostly with underwater photographs that reveal the amazing colours and intricate patterns found in this largely unknown realm of life.

There are seaweeds with the consistency of jelly, or with fronds that form an intricate mesh that rivals the best lace. These plants have evolved into a myriad of startling shapes, colours and patterns that will impress everyone who views them – underwater, or through the pages of this book.

New players in the marine protein market

Advances in food technologies are creating 'new' products that cater to changing consumer trends, including a focus on the broader environmental impacts and welfare issues associated with food choices

By **Catherine Norwood**

Right
Shiok Meats showcased its cell-cultured prawn meat in shrimp dumplings at the Disruption in Food and Sustainability Summit in Singapore earlier this year.
Photo: Shiok Meats

The race is on to find new and alternative sources of protein for people and animals, to help feed a global population that is expected to reach 10 billion by 2050. New food production technologies are providing options that will both supplement and compete with traditional seafood culinary experiences.

While no one has quite achieved the food replicators that feature in science fiction favourites such as *Star Trek*, the new base proteins being developed bring this technology a step closer.

Cellular growth

A bioengineering approach that comes direct from efforts to feed astronauts on long space missions is driving the developments of new cell-based meats and seafoods. NASA has been working on the technology since 2002, but the first successful reproduction of meat from cells is reported to have been in 2013, when the first 'in vitro' hamburger was taste-tested.

While they are still developing technologies, cell-based meats and seafoods are drawing significant investment from entrepreneurs such as Richard Branson and Bill Gates.

Leading the cell-based seafood start-ups are:

Avant Meats, Hong Kong, producing fish bladder and sea cucumber;

BlueNalu, USA, producing Yellowtail and Mahi Mahi;

Finless Foods, USA, producing Bluefin Tuna;

Shiok Meats, Singapore, producing prawns (shrimp), crab and lobster; and

Wild Type, USA, producing salmon.

The production process goes by many names, including cellular aquaculture, clean meat, cell-based seafood and cultured seafood. The technology involved, however, is similar to that used in regenerative medicine, adapted to produce food.

Below
The founders of Shiok Meats, Sandhya Sriram and Ka Yi Ling, are both stem cell scientists.
Photo: Shiok Meats

The founders of Shiok Meats, Sandhya Sriram and Ka Yi Ling, are both stem cell scientists. They were working on stem cells from organisms, including human stem cells, before quitting to establish their company in 2018.

Their initial focus is cultured prawn meat. Sandhya Sriram says to start the production process, stem cells from prawn muscle are placed in a "nutrient soup" at 28°C, mimicking the natural conditions inside wild prawns.

They grow only the muscle meat – no heads, legs or shells. In four to six weeks they can grow the equivalent of the meat yield from a whole farmed prawn, which takes 12 to 20 weeks to produce. The start-up is still in the research and development phase, but has a patent pending on its technology and plans to launch commercially in high-end Singapore restaurants in late 2020 or early 2021.

To reproduce a three-dimensional cut of meat – a whole fish fillet, for example, rather than minced meat – requires scaffolding to give the reproducing cells shape. In food production these scaffolds are commonly edible cellulose

from plants, chitosan found in mushrooms or alginate from algae. The formulation of the liquid nutrients and scaffolding used in cell growth are critical parts of the intellectual property and competitive advantages for each of the companies developing these products.

Simulated experience

The development of plant-based simulated seafoods is more advanced than that of cell-based meats. New products that simulate the taste and texture of real seafood, without any ocean animal ingredients, are already on supermarket shelves.

They are being marketed not just to vegans or vegetarians, but to 'conscious consumers' more generally – people who are concerned about the production impacts of their food choices, including those who eat meat and seafood.

Product developers report that the sheer diversity of seafood makes it more challenging to simulate than it is for consistent products such as ground mince and beef burgers. There are also two 'streams' in the development of these products: one relies almost exclusively on land-plant proteins, while the second incorporates more marine proteins – micro and macroalgae – that have similar nutritional profiles to seafood.

Simulated seafoods use grain flours and legumes such as soy, yellow peas or chickpeas as a base; other ingredients include tomatoes, yams, eggplant and different types of seaweed.

While new food technologies can create uncannily realistic products in both texture and appearance, the base ingredients are highly processed and the list of ingredients can be long and complex. As a result, such products may not have the same nutritional benefits that seafood offers. It is a potential trap for unwary consumers.

New proteins – both plant-based and cellular – deserve their own category and names, rather than denigrating the genuine products they imitate in order to demonstrate value.

Target markets

Products are increasingly found in the refrigerated or freezer section of grocery stores beside the real seafood product, rather than in a 'vegan' designated food section. In the UK, vegan food producer Good Catch has a canned tuna alternative appearing on shelves alongside cans of real tuna.

Australian supermarkets already stock products from Gardein, Sophie's Kitchen, Quorn and Linda McCartney Foods, non-fish simulations of white fish fillets, crab cakes, shrimp, salmon, tuna and scampi. Plant-based meats in general are the fastest growing food category in the developed world, and in August, the *Financial Times* reported on 20 start-up companies specifically producing plant-based seafood. Products are variously referred to as fish-free or fishless fish, vegan seafood, or more combatively, as fake fish.

Labelling is an ongoing issue, with calls for clearer regulation about what terms can and can't be used. There is a case to be made that these new proteins – both plant-based and cellular – deserve their own category and names, rather than denigrating the genuine products they imitate in order to demonstrate value.

Advocates of these new seafood proteins promote them as replacements for wild-caught or farmed seafood that address environmental and ethical issues that affect these industries in different parts of the world.

The challenges of producing food for the growing global population will be great. While some may see these new technologies as a threat to existing markets, others are hopeful that new food production techniques will complement traditional farming, fishing and aquaculture. New, more efficient ways of doing things will be essential to feed us all. **F**

Consolidation, corporatisation and safety

As a long-time fisher, and current chair of the Australian Maritime Safety Authority, Stuart Richey reflects on the trends and challenges for the Australian seafood industry and the safety of its marine workplaces

By **Stuart Richey AM, Chair, Australian Maritime Safety Authority**

Current trends indicate that the consolidation of fishing entitlements and quota in the industry is going to continue. The downside to this is that regional communities may suffer as smaller operators sell up.

On the positive side, it will bring a more corporate culture to the industry and with that will come more emphasis on safety.

There is no doubt there will be more changes in the way quota is owned and held as an investment. It is likely this will come with tensions between those who own and those who actually fish the quota.

Profitable fishing

We will need equitable share-lease arrangements that allow both parties to make a reasonable return.

The need to fish profitably is driving the consolidation and, in the long term, I think it will bring more investment in larger, more sophisticated and safer boats.

The average size of a fishing boat at the moment is probably between 18 and 24 metres. There will be fewer boats and I think we will start to see more boats in the 30 to 35-metre range. They do not need to be a lot bigger, but they need to be more efficient, with better onboard fish handling facilities. There needs to be a real focus on maintaining the quality of the catch.

I can also see more vertical integration and less reliance on wholesale markets occurring in the industry, from catching through to processing, value-adding and sales. None of this will happen overnight, but it will happen.

Safety steps

Some industry peak bodies, fishing businesses and the FRDC are already proactively working with regulators to get the safety message out, but we need more operators and more industry bodies involved Australia-wide.

Initiatives include developing training and safety modules and safety videos, holding safety management system workshops and investigating barriers to adopting a safety culture. These should be seen as the first steps in ongoing safety messaging.

The safety management systems (SMS) introduced to the fishing industry recently may be a new concept for fishers, but these systems are standard practice in many other industries.

Previously a vessel was assessed as safe during an annual survey. In reality, it might only have been safely fitted and equipped on that one day of the year. What about the other 364 days?

A safety management system is about making sure the workplace is safe all year round, with someone specifically designated to be responsible for that system, and a process in place to identify and mitigate risks.

Over time, this new process of continuous safety monitoring will become standard practice. There will also be a generational change in the industry; many younger fishers are already being more proactive in addressing safety.

Old fleet issues

Just as we have a lot of older fishers and skippers, we also have an old fleet; some of our boats are 40 years old. They continue to operate legally, but that is because the safety standards have been 'grandfathered' – the boats are exempt from current safety standards.

We need to address this issue urgently.

Take, for instance, the safety railing around the edge of a boat. Under the old code, the standard height was 800 millimetres. But the average person is now taller than they used to be, and at 800 millimetres the railing acts as a tipping point to help you fall over the side faster. The contemporary height for a safety railing is 1000 millimetres.

Some of these boats end up on the market as 'suitable for recreational fishing' – boats that used to have a licensed skipper and at least an annual survey of safety equipment. To me, it is frightening that relatively unskilled operators can go to sea with family and friends in former commercial fishing boats that do not meet current safety standards.

Legal realities

Many countries are now mandating that crew wear personal flotation devices (PFDs) on deck, and recent coronial inquiries in Australia are also pointing to this.

Just as miners and construction workers wear hard hats and steel-capped boots on-site, fishers should be wearing PFDs.

If the industry does not voluntarily take steps to ensure that crew wear PFDs on deck, regulations will have to be introduced to mandate it, and nobody wants to see more regulations. With the current style and low cost of PFDs there is no excuse not to have them on hand. Fishing boats are workplaces. It is essential that business owners and company directors provide employees with a safe workplace. When people are injured or die, lawsuits are inevitable.

As the industry moves towards a more corporate culture, we will see aquacultural and wild fishery managers deliberate more on safety and the associated legal risks.

Without a doubt, changing the safety culture in the industry is an enormous challenge. Fishing has to lose the tag of being the most unsafe job in Australia. The daredevil culture that rewards those who can work in the biggest seas or the longest hours is not the kind of culture we want to instil.

Change at sea

Having new vessels with fewer but better-trained crew will help improve safety. Though there might not be fully autonomous systems on vessels, there will be more use of autonomous systems, and increased control or monitoring from shore. That is something to look forward to.

The other big issue that I see is the need to reduce greenhouse gas emissions and decarbonise fuels while improving the fuel efficiency of vessels. There is already a push for alternative fuels, including hydrogen and ammonia.

New fuels will bring a whole new set of regulations, new safety structures and skillsets, as well as new boats. I do not think battery power alone is going to be the silver bullet, but maybe a combination of alternative fuels generating electrical power for electric drive systems will be the way of the future.

All this will be difficult to achieve in isolation.

It will take a concerted effort by industry, research agencies and government to create the new systems needed and the incentives to support adoption by industry. This might include reintroducing the government 'bounty' to encourage owners to invest in new vessels and technology.

Energy efficiency is a must to reduce greenhouse gas emissions but also to make fishing businesses more profitable. And, as with safety, it needs to be built into anything we are doing in future. Exciting times ahead! F

> ***"There will be a generational change in the industry; many younger fishers are already being more proactive in addressing safety."***
>
> Stuart Richey, Chairman, AMSA
> Photo: Peter Whyte

The innovation frontier

The latest phase of innovation is one more in the long history of human development that has allowed society to progress as we find easier, more efficient and more productive ways to do things, such as producing food and managing fisheries

By **Peter Horvat**

The evolving technological landscape – or seascape – in which we find ourselves brings with it a mix of exciting potential and disturbing uncertainty, leading many in the fishing and aquaculture sector to continuously assess factors that offer opportunities for advancement or impediments for development and growth.

Impacting on both fishing and aquaculture, for example, are issues around energy, data collection and use, and supply chains and logistics. Then there are human attributes such as training, skills, employment and the consequences for communities to consider. Aquaculture is already dealing with a range of issues, such as feed management and gaining access to locations in order to expand.

Location, location, location ...

In Australia, most of the innovation and growth for aquaculture will come from developing terrestrial operations or venturing into the deep oceans.

There are already a number of land-based aquaculture systems growing species such as abalone, Barramundi, Cobia and prawns. Land-based developments have several advantages over open-water systems, particularly the ability to control (to varying degrees) factors such as temperature and climate variability, biosecurity and feed.

Two technologies well under development that will change the game for land-based aquaculture are recirculating aquaculture systems (RAS) and algae bioreactors. A RAS is a closed, land-based production system. Being closed to the outside environment provides operators with full control over fundamentals such as water quality. The downsides are the intensive energy requirements and, to date, the comparatively small scale of operations.

However, there has been significant investment in efforts to scale up RAS from businesses such as Atlantic Sapphire. It has developed its Bluehouse™ (the water equivalent of a greenhouse) Atlantic Salmon in RAS, with a new project in Miami, Florida, and plans to produce 90,000 tonnes of fish a year at this site.

Algae is another large opportunity for the future. Algal cultivation for human consumption started more than 370 years ago, but stands to become a major food industry in the years ahead.

Food is not the only use algae has been earmarked for. In fact, back in the 1970s, the US Government started a program to produce biodiesel from high lipid-content algae grown in ponds.

And in May this year, astronauts on the International Space Station began testing an innovative algae-powered bioreactor, called a photobioreactor, to assess its feasibility to provide food and oxygen on long-duration space flights. The bioreactor represents a major step towards creating a closed-loop life-support system (Figure 1, page 52).

New investment

The other area where aquaculture can head is to the deep ocean. Australia has the world's third-largest Exclusive Economic Zone (EEZ). While the inshore areas (three nautical miles) have numerous and often competing uses, the EEZ is a 200-nautical-mile band around our coastline. This offshore zone will be the focus for the new Blue Economy Cooperative Research Centre (CRC), which will invest $329 million into ocean aquaculture, infrastructure and renewable energy initiatives. The goal is to develop technologies that couple offshore aquaculture farming with renewable energy systems to support operating in these high-energy marine environments.

Interim CEO of the Blue Economy CRC Darren Cundy says it will be an opportunity for the energy, aquaculture and infrastructure sectors to share their expertise, with mutually beneficial outcomes that support both future food and energy production.

This includes power generation from wind, wave, solar and hydrogen energy. Energy stored as hydrogen might also refuel vessels used to transport seafood products back to shore.

Species being looked at for research and development include salmonids, micro and macroalgae, oysters and Rock Lobsters.

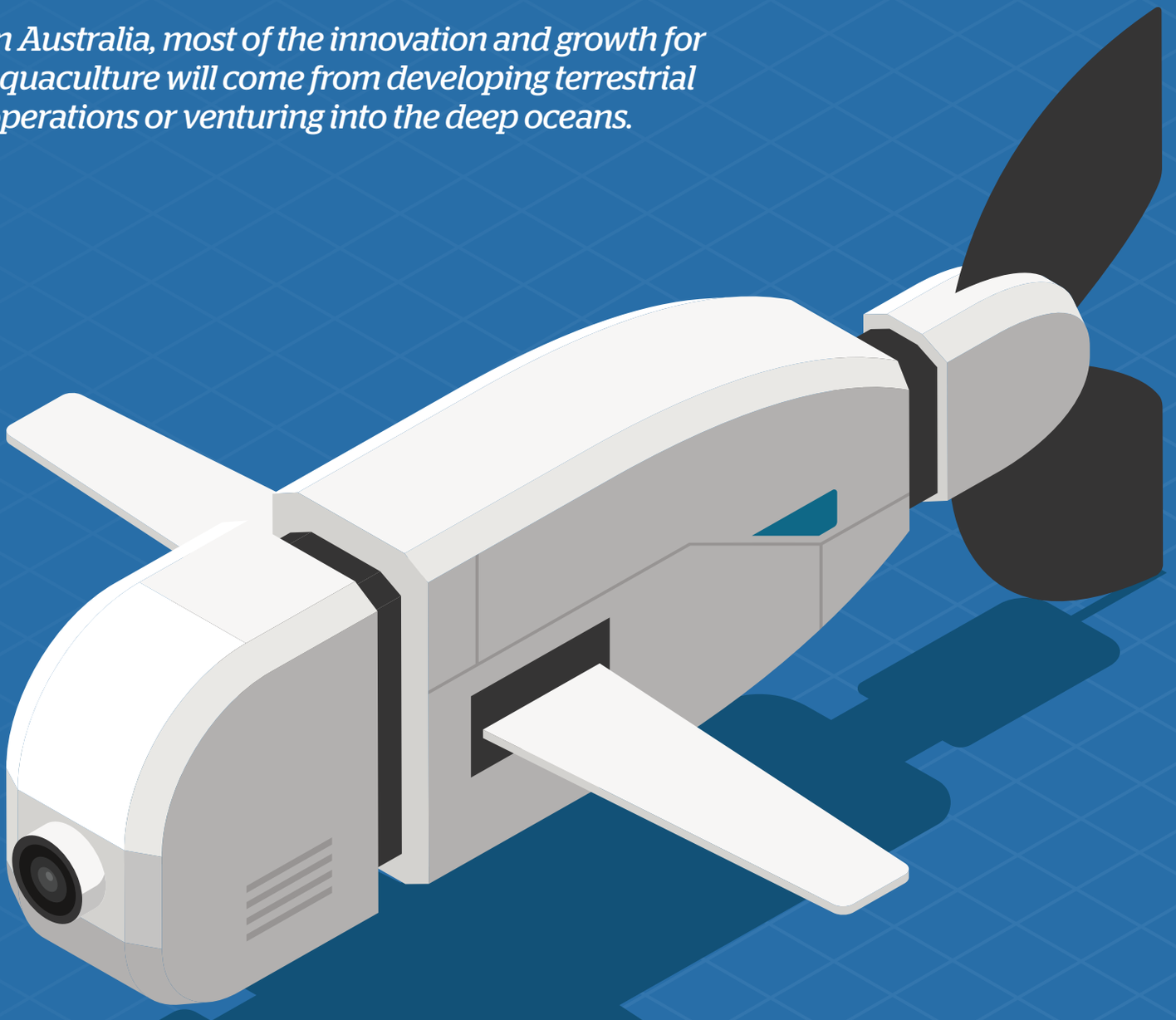
The Blue Economy CRC research programs are due to start in 2020.

The food that needs feeding

With a few exceptions, the single biggest constraint facing the aquaculture industry is feed. This is a major cost and, accordingly, research is focused on reducing feed conversion rates and seeking alternative, more efficient ingredients.

While 'alternative' protein sources may be in competition with human food markets, such as grains and legumes, they nonetheless are seen as replacing fish as an ingredient in aquaculture feeds. For the aquaculture sector, reducing reliance on wild fish stocks for fish farm feed is seen as essential in maintaining the sector's sustainability and social license to operate.

In Australia, most of the innovation and growth for aquaculture will come from developing terrestrial operations or venturing into the deep oceans.



Revolutionary innovation

Agricultural and industrial revolutions have driven a long cycle of innovation and change

- First Agricultural Revolution (10,000 years ago) – included plant and animal domestication.
- First Industrial Revolution (1760–1840) – saw the transition from hand-making products to mass production using machines.
- Second Agricultural Revolution – this followed the Industrial Revolution. Farm machinery, including the steam engine, massively increased agricultural production to feed rapidly expanding urban populations in developed countries.
- Second Industrial Revolution (or Technological Revolution) – introduced global standardisation.
- Third Agricultural Revolution (or Green Revolution) – advanced plant breeding and allied technologies – high-yielding plant varieties, fertilisers and crop protection chemicals, new methods of cultivation – drove a major lift in crop yields.
- Third Industrial (Digital) Revolution – saw the shift from mechanical and analogue electronics to digital electronics. The mass production and widespread use of digital logic, transistors and integrated circuit chips have driven rapid advances in computing, microprocessors, mobile phones, wireless devices and the internet.
- Fourth Industrial Revolution – now underway, is seeing a shift to disruptive and inter-connected technologies such artificial intelligence and machine learning. This will be quite different from the three prior industrial revolutions. It will merge the physical, digital and biological worlds at both the macro and molecular level. Concepts such as virtual reality and cellular computing will be combined with artificial intelligence (software programmed to perform complex tasks and situation analysis far faster than a human). This next revolution will change how we live, work and, potentially, evolve.

Macro and microalgae are also gaining momentum in the fish feed market, with tank-grown algae already an essential feed in hatcheries. Larger-scale opportunities are developing as research reveals more about the nutritional make-up of different algae species and their effects on fish growth. Skretting, for instance, is trialling the plankton, Calanus, in commercial salmon feeds.

Australian researchers have also created an omega-3 canola oil that can replace or supplement limited supplies of fish oil in aquaculture feeds and for human consumption. The canola variety has been developed in collaboration with the CSIRO, the Grains Research and Development Corporation, and Nuseed. Nuseed is commercialising the oil as Aquaterra® for aquaculture, and Nutriterra® for human nutrition.

Power up

Energy and power is a high-cost area for fishing and aquaculture, so it is not surprising there is significant global investment in finding more efficient, lower-cost alternatives; particularly wind, hydrogen and solar.

Just recently, The Council of Australian Governments (COAG) Energy Council released Australia's National Hydrogen Strategy. The strategy was developed by COAG's Hydrogen Working Group, chaired by Alan Finkel, and provides a plan for Australian governments and industry to grow the country's hydrogen sector and turn the resource into a major energy export by 2030.

Hydrogen is very combustible and has several advantages over other alternative fuels; it is the most common element in the universe and is readily available and cheap. So, a likely replacement for combustion engines is fuel cells that use hydrogen.

Solar energy is now the most common alternative energy technology and this will develop even further with anticipated advances in high-capacity batteries. While there are solar-powered, ocean-going research vessels, solar power is expected to be most relevant to aquaculture.

Dynamic data

Our ability to capture industry and operational data is increasing and the most valuable developments in this area are efforts to provide access to data in ways that make it functional.

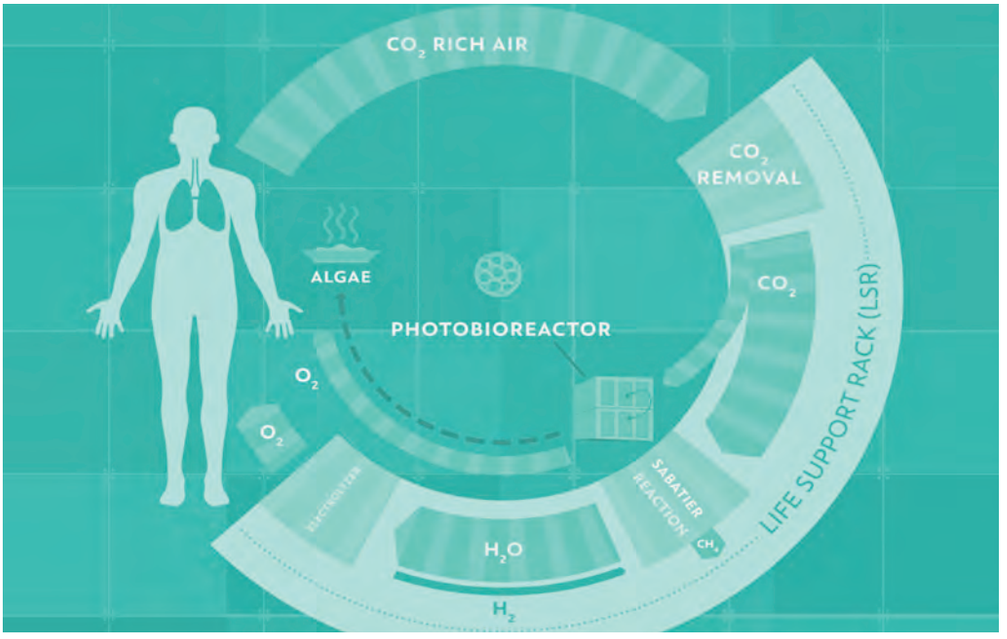


Figure 1 Integration of the photobioreactor into the air treatment system for the International Space Station.
Source: DLR Space Administration, Germany

New tools for fisheries managers and fishers are emerging from ocean and fisheries datasets including real-time EcoCast maps produced by the US National Oceanic and Atmospheric Administration (https://coastwatch.pfeg.noaa.gov/ecocast). At sea, unmanned autonomous vessels such as the Saildrones roam for up to a year, collecting data, tracking fish and reporting on ecosystem variables. By mapping ocean conditions to predict the locations of target fish species, bycatch and protected species, fisheries managers and fishers can more effectively allocate their resources on a day-to-day basis.

Closer to home, the University of Adelaide has led the South Australia Spencer Gulf Ecosystem and Development Initiative. This is integrating complex datasets into predictive modelling that includes shipping, oil and gas interests and biosecurity, along with those pertaining to commercial fishing and marine wildlife, to help streamline resource management decisions.

CSIRO has also developed CONNIE, short for CONNectivity InterfacE, as a visual tool to support timely and cost-effective decision-making. By modelling oceanographic processes, it helps users understand the influence of ocean currents on the breeding of species such as sardines, tuna, lobsters and pearl oysters, and on the spread of pollutants, pathogens and invasive species.

While the above examples focus more on how data can give us information on environmental conditions, another benefit of data is that it enables interconnectivity. For example, datasets and systems can be linked, thus providing greater value than they do in isolation.

The Internet of Things

As technology evolves, more and more systems will become interconnected and provide increases in productivity, as well as new labour requirements. Improvements and innovation in engineering and sensors, combined with machine learning and AI software development, will underpin many of the advances we can expect in the fourth industrial revolution. It is likely these will come from outside fishing and aquaculture, and be adapted.

Supply chain logistics

New technologies and data will not only be applied in production and environmental management. We can also expect to see supply chains streamlined, along with changes to the way the global seafood market operates. Driven by consumer demand, many existing supply chains will be replaced with digital platforms that directly connect suppliers and consumers. This will facilitate faster delivery of higher quality seafood to more people, plus provide data-backed product provenance.

Supporting this is new order tracking technology that incorporates built-in radio frequency identification (RFID) and temperature monitoring tags. These are all being incorporated into blockchain systems that link buyers and sellers into a seamless, secure transactions protocol. F

Briefs

Southern Bluefin Tuna documentary premieres

The world premiere of the Southern Bluefin Tuna documentary *Life on the Line* was held in Melbourne on Wednesday, 6 November 2019. More than 400 people attended the event, which was held at the Melbourne Museum's IMAX theatre, and the documentary also screened free-to-air on Channel 9 during November.

The documentary is part of an FRDC-funded project demonstrating the important role of science and global stewardship in helping populations of the migratory Southern Bluefin Tuna to recover from overfishing. It was produced by influential recreational fishing identity Al McGlashan, and project partners with the FRDC include the Australian Recreational Fishing Foundation, the Australian Fisheries Management Authority and the Tuna Champions program.

The documentary tells the story of how Southern Bluefin Tuna stock was heavily fished throughout its range, internationally, until the mid-1980s. At that point, it became apparent that the stock was at such a low level that global management and conservation was required to ensure its future. The ongoing recovery of the species has been underpinned in part by significant investment in science, especially the ground-breaking close-kin techniques pioneered by CSIRO and supported by the FRDC.

Life on the Line is expected to be available shortly after the national recreational fishing conference in Hobart on **10 to 11 December**.

Little Fish Film Festival

The FRDC will be running an international short film competition for students between the ages of 9 and 13, in conjunction with the World Fisheries Congress in Adelaide from 11 to 15 October 2020.

The competition is a way to focus a global conversation on fisheries and the role they play in the lives of millions of people, and will be open to school students from around the world. Submissions will be accepted from 1 March to 30 June 2020, and the best entries will be screened at the congress.

Key objectives of the competition are to raise awareness of the conference and to increase the younger generation's awareness of aquatic environments and the important role they play in food security, and in economic and cultural wellbeing.

Participants will be asked to make submissions around a number of themes:

- what role do fisheries play in your community? – cultural, economic, food (sustenance);
- the future of seafood; and
- looking after our aquatic world.

The FRDC will be working with partners in Australia and overseas to develop the film competition concept, the judging framework and support materials such as how-to guides. It will also promote the film competition. Organisers are keen to hear from potential sponsors, contributors or anyone who would like to be involved.

More information: http://littlefilms.fish/ or email info@littlefilms.fish

AUSTRALIA'S BEST FISH AND CHIPS

Queensland's Andrew and Renae Tobin have been crowned Australia's best fish and chippers for 2019. After winning the state award, their Townsville-based business, Tobin Fish Tales, took out the national Judges' Choice Take-away Fish and Chips Award at the Seafood Industry Awards in October. The Tobins' focus is on quality fresh seafood; local seafood sources; sustainability; and stories about fish, fishers and fisheries.

Their goal is to provide consumers with seafood from sustainable, primarily local sources, plus information about where the seafood came from, who caught it and how different species are managed.

Andrew and Renae Tobin both have doctorates in fisheries science and more than 40 years of combined experience in fisheries. They are also Reef Guardian Fishers, recognised by the Great Barrier Reef Marine Park Authority.

A full list of winners from each state and territory is available from www.fishandchipsawards.com.au

EASY-OPEN OYSTER TRIAL

A simple wax seal may prove the key to bringing more consumers to the premium eating experience of a freshly shucked oyster.

The FRDC has supported the development of the Easy-Open oyster technology – automated equipment that opens an oyster and quickly reseals it with wax. This keeps the oyster alive, but with the key benefit that it can be opened later with ease.

The need to shuck oysters is the biggest barrier to increasing oyster consumption. This new technology allows consumers to open oysters themselves and experience how they taste freshly shucked. The technology preserves the quality of oysters, making those prepared this way superior to oysters that are offered already opened in a half shell, possibly rinsed of the natural juices that contribute to their fresh flavour.

The process has been patented and the FRDC is now seeking a business willing to commercially trial Easy-Open oysters, helping to refine the technology and assess its potential to increase the sales of fresh oysters.

Automated equipment has been manufactured in New Zealand in preparation for a commercial trial, which is expected to begin within the next two months. Businesses wanting more information or to express interest can contact Len Stephens on 0418 454 726, Lrstephens@bigpond.com.

Final reports

Prawn fisheries: bycatch and fuel efficiency

2017-065

Issues of bycatch and fuel efficiency are of great concern to many stakeholders, including prawn trawl operators, environmental groups, eco-labelling agencies and the general public. Following an initial examination of a risk/gap matrix developed by the Australian Council of Prawn Fisheries, a series of 12 workshops was held at some of the key prawn-trawl ports in Australia. At each, the project's principal investigator and a fishing gear technologist gave presentations summarising information currently available on how to reduce bycatch, habitat impacts and fuel use that has been developed in Australia and other countries. During these workshops, various priority issues and potential solutions were identified for future examination.

As a result of this project, more prawn-trawl fishers are familiar with the latest modifications designed to reduce bycatch and habitat impacts and improve fuel efficiency. There is now a concrete set of agreed issues and potential solutions for fleets in each prawn fishery that fishers, scientists and managers can use as a baseline as they seek to conduct formal trials of modifications. The overall outcome should be bycatch reduction and more fuel-efficient fishing throughout Australia's prawn-trawl fisheries over the next few years.

More information: Steven Kennelly, steve.kennelly@icic.net.au

Fisheries and aquaculture statistics

2018-134

Australian fisheries and aquaculture statistics 2017 is a source of information on commercial industry catches and values, and farm-gate production of aquaculture enterprises. It is used for a wide range of purposes, including determining the Australian Government's financial contributions to fisheries research funding and setting industry levies. It also addresses a wide range of government and industry information needs.

More information: Robert Curtotti, info.abares@agriculture.gov.au

Cultural fisheries in Tasmania

2016-204

This project has been successful in highlighting the barriers to Indigenous participation and engagement in cultural fisheries, specifically the current regulatory and policy frameworks that impede progress towards regional development and the contributions that the cultural economies of Aboriginal Tasmanians can make to Tasmania.

It has identified gaps in knowledge and suggested future research directions that are Indigenous-led and centred upon connections to sea country. The project has also been successful in demonstrating the public interest in cultural fisheries through the trialling of the 'Wave to Plate' concept with commercial partners, and it has resulted in new collaborations with food tourism interests.

More information: Emma Lee, ejlee@swin.edu.au

Teacher kits and resources

2018-213

This project involved developing two teacher kits with lesson plans linked to the Australian Curriculum (suitable for Years 2–6) to support school excursions to the Coffs Harbour Fishermen's Co-operative as an interactive experience with the New South Wales fishing industry.

It also identified existing digital and hard copy teacher and student resources with a seafood, environment and fisheries theme, with the aim of collating resources into one location.

As a result, this project has developed a framework for other teacher kits to be developed for different industry sectors and different states, and has demonstrated that teachers value such resources when provided. It also demonstrated that a significant number of student and teacher resources exist online that relate to fishing and the Australian seafood industry, including the recreational sector. There are now opportunities to house and promote these collated resources on one platform to support teaching the Australian Curriculum with a focus on the industry, the environment and the products.

More information: Emily Mantilla, emily@honeyandfox.com.au

Safety at sea

2018-106

In recent years there have been a number of instances where vessels have been lost causing the deaths of a significant number of fishers. In some cases, the vessels were lost before the crew could activate the vessel's Emergency Positioning Radio Beacon (EPIRB). EPIRB forms the basis for the formal search and rescue (SAR) agencies in Australia, and the absence of an EPIRB signal can significantly diminish the effectiveness of a search and rescue mission. This project examined other electronic platforms typically found on fishing vessels and investigated if these could be incorporated into a process, policy, or procedure which could increase the maritime safety of the Australian fishing fleet.

In analysing these electronic platforms, it was concluded that EPIRB should remain the primary distress signalling platform for Australian fishing vessels. EPIRB signals are monitored globally by dedicated SAR authorities which have the expertise and resources to triage the initial distress signal, and coordinate a SAR mission.

The report also discusses other safety issues such as the development of a safety management system, and other quantitative risk assessment processes, as well as making 14 recommendations to aid in increasing sea safety.

More information: Geoff Diver, geoffdiver@iinet.net.au

Movers and ...

Greg Dyer has been appointed as new CEO of the Sydney Fish Market, succeeding **Bryan Skepper** who has now retired.
Jim Paparo has left his role as trade and international relations manager at the Western Australian Department of Primary Industries and Regional Development.
Delahay Miller has been appointed manager for Aboriginal traditional fishing at Primary Industries and Regions South Australia's Fisheries and Aquaculture division, a position formerly held by **Shane Holland**.
Paul Beeson has been appointed as executive officer for the Aquaculture Council of Western Australia.
George Day has moved from Australian Fisheries Management Authority (AFMA) to the Department of Agriculture and has accepted the role as director of the Southern Bluefin Tuna Taskforce. Replacing him as the senior manager of demersal and midwater fisheries at AFMA is **Fiona Hill.**
Sean Sloan has been appointed as deputy director general of Fisheries, New South Wales Department of Primary Industries.

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Elizabeth Howie,
02 6285 0416,
Elisabeth.Howie
@frdc.com.au

Calendar of events

DATE	EVENT	MORE INFORMATION
2019		
10–11 December	**National Recreational Fishing Conference**, Tasmania	www.arff.net.au/nrfc
28 December	**Oysters in the Vines Seafood and Wine Festival**, Port Macquarie NSW	https://portmacquarieinfo.com.au/whats-on/events/oysters-in-the-vines
30–31 December	**International Conference on Marine Ecology, Biodiversity and Pollution**, France	https://waset.org/marine-ecology-biodiversity-and-pollution-conference-in-december-2019-in-paris#
2020		
11 January	**Portarlington Mussel Festival**, Portarlington Victoria	www.portmusselfestival.com
12 January	**Cape Jaffa Seafood and Wine Fest**, Cape Jaffa SA	www.capejaffafest.com
25–26 January	**Hooked on Portland**, Portland Victoria	www.facebook.com/hookedonportland
26 January	**Kilcunda Lobster Festival**, Kilcunda Victoria	https://kcda.weebly.com/lobster-festival.html
2 February	**World Wetlands Day 2020**	
7–9 February	**India International Seafood Show 2020,** India	www.indianseafoodexpo.com
9–11 February	**Fish International 2020**, Germany	https://fishinternational.de/en
9–12 February	**Aquaculture America 2020**, Hawaii	www.marevent.com/AA2020_HONOLULU.html
11 February	**International Day of Women and Girls in Science 2020**	
14–16 February	**Apollo Bay Seafood Festival**, Apollo Bay Victoria	www.apollobayseafoodfestival.com
16–21 February	**Ocean Sciences Meeting 2020**, USA	www.agu.org/ocean-sciences-meeting
19–20 February	**AquaFarm 2020**, Italy	www.aquafarm.show/en
27–28 February	**International Conference on Fisheries and Aquatic Sciences**, Sydney NSW	https://waset.org/fisheries-and-aquatic-sciences-conference-in-february-2020-in-sydney
3–4 March	**ABARES Outlook 2020 conference**, Canberra	www.agriculture.gov.au/abares/outlook
9–15 March	**Sustainable Seafood Week Australia 2020**	
14–15 March	**Mandurah Crab Fest,** Mandurah WA	www.crabfest.com.au
15–17 March	**Seafood Expo North America,** USA	www.seafoodexpo.com/north-america
16–17 March	**International Conference on Aquaculture 2020**, Thailand	https://aemconferences.com/aqua
24 March	**Aquafeed Horizons Asia 2020**, Thailand	http://feedconferences.com

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