

# Fisheries

## Newsletter



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SPC  
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Regional  
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articles



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## Name that beche-de-mer! Toolkit to aid recognition of different species

*Sea cucumbers are soft-bodied marine invertebrates that live on the seafloor which, as the name suggests, resemble cucumbers. There are over 1000 different species in the world, of which around 30 are of commercial value in the Pacific region. So, how can we tell them apart?*



Dried and processed sea cucumbers are called beche-de-mer. Can you tell the different species apart? Image: © SPC

### A critical role

Ecologically, sea cucumbers play a critical role in physical and chemical processes of ecosystems such as nutrient recycling and cleaning sediment and sand. Economically, they are also highly valuable as the processed form – beche-de-mer – is exported, mainly to Asia, as a popular seafood delicacy. Protecting them is therefore of vital importance to maintain healthy ecosystems and for the livelihood of many coastal communities in the Pacific. Being able to identify those species most at risk of over-exploitation is an essential step towards their protection. The Pacific Community (SPC) has produced a [toolkit](#),<sup>1</sup> gathering existing or newly developed resources for training and raising awareness, to support the management and conservation of the species.

### CITES protected

In 2021, the [Convention on International Trade in Endangered Species of Wild Fauna and Flora](#)<sup>2</sup> (CITES) added two

of the highest value sea cucumber species (*Holothuria whitmaei* and *Holothuria fuscogilva* – commonly known as black teatfish and white teatfish) to its Appendix 2 list, which means that exporting countries are now required to prove that these species are fished in a sustainable way, otherwise exporting them is prohibited. To do this, a “non-detriment finding” must be rendered by a state scientific authority, which bases its opinion on the best available information that allows it to assess the risks. This information includes the state of the stocks, the recruitment rate of the species, current management measures, and the strength of control capacities. This latter point translates to the ability of key people to identify sea cucumbers in their natural habitats, or the processed beche-de-mer, and it is for this purpose that the training and video tutorials have been developed.

Identifying these species is necessary for any monitoring authority and for the fishers themselves. However, recognising the species might be tricky to the untrained eye, but even to those familiar with sea cucumbers and beche-de-mer.

<sup>1</sup> [https://www.spc.int/DigitalLibrary/FAME/Collection/Toolkit\\_Sea\\_cucumbers](https://www.spc.int/DigitalLibrary/FAME/Collection/Toolkit_Sea_cucumbers)

<sup>2</sup> <https://cites.org/>



## Recognising key species

The electronic toolkit, available in English and French, contains short awareness videos; training videos, identification cards; posters, and information leaflets. Alongside the on-line and in-person training sessions, it provides a reference point for species identification. This is especially important for the CITES-listed species as well as for other highly exploited species.

This toolkit offers guidance to fishing communities and interested parties, such as fisheries extension officers, monitoring, control and surveillance officers, or customs officers, who need to be able to recognise the key species. Where there may be ambiguity in visual identification, as some species can be difficult to distinguish from others both in the live and processed form, explicit visual and audio descriptions aid the user in telling them apart. For example, at a market or at border controls, how could you distinguish the CITES protected species, black teatfish and white teatfish (*Holothuria whitmaei* and *Holothuria fuscogilva*), from other species, and from each other?

Below are stills from the identification videos that detail how to identify different species:



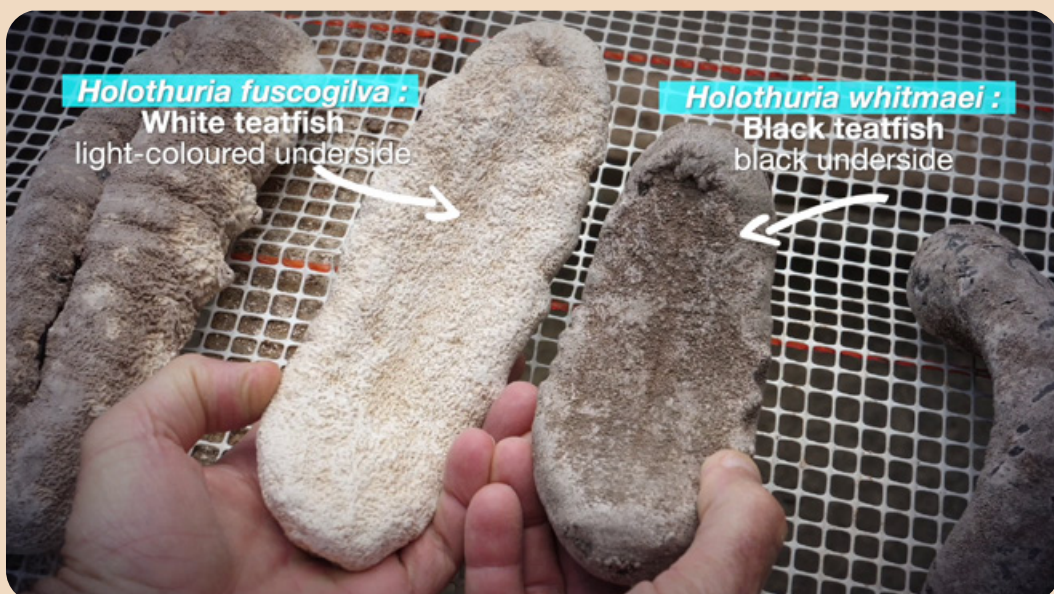
During processing, sea cucumbers are cut open and gutted, salted and cooked in several drying or smoking stages, until they become dry and as hard as rocks. They shrink a great deal and can lose up to 90% of their weight. *Holothuria whitmaei* and *H. fuscogilva* are the only ones cut open on their backs. Other species are cut open on their undersides. If you see a dorsal incision: bingo, that is probably a *H. whitmaei* or *H. fuscogilva*.





*H. fuscogilva* and *H. whitmaei* have “teats” on the margins of their underside (this is why they are called “teatfish”). These teats remain visible, even when the specimen is dry.

A glance at the colour will allow you to distinguish *H. whitmaei* from *H. fuscogilva*: *H. fuscogilva* has a light-coloured underside, unlike the *H. whitmaei*.





And what about *Holothuria scabra* (commonly called sandfish) and *Holothuria lessona* (the golden sandfish)?

These are the only species that must be cleaned of their chalky covering to be marketed. Once that layer has been removed, they become translucent. Our tip: use a torch/flashlight to check. With *H. lessona* and *H. scabra*, the light will shine through. With other species, such as the look-alike *Actinopyga palauensis*, for example, the beche-de-mer stays opaque.



To tell them apart, *H. lessona* has an almost smooth body, whereas *H. scabra* is markedly wrinkled. *H. scabra* is also generally smaller than *H. lessona*.



## There's an app for that

Once users feel confident enough to test their identification skills, they can visit the sea cucumber module in the web applications developed by SPC's Coastal Fisheries Programme.<sup>1</sup> The module uses pictures and multiple-choice type questions with three different skill levels available – beginner, advanced and expert. A score is given at the end of each session, enabling users to see how well or how poorly they perform with sea cucumber identification.

In addition to the online toolkit, training sessions in New Caledonia within the framework of the PROTEGE project,<sup>2</sup> have been delivered jointly between SPC's FAME division and Climate Change and Environmental Sustainability (CCES) programme. Further sessions will be developed for the region in the coming months.

## Acknowledgements

The authors would like to thank Wigrial Mouzin, professional fisher of sea cucumbers, who organised the training sessions in New Caledonia and assisted the Pacific Community with the production of the training videos.

The information tools in the toolkit were developed in collaboration with many partners, thanks to support from the European Union, the Government of Sweden, the New Zealand Aid Programme, the PEUMP programme, and the PROTEGE project. Their contents are the sole responsibility of the Pacific Community and do not necessarily reflect the views of the European Union, the Government of New Zealand or the Government of Sweden.

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Access the toolkit

[https://www.spc.int/DigitalLibrary/FAME/Collection/Toolkit\\_Sea\\_cucumbers](https://www.spc.int/DigitalLibrary/FAME/Collection/Toolkit_Sea_cucumbers)



Test your identification skills – register to use this handy app: <https://www.spc.int/CoastalFisheries/LearnFishID/Trainee>

<sup>3</sup> <https://www.spc.int/CoastalFisheries/LearnFishID/Trainee>

<sup>4</sup> <https://protege.spc.int/>



## Guardians of the Pacific: community fishers promote sustainable practices

*The Pacific Community (SPC) has launched a series of 17 videos featuring a range of community champions from eight countries and territories across the Pacific region. The entertaining and educational “Guardians of the Pacific” series is now available via local television stations, social media platforms, and outreach events to raise awareness of sustainable fisheries practices.*

### Raising the voices of Pacific fishers

2022 has been declared the International Year for Artisanal Fisheries and Aquaculture by the Food and Agriculture Organization (FAO) of the United Nations in recognition of the work and rights of small-scale fishers, women, fish farmers and fish workers who feed entire families and communities. To mark the occasion in the Pacific, SPC produced the “Guardians of the Pacific” series as an information and education toolkit, to highlight the vital role that fishers play in protecting local marine resources. This resource was produced under the governance of the Effective Coastal Fisheries Management Project,<sup>1</sup> the Pacific-European Union Marine Partnership (PEUMP) programme,<sup>2</sup> and the Pacific Territories Regional Project for Sustainable Ecosystem Management (PROTEGE)<sup>3</sup> in collaboration with FAO.

Across the Pacific region, communities depend on marine resources for their livelihoods, cultural heritage and wellbeing. However, coastal resources are under increasing threat from overfishing, climate change and additional pressures such as increasing population. Fishers from the Cook Islands, French Polynesia, Kiribati, New Caledonia, Papua New Guinea, Samoa, Tonga, and Wallis and Futuna

were approached to share the solutions and initiatives they have put in place to sustain the marine resources they rely on. Through their testimonies, these community champions prove that they are the real supporters and role models of the balanced management of marine resources. The actions they initiate or implement together with government agencies are a key part of the solution.

### Promoting sustainable fishing practices

Beyond raising fishers’ voices, this series of three-minute videos and photo essays showcase best fishing practices and highlight fishers as custodians of their marine resources. Each episode looks at the lives of a different fisher talking about the challenges they face and the practices that are working in their village, including the implementation of seasonal fishing closures during spawning periods, the restoration of corals, the establishment of locally managed marine areas, and the importance of respecting fish size limits to allow time for them to reproduce.

### Sharing messages of hope and authenticity

Filming each of the 17 portraits across eight countries during the COVID crisis and travel restrictions was a real chal-



“The village banned fishing of goatfish every spawning season to regain the health of its marine resources.”

Orea Terieta | Kiribati

Videographer and photographer: James Karinkao

<sup>1</sup> The Effective Coastal Fisheries Management Project is funded by the New Zealand Aid Programme.

<sup>2</sup> The PEUMP programme is funded by the European Union and the Government of Sweden.

<sup>3</sup> PROTEGE is funded by the European Union.





Jane  
Papua New Guinea

Iguar  
Papua New Guinea

William  
Papua New Guinea



Marie Renée  
New Caledonia

Marthe  
Papua New Guinea

Kirimaua  
Kiribati



Falakiko  
Futuna Island

Djelma Arutai  
French Polynesia



Malia  
Tonga

Billy  
Papua New Guinea



Tabwena  
Kiribati

Berny  
Cook Islands



Orea  
Kiribati

© James Karinkao, Kalolaine Fainu, Johnny Beasley, Judith Rostain, Sia Angilau and Joshua Saviet





"By only taking regular-sized mantis shrimp without taking the undersized one's this will help to maintain its numbers."

Kirimaua Tekaribwa | Kiribati



Videographer and photographer: James Karinkao



"(We set up) a taboo or no-take area to allow the crabs to breed and repopulate the other mangrove areas with mud crabs."

Billy Jonah and Martha | Papua New Guinea



Videographer and photographer: Kalolaine Fainu



"We leave the small ones (sea cucumbers) so they can grow; later on, we'll collect them."

William Vokais | Papua New Guinea



Videographer and photographer: Kalolaine Fainu





Guardians  
of the Pacific

"For me, sustainable fishing means only taking what you need."

Bermy Ariihee | Cook Islands



Videographer and photographer: Johnny Beasley



"You can't come and fish without permission because that's all our futures to look after... For the next generation."

Anzac Day Aliielua | Samoa



Videographer and photographer: Tarx Morrison



"Our elders have always taught us to respect the sea. You have to do this job of fishing with your heart."

Marie-Renée Pabouty | New Caledonia



Videographer and photographer: Judith Rostain





lenge. The coordination of the series was made possible by a talented network of local Pacific Island-based videographers, supported by the team from Flinch Marketing based in Wellington, New Zealand.

So far, several episodes have been released online with over 500,000 views. Many of the online comments show just how much these stories resonate with viewers who share many of the same challenges in supporting the sustainable management of their local marine resources. In a post-COVID-19 world, the series' messages of hope and authenticity, paired with beautiful imagery, help people connect with those in the Pacific, understand the value of traditional fishing practices and build greater awareness of the importance of sustainable fisheries management and protection of the Pacific Ocean.

To capture truly authentic and engaging stories it was crucial that each of the fishers' stories was brought to life by local filmmakers and photographers who share an understanding of the connections between the local communities and their coastal environment. Each of the fishers was selected after consultation with government agencies, local networks and development partners. The videographers then went into the field to interview the selected champions and film their fishing activities.

From Papua New Guinea, Kalolaine Fainu, captured five profiles with an array of beautiful camera shots including mangroves, market days and mud crabs. In Kiribati, Kari-nako James travelled to the village of Buariki to film and interview four fishers who set up a seasonal ban during the spawning season of goatfish. Among them, we discovered how fishing for sea worms provides livelihoods for Tabwena and her family. In Tonga, Sia Angilau and Joshua Saviet profiled volunteer Malia Peata Sioko Noa. A leader in her community, Malia is the only woman in her village of Kolonga to sit on the fisheries management committee and loves helping older fishers. And these are just nine of the 17 stories told in the "Guardians of the Pacific" series.

The success of the series was based on the desire to tell genuine and personal stories that were driven by the voice of each fisher. The idea behind this was to give the audience a sense of the fishers' world and highlight their connection to the

ocean and environment as a source of sustenance and livelihood. We looked at each episode as a short film – each with a clear structure – and ensured that the trajectory of each story was led by the fisher's own words. The series highlights the unique, efficient systems of Pacific communities, where there is strong reliance on one another for their livelihoods, and a mutual alliance with the ocean. At a visual level, our main goal was to help the audience feel as if they were there with each fisher, walking through the water and the mangroves, experiencing the magnificent beauty, isolation and intimate connection between each fisher and the marine environment on which they and their communities rely.

## A multi-channel dissemination

The series of videos is now available for fisheries authorities and local networks to air on local television stations, or during community workshops and will be soon adapted into photo exhibitions as an awareness raising tool.

## Link for Guardians of the Pacific:

 [YouTube playlist](#)

Do you want to have the videos files for your workshops or awareness activities? Please send an email to SPC.

The contents of the videos are the sole responsibility of the Pacific Community and do not necessarily reflect the views of the Government of New Zealand, the European Union or the Government of Sweden.

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## Practising what you teach: field-based training with SPC's e-data systems

*Bringing back the personal touch is important when following up online training. Scientists from the Pacific Community (SPC) develop e-data systems to be relevant to member's specific needs, and how better to get to know these individual requirements than in person? SPC's coastal fisheries scientists paid a visit to the Ministry of Fisheries in Fiji to fine-tune their e-data system approach.*

SPC's Coastal Fisheries and Aquaculture Programme (CFAP) has developed a web-based e-data system with an accompanying app, Ikasavea.<sup>1</sup> This system is being introduced to Pacific Island countries and territories (PICTs) to enable them to transition from paper to electronic-based monitoring of their coastal fisheries. Use of the e-data system will also enable standardisation of data collection between relevant divisions within member countries. SPC staff visited Fiji in July 2022 to provide training to the Inshore Fisheries Management Division (IFMD) and Research and Development Division (RADD) teams within the Ministry of Fisheries (MoF), in the use of the e-data systems for market and creel surveys.

Before travelling to countries, the science and database team within CFAP works collaboratively with members to ensure development and application of the e-data system remains relevant to their needs. Online training was provided to MoF prior to our arrival, via one-week virtual workshops in 2020 and 2021. These workshops provided the foundational knowledge needed to undertake market and creel surveys using the e-data systems. Topics covered included invertebrate and finfish identification, fish market and creel survey methods, use of the Ikasavea app for data collection, and use of the web-based portal for data management.

While virtual training works well for introducing the system and providing familiarity with the app and associated tools, there is always a need to work face-to-face with members as they learn where and how to best apply the new system. Fiji has a complex coastal fisheries environment with markets and landing sites of varying size and activity levels. This means there is no one-size-fits-all approach with sampling protocols and so, in-person visits by SPC staff with MoF staff are required. Working together in-country has enabled trainers and trainees to think about how existing survey methods for assessing landing sites and markets can be adjusted so that they fit with the new e-data system approach.

After completing the training, which included two weeks in the field with IFMD and one week with RADD, both teams were comfortable in using Ikasavea and the web applications for market and creel surveys. The online training, followed closely by in-person visits, have given RADD and IFMD staff a much-improved understanding of, and practical skills for, what is needed to carry out effective market and landing surveys using the e-data systems. In addition, the teams have acquired knowledge on appropriate measurement protocols for the various non-standard commodities sold at the markets and/or landed by fishers/collectors. These commodities, which can include clam shell meat, piles of bivalves or



Mixed invertebrate commodities including mud crabs (*Qan*) and *Polinices flemingianus*, or moon snails (*Drevela*), being sold at Suva fish markets. Image: © SPC

<sup>1</sup> <https://www.spc.int/CoastalFisheries/FieldSurveys/MktSurvey>



gastropods, and plates of algae, are a poorly reported but fundamental component of fisheries catches.

Online training followed by in-country support is only the first step in what will be an ongoing relationship between SPC and Fiji's MoF. Further hands-on training, advice and support will be necessary as MoF makes the necessary adjustments to transition their various monitoring programmes from paper to online. Future training activities will focus on analysis and reporting within the e-data system.

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Large berried female *Panulirus ornatus* (ornate rock lobster) sold at Suva Fish markets Fiji. Image: © SPC



RADD staff undergoing training in measurement protocols using a mock practical market setup at Ministry of Fisheries Research Station – Lami. Image: © SPC



IFMD staff (left) underwent training previously and are now assisting as trainers for RADD staff (right) in correct data entry using Ikasavea application on the tablet. Image: © SPC



Mixed invertebrate commodities including giant clam meat and whole trochus being sold at Suva fish markets. Image: © SPC



## AMPLE: A “Shiny” new approach to capacity building for Pacific tuna harvest strategies

Capacity building is an important component of the work performed by SPC. The FAME division alone has delivered training to over 4000 people since 2016. However, there is no single best way of capacity building. It depends very much on the target audience, the subject matter, and of course on the individual, as people learn in different ways.

A common method of capacity building is the ever-present PowerPoint presentation. Although slideshow presentations can be informative, their static nature can make them unsuitable for technical subjects. While there are ways to make them more engaging, after two years of online workshops, many of us are experiencing PowerPoint fatigue!

A more interesting alternative is the use of interactive tools. By giving people the opportunity to be more hands-on in their learning using interactive tools, a subject can come alive allowing the audience to really get to grips with the subject matter. This has been the approach taken by members of the FAME Stock Assessment and Management (SAM) team; they have developed several applications, called AMPLE, to support capacity building for developing harvest strategies for the region’s tuna stocks.

The Western and Central Pacific Fisheries Commission (WCPFC) has agreed to a workplan for adopting a harvest strategy approach for the four main tuna stocks. A harvest strategy is a formalised framework for fisheries management that provides the best chance of achieving management objectives, both for the fishery and the fish stock. It represents a best-practice approach for fisheries management as well being an important consideration for Marine Stewardship Council certification.

The development of a harvest strategy is driven by fishery managers and stakeholders who are required to make a range of informed decisions during the development process. The WCPFC harvest strategy development work is being carried out by SPC along with the Pacific Islands Forum Fisheries Agency (FFA). Capacity building and stakeholder engagement has focused on the delivery of national workshops around the region. So far, 15 of these workshops have been conducted, including in Fiji, Kiribati, Palau, Papua New Guinea, Solomon Islands, and Tonga.

Central to a harvest strategy is a management procedure that sets fishing opportunities, such as effort or catch lim-



Participants at a workshop in Tonga using performance indicators to compare and select different harvest control rules. Image: © SPC



Getting to grips with uncertainty in the long-term performance of a harvest control rule.  
Image: © SPC

its, using an estimate of stock status, such as the current biomass. A management procedure has three components: data collection, a stock status estimation method, and a pre-agreed rule known as a harvest control rule (HCR). Agreeing the management procedure is a key step on the road to developing a harvest strategy.

Harvest strategies are new to the region, and they may be unfamiliar to many people. Many of the components of a harvest strategy present challenges for capacity building. In particular, HCRs can be difficult to explain. Yes, it is possible to describe them using PowerPoint presentations, but these do not capture their dynamic nature. As an alternative, SPC has developed three different interactive apps that explain how HCRs work.

These apps include several novel features that make them particularly suitable for participants with no pre-existing knowledge of HCRs. For example, they include a very gentle introduction to how HCRs work that allows users to go step-by-step through the HCR process. There is also a basic introduction to the impact of uncertainty on the performance of an HCR that allows users to run individual stochastic simulations that, taken together, can be used to measure performance.

The apps are intended solely for training purposes and for facilitating discussions around the decision-making process for Pacific tuna harvest strategies. They are not tools for developing the HCRs that will be adopted across the WCPO, but tools for capacity building and communication so that stakeholders can actively participate in the harvest strategy development process.

During the capacity building workshops, these apps have proved to be a popular and successful platform for learning. Using them for group activities and competitions helped to invigorate workshops and stimulated lively and constructive discussions. This was particularly the case during recent times, when travel was restricted by the COVID pandemic, and all workshops were conducted online. By sharing their screen showing the app, participants could be guided by the trainers, making the workshops more interactive.

The apps are hosted online which means that they are accessible to everyone. Instructions and short tutorials are available through the apps:

- Introduction to HCRs (<https://ofp-sam.shinyapps.io/AMPLE-intro-hcr/>)
- Measuring performance (<https://ofp-sam.shinyapps.io/AMPLE-measuring-performance/>)
- Comparing performance (<https://ofp-sam.shinyapps.io/AMPLE-comparing-performance/>)

If you are interested in the technical background, the apps were built using R and the Shiny package. They are available as a package (AMPLE) from the Comprehensive R Archive Network, or CRAN. The apps were also recently published in a peer-reviewed journal.<sup>1</sup>

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<sup>1</sup> <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0269543>



## Hitting the spot! Behind the scenes of the PIMPLE training videos

PIMPLE, not a pretty name but a memorable one, stands for Performance Indicators and Management Procedures Explorer. This app has been developed by the Fisheries, Aquaculture and Marine Ecosystems Division of the Pacific Community to support the harvest strategy decision making process, with new training videos now available to help users.

The Western and Central Pacific Fisheries Commission has agreed to a workplan for adopting a harvest strategy approach for the four main tuna stocks. A harvest strategy is a formalised framework for fisheries management that provides the best chance of achieving management objectives, both for the fishery and the fish stock. It represents a best-practice approach for fisheries management as well being an important consideration for Marine Stewardship Council certification.

Central to a harvest strategy is a management procedure that sets fishing opportunities, such as effort or catch limits, using an estimate of stock status, such as the current biomass. A management procedure has three components: data collection, a stock status estimation method, and a pre-agreed rule known as a harvest control rule (HCR). Agreeing the management procedure is a key step on the road to developing a harvest strategy.

This requires members to interrogate the results of the computer simulations performed by SPC's Oceanic Fisheries Programme's Stock Assessment and Management Team (OFP SAM), investigate the resulting performance indicators for each management procedure, and identify which of the candidate management procedures they prefer. This is not a trivial task given the large amount of information that is produced!

To support this process, an online tool, called PIMPLE,<sup>1</sup> has been developed by OFP SAM that allows users to explore the simulation results for skipjack in the WCPO. To help members use this tool, two training videos have been produced. The first video takes users on a tour of the app and explains some of the many features. The second video is a demonstration of how PIMPLE can be used to help select preferred management procedures.

The videos see the return of established (fisheries) film star Marino-O-Te-Au Wichman, last seen in the harvest strategy video.<sup>2</sup> They also introduce the rising talent of Ludwig Kumoru, who surely has a glittering acting career ahead of him.

Less frantic in nature than the previous harvest strategy film, the videos produced their own challenges, mainly how to make a potentially dry subject, such as an instructional video for an online tool, engaging for the viewer. The so-



PIMPLE allows users to explore simulation results to help select the preferred management procedure.

<sup>1</sup> <https://ofp-sam.shinyapps.io/PIMPLE2022/>

<sup>2</sup> <https://www.youtube.com/watch?v=zM3B9DLmtZg&list=PLCq-WnF3HdriCtkevYvru-OciMOxD4oZn&index=3>



## • SPC activities •

lution was to stage it as a conversation between users, with one asking the questions and the other providing guidance. This emphasises the human element of the harvest strategy development process. Stakeholders and members make all the key decisions! Hopefully, the result will be informative to viewers but still entertaining to watch.

Silver screen veteran Marino said of the film: “The harvest strategy videos have been a great learning tool both for

myself and our target audience. I’ve enjoyed tackling these difficult and technical concepts and trying to convey them to fisheries folks in a fun but serious manner. The Monitoring Strategy Evaluation team have been great in delivering a solid script and our seasoned film director, Brian, has used some cool filming techniques that have produced a high-quality product. The hours have been gruelling where my best has always been demanded. But I remind myself that it is anything for the members! I hope you enjoy this video because we enjoyed filming it.”



Marino explains the PIMPLE app to Ludwig, who has many questions.  
Image: © SPC



The final films are available here:

<https://www.youtube.com/playlist?list=PLCq-WnF-3HdrjCtkevYvru-OeiMOxD4oZn>

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The stars, Ludwig and Marino, getting made-up for the bright lights. © SPC





## Leadership programme “changed everything for me”

### Pacific Fisheries Leadership Programme supporting successful women in fisheries

*The Pacific Fisheries Leadership Programme (PFLP), launched in 2018 by the New Zealand Government aims to address the complex challenges facing the region’s fisheries sector. The programme works to strengthen the leadership capabilities and capacities of emerging leaders in the sector, with 237 Pacific Islanders – half of them women – some starting and some continuing their leadership journeys through the programme.*



Pacific Fisheries Leadership Programme participant, Lorian Finau-Groves - Principal Fisheries Officer for the Fisheries Division Competent Authority under the Ministry of Agriculture and Fisheries in Samoa. Image: © SPC

Lorian Finau-Groves, newly appointed as a Principal Fisheries Officer for the Fisheries Division Competent Authority under the Ministry of Agriculture and Fisheries in Samoa, figured this was the perfect time to enrol on the Pacific Fisheries Leadership Programme. Encouraged by her supervisor, she seized the opportunity to hone her leadership skills.

PFLP offers a unique, customised programme for current and emerging Pacific fisheries leaders to develop additional skills and tools to support the mobilisation of change on national and regional fisheries priorities. Participants engage in a suite of courses including Inclusive Strategic Leadership, Leading and Managing People and Leadership for Change, contextualised mini-workshops, and personalised coaching support to enhance learning.

The people-centred approach enables participants to explore their own style of leadership and how they can strengthen their skillset. “It changed everything for me; it opened my eyes to new ways of seeing and understanding what

leadership is,” says Lorian. “It was a whole new mindset; I had never previously thought about how far I could go or the significant roles of women working in fisheries. I am in a leadership role now and the course offered guidance that can only help me go up from here.”

The courses are intended to enhance participants’ capacities to confront challenges across organisational and regional boundaries through the application of analytical tools to address the complexity of change in social systems. The participants learn and develop strategies for effective intervention in challenges they currently face. “The course helped me to understand myself better and to understand my colleagues and how they work,” Lorian explains. “It enabled me to be more sensitive but also to lead effectively. I learned different ways of leading and building a team that works well together. Now we do better planning, set realistic goals, and communicate clearly and openly. The programme gave me many tools that I continue to use every day.”

The Pacific Community (SPC) estimates that women carry out 50 per cent of traditional fishing activities that are crucial to Pacific livelihoods, much higher than the international average,<sup>1</sup> yet their contributions to the fisheries sector is largely undocumented and therefore not recognised. Despite their critical role in this sector, women in Pacific fisheries still face major obstacles when it comes to decision-making, career advancement and access to finance.

This sentiment is echoed by other women who have participated in PFLP. For example, one female participant was facing challenges in managing her team, including men who are older than her, adding further complexities and cultural considerations. At times she felt undermined and invisible. Navigating cultural values in this context is challenging and participants have noted the frameworks and support provided by PFLP as valuable. PFLP provides a culturally sensitive approach to these issues and one participant noted that it was very different to other leadership programmes in this respect. “After undertaking the Leadership for Change course, I learned tools and techniques to better understand and manage the team dynamics. I felt more confident and was able to build trusting working relationships with my team.”

Lorian acknowledges how things have changed for her: “Many years ago, Samoa Fisheries used to be male-dominated, where people would say ‘only men fish and men do the fieldwork.’ But now, with acknowledgement of equal opportunities, everyone appreciates having women on board. There are a great number of us women now working in Samoa Fisheries, with a perfect balance of males and females. I’ve had the chance to go on a boat deploying FADS with other female colleagues, and to participate in surveillance programmes on-board patrol boats. We are breaking down the old stereotypes that only men can do this job, and fisheries women are now being acknowledged and respected. It is indeed a great change for Samoa Fisheries.”

In interviews with other women participants, the impact of PFLP on their lives and careers appears to be particularly significant with the women telling stories of major positive changes in their lives after doing PFLP courses. Many of the women interviewed attributed their work promotions as well as their ability to make real change in their workplaces (using their newly acquired leadership skills and tools) to their participation in PFLP. The impact on their confidence and their ability to speak up in the workplace and in their communities is impressive and a major change for all the women interviewed. As a successful course attendee, Lorian gives it a positive review and recommendation. “The coaching was a delightful and unique part of the programme. It was good to have someone looking out for me, checking in on me, supporting me, and saying, ‘you can do this!’ Everyone out there needs to do this programme.”

The Pacific Fisheries Leadership Programme is managed by a consortium, led by the Pacific Community (SPC), with the Pacific Islands Forum Fisheries Agency (FFA), the University of Queensland Business School and CLA Consulting. To date, participants have come from 16 Pacific Island countries and territories and a total of three different courses and 10 mini workshops have been delivered. The first course to be delivered face-to-face since the COVID-19 lockdowns, Leadership for Change, will be held in Fiji in November 2022.

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<sup>1</sup> <https://www.spc.int/updates/news/2020/03/new-report-highlights-womens-invisible-roles-in-the-pacifics-fisheries-sector>



# The importance of social science to implement good governance principles in community-based fisheries management

The Pacific region is characterised by vast expanses of ocean with thousands of islands, some of them very remote. Pacific peoples have a close relationship and intimate knowledge of the sea, and for thousands of years they established traditional ways of managing their resources. Western colonisation changed this by establishing centralised laws and regulations to control fisheries, with limited enforcement capability. Govan (2015) highlights that most government agencies do not have enough personnel nor funds to control fisheries, particularly in the more remote areas. A shift from mostly subsistence fishing to an increasing commercialisation, in addition to non-fisheries threats, has further influenced the decline of fisheries resources and their habitats. Since the 1990s, community-based fisheries management (CBFM)<sup>1</sup> initiatives, where communities have a lead role, have significantly increased. Considering the success of some of these initiatives, Pacific Island countries and territories (PICTs) have endorsed the *Pacific Framework for Action on Scaling up Community-based Fisheries Management*. This regional framework aims to move beyond working with a few communities to developing systems that provide adequate support to a significant proportion of communities (Pacific Community 2021).

To facilitate the implementation of such a framework, it is important to ensure that governance regimes are adequate to support the management of common resources. The term governance has substantially increased in the literature in recent years, but its definition remains hazy and is sometimes confused with management. Management refers to the process of putting together different resources to attain a specific objective. In turn, governance refers to the process by which different government and non-government actors make deci-

sions, establish who is involved, their responsibilities and how they are held accountable (Worboys et al. 2015).

Good governance is essential to ensure that management decisions are in fact implemented and that the distribution of costs and benefits are fair. When we talk about community-based management, it is easy to fall into the trap of idealising them, assuming that each of them is one homogeneous group and that they make decisions as a whole. The reality is that small communities can have similar problems to large ones, where social and power structures segregate different members and decisions can often lack transparency and be misguided by individual interests (Mohan and Stokke 2000).

In this article, I provide an overview of good governance principles, how power structures inside communities can affect these principles, and how social science, particularly participatory action research, can help practitioners understand the issues and guide improvements.

## Good governance principles

Several authors have proposed a series of principles to guide governance regimes (European Commission 2001; Graham et al. 2003; Lockwood et al. 2010; UNDP 1997), whether they are government-led, community-based, private, or a combination of these. These principles could be grouped into four key criteria:

### *Inclusiveness and fairness*

To ensure inclusiveness, participatory processes require the involvement of stakeholders from the beginning and

<sup>1</sup> Encouraging, motivating and empowering communities to sustainably manage their own coastal resources.

Around the world, participatory management planning at local communities adapt to the local context and use the best suited tools. Here, youth developing communication tools in the Colombian Pacific coast, ©Carolina Garcia, SPC and planning workshop in Auki, Malaita, Solomon Islands. ©Watisoni Lalavanua, SPC



throughout the process, rather than at specific stages. Methods need to go beyond symbolic participation (Bammer 2022) and be appropriate for the specific settings. The leading organisation might need to consider options to facilitate the involvement of marginalised sectors of the population and overcome potentially unbalanced social structures. If costs and benefits are inevitably unfair, final decisions should openly balance different interests and consequences, and if appropriate, compensate negatively impacted parties.

### *Accountability and transparency*

Decision-making processes require clear procedures and roles. Information about who, how, and the justification of decisions should be publicly available.

### *Legitimacy*

This is mainly understood as the official authority conferred by a legal mandate, but other forms of legitimacy are important. Legitimacy can be gained by support of stakeholders, by the long-term link of indigenous people to their territories or by evidence of good performance. Either ancestral or legal legitimacy can be in place, but the recognition and support of the stakeholders is crucial in either case, particularly from those who will be responsible of implementing those decisions.

### *Performance*

Efficiency in governance refers to the optimal use of funds, prioritising decisions to be discussed, reducing meetings, and finding alternative discussion mechanisms. Effectiveness of governance involves the periodical evaluation of the regime and the adjustment of less-than-optimal governance arrangements. Coordination across governance levels, coherence of policies and direction, and integration across sectors are considered key requirements.

## **Power structures**

Power or influence can be defined as the capacity of an actor to affect the actions of others in an intended and calculated way (Wrong 1979). It can be overt or covert, and stakeholders can use different sources of power – political, ideological, economic or military – or more frequently, a combination of them.

## **The importance of social science to understand and guide governance regimes**

Social sciences offer a variety of methods that allow practitioners to understand specific communities, particular management and governance regimes, along with the enablers and limitations of each of them, and the consequences of following or not following good governance principles. Social methods can be quantitative, qualitative, or use a combination of them.

In general terms, quantitative methods are those that use numbers to qualify results and include among others: surveys (the most frequently used), Q-methodology, economic experiments and social network analysis. Reporting tends to be more straight forward as readers tend to better understand tables, figures and percentages. It is often associated with a more objective analysis of information. Surveys in particular, if well designed, with the inclusion of local knowledge, can provide a representative view of a population's opinions and attitudes.

On the other hand, qualitative research is often associated with more subjective analysis of information. It includes the most widely known tools, such as interviews and focus group discussions (Young et al. 2018), but also observations and ethnographies. While it is impossible to generalise results from qualitative methods, it often provides key insights into the worldviews and reasonings behind opinions or attitudes of research subjects. Direct quotes from participants can provide readers with a connection to the real world. Again, methods should be carefully designed to suit the objectives of the study, but given its perceived subjectivity, they are often conducted without paying attention to validity criteria. A combination of qualitative and quantitative methods can help combine the benefits of both approaches, but such an approach often requires more resources – financial and human.

Whichever approach is selected, social research can provide information about the quality of governance and identify key issues; can help explain factors of success or failure and recommend ways to strengthen positive aspects and to address issues; can show the level of support that a regime has and the perceived effects of specific management decisions.

Social research, however, only contributes a fraction of what needs to be done to promote good governance practices in fisheries management or co-management. Other criteria to be considered include:

- Clear and attainable objectives – establishing a common purpose for the process helps stakeholders to understand why they participate, value the opportunity to participate and make compromises between individual and common benefits.
- Flexibility to adjust the process to specific circumstances – all communities are different, and for this reason, a standard process might need to be adjusted to their circumstances. Some of the factors that can affect the process can include, for example, the existence or non-existence of clear local leaders, knowledge of their resources, social norms and available resources.
- Integration of different sources of knowledge, particularly scientific, local and traditional – traditional knowledge might be sufficient to support decisions in some cases. However, with current synergy of pressures, like climate change, changing economies and population





Socio-economic survey in Daliconi, Vanua Balavu, Fiji. © Sailasa Tagica

shifts, communities might need to complement their knowledge with scientific knowledge. Both scientists and communities need to be open to accepting a different kind of knowledge.

- Good communication channels – all relevant stakeholders need to be able to exchange information independently and on a regular basis, including for instance about emerging problems, funding opportunities, or new regulations.
- Professional facilitation of processes – participatory workshops should not be improvised, particularly in places with high levels of conflicts. A professional, impartial facilitator can help steer discussions to reach an agreement.
- Institutional support from government structures – sometimes processes are led by the communities themselves or by non-government organisations; while this is a valid starting point, eventually it is recommended that authorities endorse the process, and that the legal framework supports it.
- Long-term financial and technical support until a regime is self-established – when the process is financed through annual governments' budget, there is more certainty about continuing the process until it is mature and can function on its own. However, when funds come from short projects, processes might be left without funds to continue, leaving them half-way. These cases are particularly hurtful for the overall CBFM scaling-up, as communities can lose faith in external organisations and be reluctant to be involved in the future. This is particularly true when one considers that participatory processes are usually not fun, and stakeholders get involved due to a real interest in improving the management of the marine resources.

As a concluding remark, it is inspiring to know that PICTs have endorsed the CBFM Framework for Action, as it seems the most appropriate approach to devolve management powers to the communities that depend on fisheries resources, in a region where government control is practically impossible. This article aims to inspire a reflection on the role that social sciences can play in supporting participatory processes, key in turn to assist more communities in implementing CBFM.

## References

- Bammer G. 2022. Stakeholder engagement: Learning from Arnstein's ladder and the IAP2 spectrum. Integration and Implementation Insights Blog August 30, 2022. <https://i2insights.org/2022/08/30/learning-from-arnsteins-ladder-and-iap2-spectrum/>.
- European Commission. 2001. European governance: a white paper. Office for Official Publications of the European Communities. [https://ec.europa.eu/commission/presscorner/detail/en/DOC\\_01\\_10](https://ec.europa.eu/commission/presscorner/detail/en/DOC_01_10)
- Govan, H. 2015. Area-based management tools for coastal resources in Fiji, Kiribati, Solomon Islands, Tonga And Vanuatu. Volume 1: Status, capacity and prospects for collaborative resource management. Report for the Marine and Coastal Biodiversity Management in Pacific Island Countries (MACBIO) project.
- Graham J., Amos B. and Plumptre T. 2003. Principles for good governance in the 21st century. Policy Brief, 15. [https://www.academia.edu/2463793/Principles\\_for\\_good\\_governance\\_in\\_the\\_21st\\_century](https://www.academia.edu/2463793/Principles_for_good_governance_in_the_21st_century)
- Lockwood M., Davidson J., Curtis A., Stratford E. and Griffith R. 2010. Governance principles for natural resource management. Society and Natural Resources 23(10):986–1001. <https://doi.org/10.1080/08941920802178214>
- Mohan G. and Stokke K. 2000. Participatory development and empowerment: the dangers of localism. Third world quarterly 21(2):247–268. <http://www.jstor.org/stable/3993419>
- Pacific Community. 2021. Pacific Framework for Action on Scaling up Community-based Fisheries Management: 2021–2025. Noumea, New Caledonia: Pacific Community. <https://purl.org/spc/digilib/doc/yr5yv>
- UNDP. 1997. Governance for sustainable human development. United Nations Development Program. Retrieved 1 August 2013 from <https://digitallibrary.un.org/record/3831662?ln=en>
- Worboys G., Lockwood M., Kothari A., Feary S. and Pulsford I. 2015. Protected area governance and management. ANU Press.
- Wrong D.H. 1979. Power: Its forms, bases, and uses. Basil Blackwell Publisher. <http://library.oapen.org/handle/20.500.12657/33134>
- Young J.C., Rose D.C., Mumby H.S., Benitez-Capistros F., Derrick C.J., Finch T., Garcia C., Home C., Marwaha E. and Morgans C. 2018. A methodological guide to using and reporting on interviews in conservation science research. Methods in Ecology and Evolution, 9(1):10–19. <https://doi.org/10.1111/2041-210X.12828>

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## Strengthening the knowledge base for fisheries monitoring technology: the Global Electronic Monitoring Symposium (GEMS)

*Esther Wozniak<sup>1</sup> and Robert Gillett<sup>2</sup>*

Electronic monitoring (EM) as a means of enhancing fisheries data is on the increase. These new tools provide a more efficient means of capturing, storing, and reporting data which is vital for effective fisheries management. How this is implemented on a global scale with compatible standards and technologies is a challenge that requires international coordination and knowledge sharing.

To catalyse the development and use of electronic monitoring (EM) programmes to increase fisheries data collection and transparency, the Pew Charitable Trusts convened more than 50 stakeholders, both in-person and virtually, for a three-day workshop in June 2022 in Honolulu, USA. The symposium brought together government officials, regional fisheries management organisation (RFMO) staff, and representatives from industry, academia, and civil society to exchange lessons learned, discuss barriers, and jointly develop solutions to increase EM adoption.

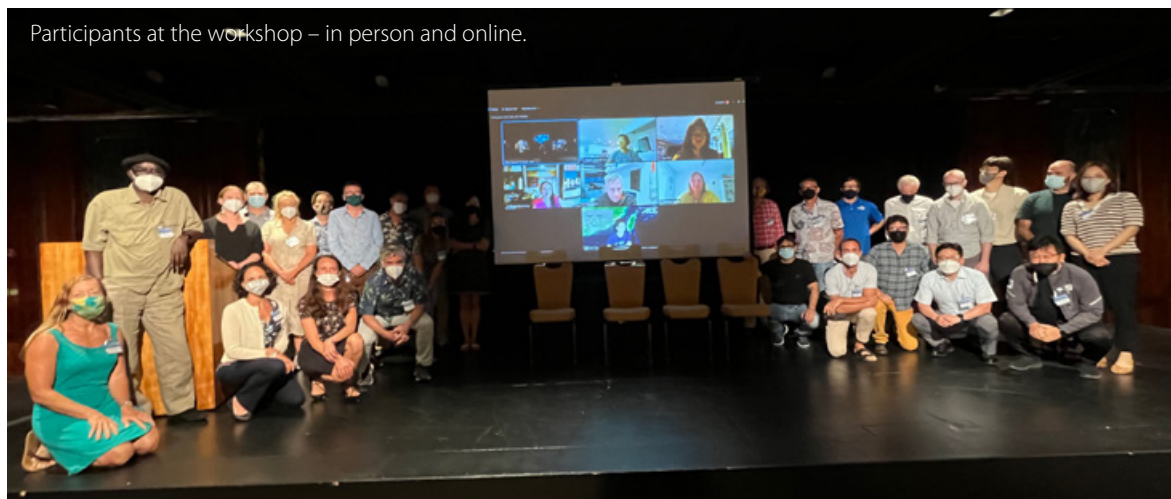
Despite the many benefits of EM, adoption of the technology is not yet widespread in the world's fishing industry. EM programmes are usually limited to the local or national level with minimal coordination between countries and stakeholders. This symposium was designed as a venue for information sharing, with a focus on how to expand the use of EM on commercial fishing fleets. A symposium steering committee of EM experts developed the agenda, produced background papers, compiled the latest literature on the technology, and helped facilitate discussions during the meeting. The agenda included presentations and discussion sessions that centred around harmonisation of EM standards, EM costs and benefits, artificial intelligence/machine learning and EM market drivers.

Based on the discussions during the symposium, the participants agreed on four main takeaways/priority areas:

1. The need for better coordination across the different RFMOs developing EM standards. This can be achieved through inter-RFMO processes such as closer cooperation between EM working group chairs.
2. The need for an EM provider/vendor coalition to exchange information with other stakeholders to build a shared understanding of what can be delivered and how to specify requirements.
3. Templates are required to improve EM data collection for various initiatives e.g., EM costs and benefits for input into already-developed analysis models.
4. A practical review of artificial intelligence/machine learning and its potential to improve the efficiency of EM programmes.

Each priority area will form the basis of an output paper that captures the key points of the discussion and includes recommendations for future action and will be shared with RFMOs, fisheries managers, and other EM stakeholders to help drive EM implementation.

These output papers will also be presented at a series of topical workshops (either in-person or virtual, depending on global conditions and travel restrictions) with relevant stakeholders. These workshops may also develop recommendations on how to best integrate emerging technologies within existing or future EM programmes.



Participants at the workshop – in person and online.

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# Forecasts of future ocean state and potential application to tuna availability

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## Background

Commercially valuable species targeted by Australian longline fisheries (bigeye tuna, *Thunnus obesus*; yellowfin tuna, *Thunnus albacares*; albacore tuna, *Thunnus alalunga*; striped marlin, *Kajikia audax*; broadbill swordfish, *Xiphias gladius*) have a wide distribution in the southwest Pacific, but the influence of ocean state and variability on their distribution, abundance and phenology is poorly understood. A recently completed research project funded by the Fisheries Research and Development Corporation (FRDC) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) sought to investigate the influence of oceanographic conditions on these species' distributions.

A key project result is that sub-surface ocean state variables are important in explaining the distribution of catches. Previous work has focused on surface variables such as sea-surface temperature, which have historically been available in seasonal forecast models and Earth System models such as those included in the Intergovernmental Panel on Climate Change Coupled Model Intercomparison Project (CMIP). However, modelled sub-surface variables are now becoming increasingly available and have revealed their importance for predicting these target species' distributions.

## Reanalysis of past conditions

Catch and effort data for the five target species from 13 nations and territories across the southwest Pacific region (Cook Islands; French Polynesia; New Caledonia; New Zealand; Norfolk Island; Samoa; Solomon Islands; Tokelau; Tonga; Tuvalu; Vanuatu; Fiji and Australia) were provided by the Western and Central Pacific Fisheries Commission (WCPFC) and Australian Fisheries Management Authority (AFMA). Using this data, we investigated a suite of modelling techniques to assess the influence of ocean state variables in explaining variability in catch rates. Boosted regression trees (BRTs) were considered to perform best; full details of this modelling approach can be found in a soon to be published FRDC report<sup>5</sup> and a manuscript currently in preparation (Scales et al. in prep). The catch and effort data were aggregated by month and 0.25-degree latitude/longitude grid cell for the years 2008–2020. For each of

the five target species, boosted regression trees (BRTs) were used to model the observed catch in each 0.25-degree grid cell in each month, assuming a Poisson distribution. The number of hooks was included as an offset and the selected ocean variables as predictors. Data from 2008–2015 were used to train the BRT models, and 2016–2020 data were used for testing and validation.

During the project two different reanalysis products were used: CSIRO's CAFE60 ocean reanalysis (O'Kane et al 2021a, O'Kane et al 2021b), and the Bureau of Meteorology's ACCESS-S (Australian Community Climate and Earth-System Simulator-Seasonal) ocean reanalysis. The benefit of using these products is that all the ocean state variables are on the same spatial grid, and the data assimilation schemes ensure that there are values at all locations for all time points in the historical period. As ACCESS-S is an operational service provided by the Bureau, we will focus on this reanalysis and forecast system.

## ACCESS-S

ACCESS-S is the Bureau of Meteorology's operational coupled ocean-atmosphere seasonal prediction system. ACCESS-S1 (version 1) (Hudson et al. 2017) was operationalised in August 2018 and then upgraded to ACCESS-S2 (version 2) (Wedd et al., in review) in October 2021. This study uses ACCESS-S2. The ocean model is eddy-permitting, with a 0.25-degree resolution and 75 depth layers, with the top 1-metre layer representing sea surface temperature. Ocean model initial conditions are created using a weakly coupled data assimilation scheme, which assimilates in situ profiles of temperature and salinity observations (Wedd et al. in review). The resulting gridded ocean data reanalysis was used in this study to provide input subsurface data for training the BRT models.

## Choice of study regions

The southwest Pacific domain was partitioned into four regional sub-domains based on the time-mean ratio of eddy kinetic energy to mean kinetic energy (EKE/MKE, Figure 1a). This was generated from BRAN2020, an eddy-resolving, near-global ocean reanalysis (Chamberlain et al. 2021), and subsequently used to identify boundaries between regions dominated by mesoscale eddies or mean currents.

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<sup>5</sup> <https://www.frdc.com.au/project/2017-004>

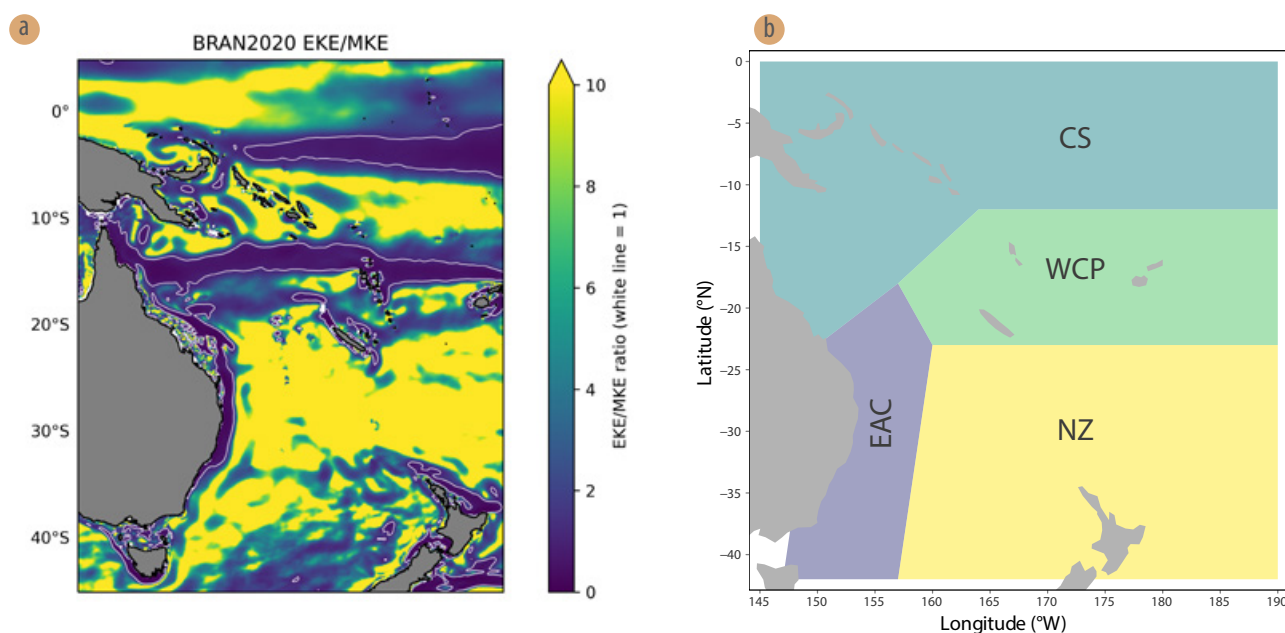


Figure 1 – a) Ratio of EKE to MKE and b) Four key regions defined for analysis. EAC = East Australian Current-dominated; CS = Coral Sea and Equatorial; WCP = Western-Central Pacific; and NZ = New Zealand.

By combining the EKE/MKE analysis with a geographical breakdown of Western and Central Pacific Fisheries Commission (WCPFC) nations, four key regions were identified. These are referred to here as East Australian Current-dominated (EAC), Coral Sea and Equatorial (CS), Western-Central Pacific (WCP) and New Zealand (NZ), and are shown in Figure 1b.

## Results

Full results of this modelling approach will be in the soon-to-be released FRDC report, but to illustrate the approach, we consider yellowfin tuna for the whole domain and the four sub-regions. Although predictive power of the models is often generally low (maximum

R-squared values of 0.45), it is still of interest to consider which ocean variables are contributing the most to explaining the deviance in the CPUE (catch per unit effort) for each species and region. The variables that are most influential vary significantly between the four regions (Figure 2). For yellowfin tuna (YFT), sea surface salinity (sss), eddy kinetic energy integrated over 0-300m depth (eke300) and temperature at 500-m depth (t500) were most influential in the whole domain model. Conversely in the EAC sub-region, mixed layer depth (mld), t500 and sea surface temperature (sst) came out as the best predictors, showing the importance of considering both the region and the sub surface variables describing ocean structure.

Table 1. List of oceanographic variables available from the ACCESS-S2 reanalysis data (direct and derived products) used in BRTs. Bathymetry data taken from TerrainBase (<https://www.ngdc.noaa.gov/mgg/gravity/1999/document/html/tbase.html>).

Variable name	Description
eke300	Eddy kinetic energy – weighted sum of 0-300 m
hc300	Heat content – upper 300 m
mld	Mixed layer depth
ssh	Sea surface height (corrected)
sss	Sea surface salinity
sst	Sea surface temperature
td	Thermocline depth
t500	Temperature at 500 m
u100	East/west velocity at 100 m
v100	North/south velocity at 100 m
bathy	Bathymetry



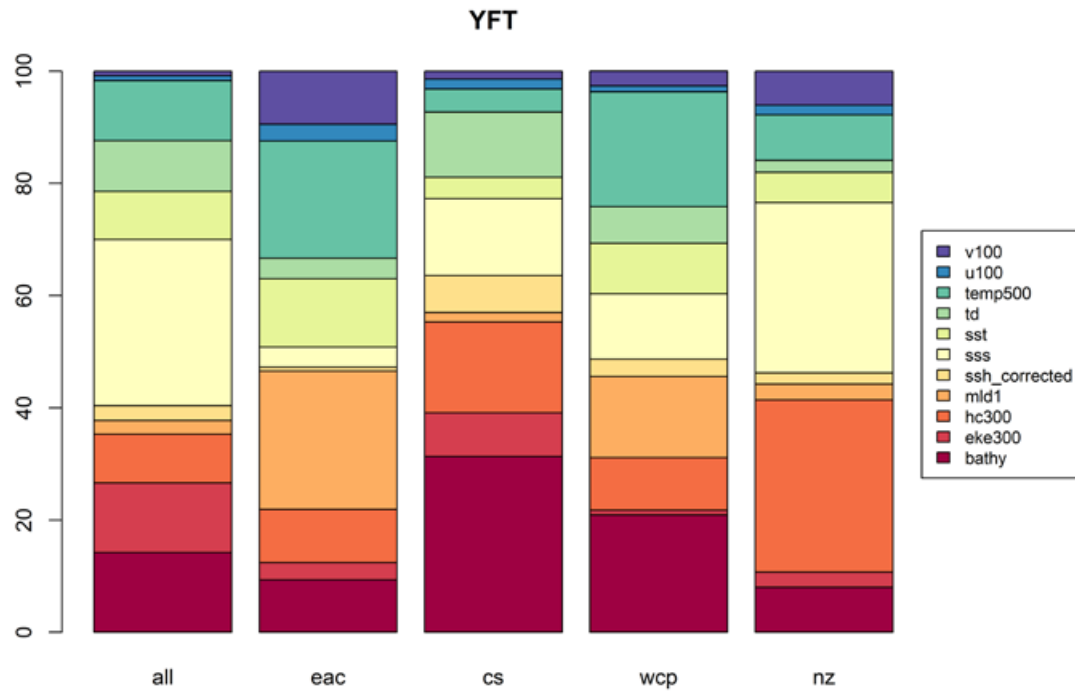


Figure 2. Relative contributions of each of the oceanographic variables included in the BRTs for yellowfin tuna (YFT) and region (all = whole region; eac = EAC-dominated region; cs = Coral Sea; wcp = Western-Central Pacific; nz = New Zealand) (see Figure 1b). See Table 1 for definitions of oceanographic variables.

## Forecasts of future ocean state and catch distribution

One of the goals of the project was to investigate the feasibility of providing forecasts of fish distribution for the five key species for Australia and regional partners, using the habitat models developed in this work. Although the BRTs model catch rather than fish abundance, they can still be used to provide forecasts of catch distribution rather than

fish distribution directly. Unfortunately, not all the ocean variables that were included in developing the ACCESS-S2 BRT models are available as real time forecasts at this time. Currently, four variables are available: sea surface temperature (sst), sea surface height (ssh), heat content in the upper 300 m (hc300), and mixed layer depth (mld). Thus, to use the BRTs to provide forecasts, the models were re-trained using only these four variables and bathymetry. An example of a forecast of yellowfin tuna CPUE for the whole region model is shown in Figure 3.

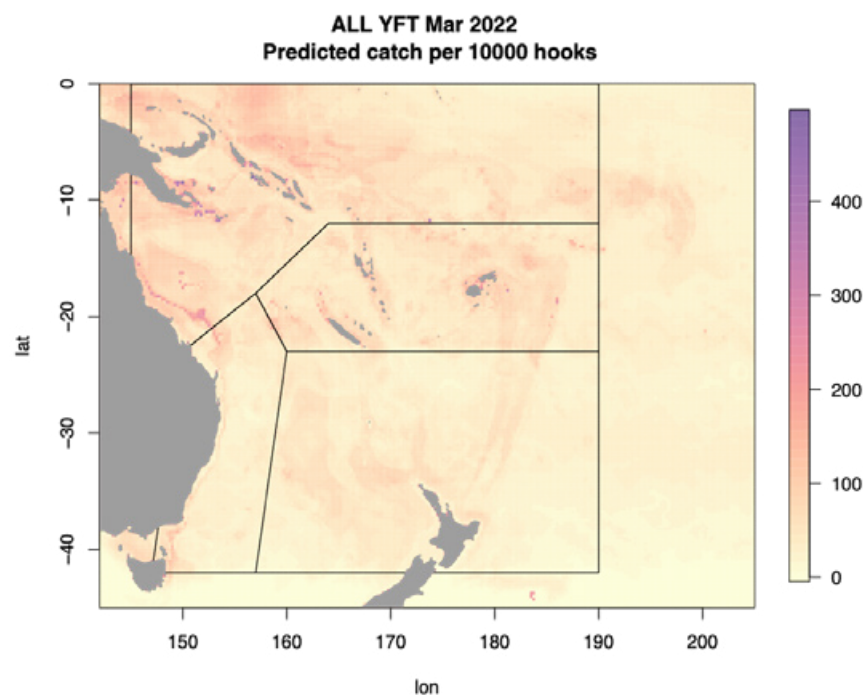


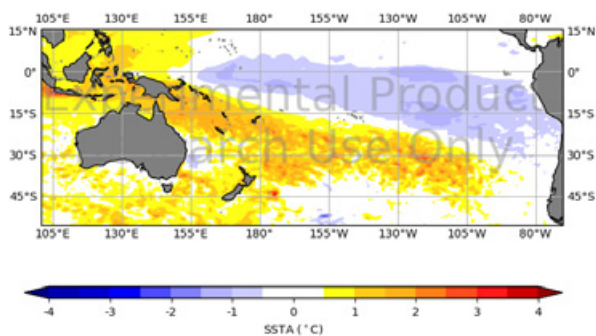
Figure 3. Example map of predicted CPUE for yellowfin tuna (YFT) for the whole domain model in March 2022, for an ACCESS-S2 forecast issued in January 2022.

• News from in and around the region •

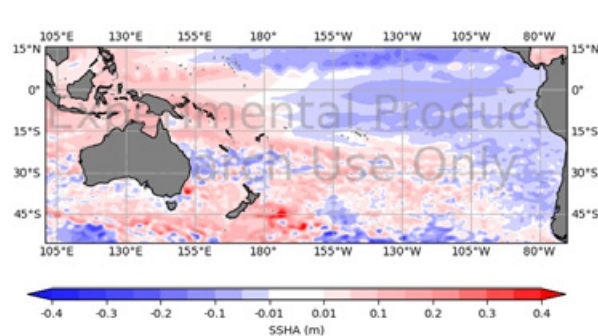
Operational ACCESS-S ocean forecasts, available to the public, can be viewed on the web portals listed in Table 2. In addition, we have an experimental project page with

real-time ocean seasonal forecasts for trialling with project partners and customers (examples shown in Figure 4).

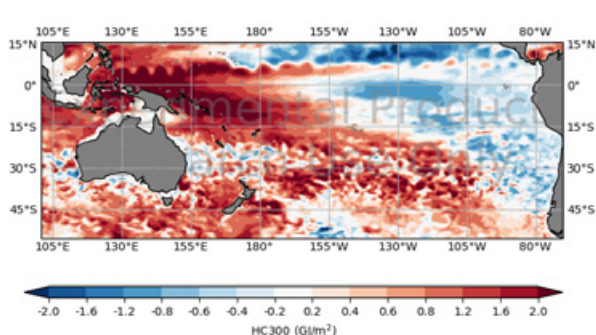
**Seasonal emn Sea Surface Temperature Anomaly** Start: 30-Jul-2022  
Region: Central and South Pacific Period: Season 01-Aug-2022 to 31-Oct-2022



**Seasonal emn Sea Surface Height Anomaly (corrected)** Start: 30-Jul-2022  
Region: Central and South Pacific Period: Season 01-Aug-2022 to 31-Oct-2022



**Seasonal emn Heat Content 300** Start: 30-Jul-2022  
Region: Central and South Pacific Period: Season 01-Aug-2022 to 31-Oct-2022



**Kara Mixed Layer Depth (mld1) anomaly** Start: 30-Jul-2022  
Region: Central and South Pacific Period: Season 01-Aug-2022 to 31-Oct-2022

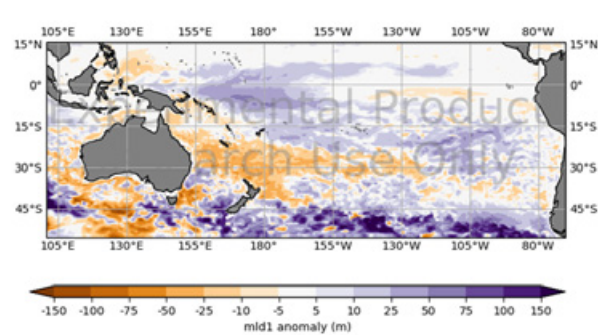


Figure 4. Example of trial ACCESS-S forecasts of surface and sub-surface ocean state for the August-October 2022 season. Each forecast is shown as an anomaly (deviation for the long-term mean) for the variable presented and shows the ensemble mean (emn) of the 99 individual model runs.

Table 2. Locations of portals and websites for investigating ACCESS-S forecasts.

Name	URL
Climate and Oceans Support Program in the Pacific (COSPPac)	<a href="http://oceanportal.spc.int/portal/app.html#climate">http://oceanportal.spc.int/portal/app.html#climate</a>
Global and Pacific ACCESS-S outlooks and Pacific climate monitoring	<a href="http://access-s.clide.cloud/">http://access-s.clide.cloud/</a>
Seasonal ocean temperature outlook for Australia	<a href="http://www.bom.gov.au/oceanography/oceanemp/sst-outlook-map.shtml">http://www.bom.gov.au/oceanography/oceanemp/sst-outlook-map.shtml</a>
Marine heatwave forecasting	<a href="https://research.csiro.au/cor/climate-impacts-adaptation/marine-heatwaves/dynamical-forecasting-of-marine-heatwaves/">https://research.csiro.au/cor/climate-impacts-adaptation/marine-heatwaves/dynamical-forecasting-of-marine-heatwaves/</a>



## Other applications

Along with the work presented in this article, we have also applied seasonal forecasts to other tuna fisheries (Hobday et al. 2011; Eveson et al. 2015; <http://www.cmar.csiro.au/gab-forecasts/index.html>), as well as prawn and salmon aquaculture (Hobday et al. 2014; Spillman et al. 2015). Typically, we found that forecasts were generally skilful out to three months into the future, depending on location and time of year. These applications have demonstrated that dynamic model forecasts provide a viable option for managing environmental risk for marine industries in a changing climate (Hobday et al. 2018).

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## References

- Chamberlain M.A., Oke P.R., Fiedler R.A.S., Beggs H.M., Brassington G.B. and Divakaran P. 2021. Next generation of Bluelink ocean reanalysis with multiscale data assimilation: BRAN2020, Earth System Science Data 13:5663–5688. <https://doi.org/10.5194/essd-13-5663-2021>
- Eveson J.P., Hobday A.J., Hartog J.R., Spillman C.M. and Rough K.M. 2015. Seasonal forecasting of tuna habitat in the Great Australian Bight. Fisheries Research 170:39–49. <http://www.sciencedirect.com/science/article/pii/S0165783615001496>
- Hobday A.J., Hartog J.R., Spillman C.M. and Alves O. 2011. Seasonal forecasting of tuna habitat for dynamic spatial management. Canadian Journal of Fisheries and Aquatic Sciences 68:898–911.
- Hobday A.J., Spillman C.M., Eveson J.P. and Hartog J.R. 2014. Seasonal forecasting for decision support in marine fisheries and aquaculture. Fisheries Oceanography. <https://doi:10.1111/fog.12083>
- Hobday A.J., Spillman C.M., Eveson J.P., Hartog J.R., Zhang X., Brodie S. 2018. A framework for combining seasonal forecasts and climate projections to aid risk management for fisheries and aquaculture. Frontiers in Marine Science 5(137).
- Hudson D., Alves O., Hendon H.H., Lim E., Liu, G., Luo J.-J., MacLachlan C., Marshall A.G., Shi L., Wang G., Wedd R., Young G., Zhao M. and Zhou X. 2017. ACCESS-S1: The new Bureau of Meteorology multi-week to seasonal prediction system. Journal of Southern Hemisphere Earth Systems Science 67:3(132–159). <https://doi:10.22499/3.6703.001>
- O’Kane T.J., Sandery P.A., Kitsios V., Sakov P., Chamberlain M.A., Collier M.A., Fiedler R., Moore T.S., Chapman C.C., Sloyan B.M., and Matear R.J. 2021. CAFE60v1: A 60-year large ensemble climate reanalysis. Part I: System design, model configuration, and data assimilation. Journal of Climate, 34(13):5153–5169.
- O’Kane T.J., Sandery P.A., Kitsios V., Sakov P., Chamberlain M.A., Squire D.T., Collier M.A., Chapman C.C., Fiedler R., Harries D., Moore T.S., Richardson D., Risbey J.S., Schroeter B.J.E., Schroeter S., Sloyan B.M., Tozer C., Watterson I.G., Black A., Quinn C. and Matear R.J. 2021. CAFE60v1: A 60-year large ensemble climate reanalysis. Part II: Evaluation. Journal of Climate 34(13):5171–5194.
- Scales, K.L., Moore, T.S., Sloyan, B., Spillman, C.M., Eveson, J.P., Patterson, T.A., Williams, A.J., Hobday, A.J., Hartog, J.R. (in prep.). Forecast-ready models of tuna and billfish catches to support fisheries adaptation to global variability and change.
- Spillman C. M., Hartog J.R., Hobday A.J. and Hudson D. 2015. Predicting environmental drivers for prawn aquaculture production to aid improved farm management. Aquaculture 447:56–65.
- Wedd R., Alves O., de Burgh-Day C., Down C., Griffiths M., Hendon H.H., Hudson D., Li S., Lim E., Marshall A.G., Shi L., Smith P., Smith G., Spillman C.M., Wang G., Wheeler M.C., Yan H., Yin Y., Young G., Zhao M., Yi X. and Zhou X. In Review. ACCESS-S2: The upgraded Bureau of Meteorology multi-week to seasonal prediction system. Journal of Southern Hemisphere Earth System Science.

# From control to community: A personal perspective on 30 years of change in Pacific Island artisanal fisheries and aquaculture

Timothy Adams<sup>1</sup>

## Introduction

Thirty years ago, I joined the Coastal Fisheries Programme of the Pacific Community (SPC). I had just spent seven years with the Fisheries Division of the Fiji Ministry of Primary Industries – the last two of these years as caretaker Director. Much of my work in Fiji had been on coastal fisheries and aquaculture because these produced the most difficult and frequent problems and created the biggest workload for the Division. Tuna fisheries were certainly important to Fiji, with a local pole-and-line fleet feeding skipjack to the PAF-CO cannery and rapidly growing interest in longlining to fish for export-grade yellowfin and bigeye (albacore was not a primary target for the local longliners at that point). But tuna involved relatively few actors, while artisanal fisheries and aquaculture involved thousands. And they also involved major constitutional questions like resource rights and ownership, with disputes between neighbouring communities, overfishing of artisanally-caught export invertebrates, the need to monitor hundreds of landing points and/or dozens of markets, and an apparently limitless need for science – not just for assessment of the limits to fishing on thousands of individual reef and lagoon fish stocks, but also to develop basic biological and ecological knowledge on fish species that were not being studied much (at the time) by research scientists in developed countries. And in artisanal aquaculture there was the constant struggle to develop farming systems to the point where they could be cost-effective for rural communities to invest their time.

I worked as Senior Inshore Fisheries Scientist at SPC for five years before moving upstairs in 1997 to become the first<sup>2</sup> Director of SPC's Marine Resources Division (now FAME). As director I continued to work more with the Coastal Fisheries Programme than Oceanic because the CFP lacked a programme manager until 2005, while the Oceanic Fisheries Pro-

gramme (OFP) had Tony Lewis as manager and hardly needed me to interfere with their journey to excellence. A decade later I left what had become a middle-management job under an increasingly centralised structure and became immersed in tuna fisheries for the next 15 years, first helping the Nauru Fisheries and Marine Resources Authority in nationally implementing the PNA Purse-seine Vessel Day Scheme, then with the Forum Fisheries Agency as Director of its Fisheries Management Division, and latterly with the Kiribati Ministry of Fisheries Management and Resource Development as part-time Offshore Fisheries Management Adviser.

So, in this International Year of Artisanal Fisheries and Aquaculture it was very interesting to be asked by SPC to return to the non-tuna side of the fence for a few days to see just how many of our plans and hopes of 30 years ago had come to pass. For example, has a new paradigm for coastal fisheries management been achieved, as proposed by Bob Johannes in 1994 and 1998? Johannes suggested that another approach is required where less emphasis is placed on “hard” data and more on gathering information from the people who fish. He noted that “conventional fisheries research requires data collection over long time periods before it can generate significant answers, whereas management decisions are usually required immediately, and a trial-and-error approach, where errors are part of the learning process, would be more suitable in the Pacific islands context”. Has the management of coastal fisheries in the Pacific Islands developed into an “amalgam of conventional approaches, including those where data are gathered according to sampling criteria to test hypotheses, and the less data-intensive approach advocated by Johannes” as predicted by Dalzell et al. (1996)?

This will be a personal perspective.<sup>3</sup> An immense amount of literature and knowledge has accumulated in the last few years and there has not been enough time to carry out the kind of comprehensive “Status of Coastal Fisheries and Aquaculture” reviews that we did in 1995–96 (Dalzell et al. 1996, Adams 1996) and 2008 (Adams et al. 2008), and which was followed up by SPC in 2013 (Anon 2013), so I'm afraid that this article will be full of generalisations and opinions. This is not a formal review, nor a programme planning aid. However, these informal comparisons between past and present will hopefully provide food for thought.

The term “artisanal” is difficult to define in a way that satisfies everyone. Throughout this article, the artisanal fisheries that I refer to will be small-scale family or community fisheries whether purely for subsistence or also for income, and will not include fishing and fishery related or aquaculture activities by commercial companies.

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<sup>2</sup> Note that the title of the Fisheries Coordinator post was changed to create this “first” Director post.

<sup>3</sup> An email sent to most Heads of Fisheries asking about the main coastal fisheries and aquaculture issues crossing their desks recently, and inviting any other comment, received very little response. Questionnaire overload appears to be growing problem in its own right.





Tahiti, French Polynesia 1970. © Val Hinds, SPC

## The Pacific Islands coastal fisheries subsector, then and now

### *Then: 1992 context*

- The total population of the South Pacific (as the Pacific Islands region was known at the time) was around 6.5 million people, 62% of those living in Papua New Guinea (PNG). Of the 4 million people in PNG, only one-quarter of them lived on the coast. The total coastal population of the region was therefore estimated at approximately 3.25 million people, equivalent to the population of a medium-sized continental city, but spread over an area of 29 million km<sup>2</sup> of ocean (Dalzell et al. 1996)
- Many Pacific Island nations had become notably “macrocephalic”, with large proportions of their population congregating into one capital city or island, often with erosion of their marine custodial traditions and knowledge along the way.
- Experimental aquaculture had been underway for 50 years or more, and the export of relatively non-perishable coastal fishery products such as beche-de-mer and mother-of-pearl shell had been established for over a century. Coastal food fisheries had been in place for up to 40 millennia. Despite the vast area of nearby ocean, Pacific Island fishers<sup>4</sup> had no great, shallow continental shelves to exploit, while coastal reef and lagoons areas were fragile and relatively limited in size, and easy to overexploit. Pacific Island coastal fisheries could thus be considered mature well before the 1990s, with little room for sustainable increases in exploitation around most islands and considerable worries emerging about excessive exploitation exacerbated by the breakdown of traditional governance structures.
- In many places there was felt to be too-hasty commercial development without adequate safeguards, due to severe misconceptions about potential coastal fisheries productivity<sup>5</sup> by some government economic planners. And there was very little awareness by many governments about the scale and importance of subsistence (non-commercial family or village-bounded) fisheries. Average fish consumption per head in most Pacific islands was much higher than for continental populations – and still is, although per-capita fish consumption appears to have increased in the rest of the world over the past 30 years as aquaculture has expanded.
- There were fears at the time that the upsurge in market demand for exotic marine products in China could place Pacific Island coastal fisheries in further jeopardy. For example, Crocombe (1994) suggested that one of the major challenges to fisheries management and marine tenure would be the increasing influence of Northeast and Southeast Asia. And if the pressure from Asia to share in the exploitation of the region’s coastal resources increased, this would be bound to cause conflict with traditional tenure.
- There was no regular regional update on the status of coastal fisheries and aquaculture production analogous to the SPC Tuna Fisheries Assessment Reports (eg Kearney 1981, Hampton et al. 1999, Hare et al. 2021), and there was certainly no possibility of the assessment of coastal capture fisheries status relative to targets and limits.

These and other issues informed a 1996 discussion paper on the institutional future of the SPC Coastal Fisheries Programme that was discussed by the 26th SPC Regional Technical Meeting on Fisheries.<sup>6</sup>

<sup>4</sup> (apart from those in southern PNG)

<sup>5</sup> Often expressed in glowing terms such as the “teeming bounty of the reef”

<sup>6</sup> <https://purl.org/spc/digilib/doc/34ff2>

### *Then: 1992 sectoral production*

In the early 1990s, Dalzell and Adams (1994) estimated annual SPC island member coastal fisheries total production, averaged over the four years 1989–92 as follows:

These numbers were extremely approximate, but at the time they were eye-opening because nobody had tried to put together this kind of region-wide estimate before. And they indicated that the nominal value of coastal fisheries (if subsistence fisheries had been given a market value) might be

similar to the nominal value of tuna fisheries to the Pacific Islands at the time (in terms of landed value by Pacific Island-owned tuna vessels plus licence revenue). It should be noted that most of this coastal fishery value was produced by subsistence, and commercially marketed, village-level, non-company fisheries i.e. artisanal fisheries.

Much more sophisticated analyses have been carried out since then, particularly by Bob Gillett and his various collaborators and we will look at these later.

Table 1: Mean annual coastal fisheries production in the South Pacific 1989-92

Catch	Weight (t)	Nominal Value (USD)
Commercial reef and deep slope fish	10,476	26,034,723
Commercial coastal pelagics	4,419	14,708,216
Commercial estuarine fish	1,586	4,280,170
Commercial crustaceans	1,903	15,343,502
Commercial beche-de-mer (processed to 10% fresh weight)	1,717	12,371,240
Commercial trochus-, green snail-, pearl-shell (whole weight)	2,147	8,688,686
<b>Total commercial catch</b>	<b>24,609</b>	<b>83,353,790</b>
<b>Total subsistence catch</b>	<b>80,049</b>	<b>160,323,747</b>
<b>Total coastal fisheries catch</b>	<b>104,658</b>	<b>243,677,346</b>

Nauru Island, 2018. © Ariella D'Andrea, SPC





### *Then: 1992 national institutional capacity*

It has always been difficult for SPC to quantify national institutional capacity because it requires regular requests for information from national fisheries administrations, unless countries produce regular annual reports including descriptions of their staff structure and work programmes. SPC did make an attempt to bring this information together in 1995 for the monumental two-week Forum Fisheries Agency/

SPC Workshop on the Management of South Pacific Inshore Fisheries (Adams et al. 1995), but it was recognised that this was not definitive due to the patchiness of questionnaire responses. Even though all but two of SPC's island members provided some response to the questionnaire (covering staff, budget, levels of training and areas of focus, etc.) few members answered, or had the data on hand to answer, all the questions.

Table 2: SPC island member fisheries institutional capacity

SPC island member	Staff	Budget
American Samoa	15	USD 450,000
Cook Islands	78	USD 4,026,020
Federated States of Micronesia	ND	ND
Fiji	112	ND
French Polynesia	79	USD 5,500,000
Guam	ND	USD 750,000
Kiribati	ND	ND
Marshall Islands	ND except for mariculture – 8	ND except for mariculture- USD 448,000
Nauru	3	ND
New Caledonia (National Marine Marchande)	5	USD 75,000
Niue	2	ND
Northern Marianas	ND	USD 500,000
Palau	ND	USD 227,000
Papua New Guinea (DFMR)	164	USD 6,830,000
Pitcairn Islands	0	0
Samoa	ND	ND
Solomon Islands	24	ND
Tokelau	3	USD 23,000
Tonga	ND	ND
Tuvalu	ND	ND
Vanuatu	ND	USD 240,000
Wallis and Futuna	ND	ND

(Most estimates are from 1993 data)

## Now: 2022 coastal fisheries context

- ◆ The total population of SPC island members is estimated to now be around 12,400,000 – approximately double what it was in 1992.
- ◆ Unlike 1992, there is now a set of regional frameworks that include national coastal fisheries and aquaculture including:
  - ✧ the Forum Secretariat's *2050 Strategy for the Blue Pacific Continent* (<https://www.forumsec.org/2050strategy/>);
  - ✧ the Pacific Island Leaders' *Future of Fisheries Roadmap* (<https://www.ffa.int/node/1569> and <https://fame1.spc.int/en/publications/roadmap-a-report-cards>);
  - ✧ the *New song for coastal fisheries – Pathways to change: The Noumea strategy* (<https://purl.org/spc/digilib/doc/b8hvs>);
  - ✧ the forthcoming *Regional Aquaculture Strategy* ([https://www.spc.int/DigitalLibrary/Doc/FAME/Meetings/HOF/14/HoF14\\_WP6\\_EN.pdf](https://www.spc.int/DigitalLibrary/Doc/FAME/Meetings/HOF/14/HoF14_WP6_EN.pdf));
  - ✧ the *Pacific framework for action on scaling up community-based fisheries management: 2021–2025* (<https://purl.org/spc/digilib/doc/yr5yv>); and
  - ✧ the *Regional framework on aquatic biosecurity* (<https://purl.org/spc/digilib/doc/23nkb>).

## Now: 2022 sectoral production

Bob Gillett's compilations of nation-specific information about the contribution of fisheries to Pacific Island economies (Gillett 2016) and the latest iteration of the FAO Pacific Island national fisheries profiles (Gillett and Tauati 2018) are far more specific and comprehensive than our first attempts to quantify this diversity in the early 1990s. But there are no more recent overviews of Pacific Island coastal fisheries production or usage data published, as far as I'm aware.

On the face of it, despite the doubling in size of the human population there has only been an approximate 50% increase in coastal fisheries production. However, it could be unwise to directly compare these two estimates (i.e., Gillett 2016 and Dalzell et al. 1996) because it is quite possible that the margins of error, particularly for the less sophisticated earlier estimate, are wider than the apparent difference between the two, and the methodologies used in the two studies are quite different, particularly through the incorporation of national Household Income and Expenditure Surveys (HIES) by Gillett.

It is beyond the scope of this brief opinion piece to analyse this more deeply. However, at the least, both these estimates make it clear that the coastal fisheries subsistence catch was, and still is, considerably larger than the commercial, across the region as a whole.

Table 2: Mean annual coastal fisheries production in the South Pacific, then & now

Catch	Weight (t)	Nominal value (USD)	Unit value (USD per kg)
1989–92 Regional annual commercial catch	24,610	83,353,800	by category
2014 Regional annual commercial catch	53,753	215,012,000	4.00
1989–92 Regional annual subsistence catch	80,050	160,323,700	2.00
2014 Regional annual subsistence catch	110,183	231,383,300	2.10
<b>1989–92 Total annual coastal fisheries catch</b>	<b>104,660</b>	<b>243,677,500</b>	
<b>2014 Total annual coastal fisheries catch</b>	<b>163,936</b>	<b>446,396,300</b>	
<b>1996 Total aquaculture product value</b>		<b>156,788,000</b>	

Note:

- 1989–92 fisheries estimates are from Table 1 in this article
- 2014 estimates from Gillett 2016
- 1996 aquaculture value estimate from Adams et al. (2000), based on Bell and Gervis (1999). This value is dominated (93%) by black pearl mariculture, mainly in French Polynesia. Does not include subsistence aquaculture production. Note that the value of French Polynesian black pearl production peaked around 2000 and has since declined significantly, mainly because of market price erosion.





Suva, Fiji, 2022. © Pauline Bosserelle (SPC)

### *Now: Current national institutional capacity*

Hugh Govan produced for SPC a relatively complete review of national policy, operational budget and staffing support for coastal fisheries (Govan 2015). The following extract has

been put together to provide a simple comparison with the previous national institutional capacity estimates by Adams et al. 1995, but the rest of Dr Govan's report provides additional analysis beyond that attempted in 1995.

Table 3: Recent SPC island member fisheries institutional capacity (from Govan 2015, Table 2 – most numbers are from 2012–2014)

SPC island member	Total staff	Coastal staff as % of total staff	Total fisheries budget (USD rounded estimate)	Coastal budget as % of total budget
American Samoa	31	100%	1,082,283	43%
Cook Islands	65	26%	1,300,000	27%
Federated States of Micronesia	66	56%	755,000	56%
Fiji	147	50%	3,200,000	60%
French Polynesia	51	14%	6,261,778	13%
Guam	7	100%	1,570,000	47%
Kiribati	103	70%	1,162,604	ND
Marshall Islands	90	67%	2,380,000	ND
Nauru	46	39%	1,278,865	15%
New Caledonia	35	69%	6,810,693	27%
Niue	4	50%	154,612	ND
Northern Marianas	17	65%	581,302	72%
Palau	32	34%	755,693	22%
Papua New Guinea	290	44%	39,000,000	44%
Pitcairn	0.125	50%	ND	ND
Samoa	57	33%	850,365	18%
Solomon Islands	79	59%	1,500,000	21%
Tokelau	7	43%	ND	ND
Tonga	50	24%	927,671	17%
Tuvalu	43	23%	463,835	13%
Vanuatu	54	39%	1,075,373	29%
Wallis and Futuna	3	100%	193,265	59%



Although there is not enough 1995 data to make an overall comparison of total staff numbers between 1995 and 2015, some comparisons can be made for individual countries, and if the same trend holds true for the total there has not been the same dramatic increase in government resources devoted to coastal fisheries in the last 30 years as had occurred in the previous 30 years, before which some SPC island members did not even have a dedicated fisheries administration.

What *has* increased significantly in the last 30 years appears to be the amount of government resources put into the day-to-day management of oceanic fisheries within SIDS EEZs. Thirty years ago, at the national level there was no clear distinction between oceanic and coastal fisheries in most jurisdictions – Fiji Fisheries for example was divided into Extension, Resource Assessment and Development, and Technical Services Sections and there were no separate oceanic and coastal units. With the development of the FFA Harmonised Minimum Terms and Conditions and the advent of Western and Central Pacific Fisheries Commission (WCPFC) and the need for compliance with an increasing body of regional obligations, together with the need to manage (or generate) the immense mass of data being generated by industrial tuna fisheries, the oceanic arms of national fisheries administrations have become more elaborate.

There is, however, no obvious, regionally-shared driver for the similar elaboration of national coastal fisheries services in most countries. Nor, perhaps, should one be expected, because each Pacific Island country has a different mixture of coastal fisheries to manage. Various integrative regional-level coastal fisheries initiatives have been launched over the years, and the “New song” (SPC, 2015) is particularly notable, not least for its capacity to bring coastal fisheries issues to the attention of fisheries ministers and Pacific Forum Leaders. However, coastal fisheries waters are muddled by a number of different actors, and there are no clear, legally-binding external fishery frameworks to respond to in the same way that countries have enthusiastically risen to the challenge of collaboratively managing regional tuna stocks and moving towards the full control of regional tuna fisheries in and around their own waters.

And of course, there is much less prospect in most coastal fisheries for recovering the institutional costs of research and management than there is from tuna fisheries – especially the equatorial EEZ tuna fisheries. Different models have had to be found, and the resurgence of community-based management and local marine management areas in many places has been particularly encouraging (SPC et al., 2021).

Kiribati, 2021 © Kinanoua Abaiang (MFMRD)





## SPC coastal fisheries institutional capacity then and now

In 1992, SPC didn't have a Fisheries, Aquaculture and Marine Ecosystems Division. In fact, it didn't have any divisions at all. It had a Coastal Fisheries Programme consisting of a Fisheries Coordinator, an Information Section, a Training Section, a Postharvest Section, a Development Section and an Inshore Fisheries Research Project, and it had a Tuna and Billfish Assessment Programme (TBAP). And "Coastal Fisheries" was not just confined to reef and lagoon work, but included all fisheries-related activities apart from those carried out by large-scale tuna vessels. That was the domain of the SPC TBAP (oceanic fisheries data, stock assessment and biology) and the Forum Fisheries Agency (everything else to do with industrial tuna fishery management apart from science).

At the time member countries kept SPC's coastal fisheries activities strongly focussed on "development", and the word "management" was only starting to be heard in 1992 – not so much as a result of the identification of problems through coastal stock assessment but more as a result of Pacific Island citizens increasingly complaining to their fisheries administrations about it becoming harder to catch certain important aquatic resources. These were usually more financial than food security complaints, concerning overfishing of commercially valuable resources rather than staple food fisheries. In the early 1990s, despite the publication of *Words of the Lagoon* a decade earlier (Johannes 1981), support for artisanal fisheries and recognition of community-based management were still only beginning to come onto government and regional radars in most SPC island member countries and territories.

In 2022, SPC supports artisanal fisheries and aquaculture through the Coastal Fisheries and Aquaculture Programme of the Fisheries, Aquaculture and Marine Ecosystems Division. Notable additions to the functionality of the division have been legal and economic<sup>7</sup> support, MCS (monitoring, control and surveillance – coastal fisher regulatory compliance) and of course aquaculture. On the other hand, training has been lost as a section in its own right, and the formerly substantial development section is now much smaller. The women's fisheries development section that existed for several years had morphed into the community-based fisheries management section, and the coastal fisheries research function has varied in size depending on donor interest since its establishment in 1987. The support for this latter work over the years had come mainly from the UK govern-

ment and the European Union, but financial support for coastal fisheries science now seems to be going through another downturn phase. CFAP now also has dedicated data management support and coastal fisheries data now being archived on behalf of member countries by CFAP. This represents a major step forward from 1992 when only tuna data was being compiled.

In terms of number of staff, the SPC Coastal Fisheries Programme has changed as follows:

- In 1992, there were 11 internationally-recruited and 4 locally-recruited staff working on coastal fisheries.
- In 2007 (15 years later), there were 25 internationally-recruited and 5 locally-recruited staff in the Coastal Fisheries Programme.
- In 2022, there are 26 internationally-recruited and 5 locally-recruited staff in the Coastal Fisheries and Aquaculture Programme, although some additional coastal fisheries functionality also rests in activities administered by the Director's office.

In terms of recruitment policy, the informal CFP priority in the late 1990s and 2000s was to increase the Pacific Island national staff ratio to at least 50%, which was largely achieved in 2008. Given the high proportion of women in

### *The view from 1962*

In the course of writing this 30-year comparison, I also looked at the state of regional fisheries support 30 years before that, through the lens of the first SPC Regional Technical Meeting on Fisheries in 1962, 60 years ago (Anon., 1962). The shift in focus is noticeable. In 1962 it was all about developing fisheries for food security to support "rapidly growing island populations"<sup>1</sup> and resource appraisal was for the purpose of assessing the abundance of new resources for development, not to inform management plans. One of the biggest coastal fishery problems at the time was controlling the use of left-over World War II explosives to catch fish. In 1992, it was still about development, but the need to prevent overexploitation and restore overfished areas (reinforced in the public eye by the 1992 Rio Earth Summit) was starting to turn the region towards sustainable development, and the calls on SPC CFP time were as much to help national administrations deal with problems as to develop opportunities. In 2022, it is increasingly about conservation and restoration of nearshore ecosystems and heavily-targeted reef fishes, and aquaculture is seen as the only aquatic food production systems with future growth potential.<sup>9</sup>

<sup>7</sup> By some measures this is long overdue. The Chair of the 1st SPC Regional Technical Meeting on Fisheries in 1962 said: "It seems to me that the economic aspects of the fisheries of the Commission's area are vital elements in plans and programmes and are elements which are not presently well enough known to provide a basis for such planning and programming."

<sup>8</sup> Although the limits to growth of fisheries were clearly recognised at the time, and priority put on the need to determine those limits

<sup>9</sup> There is of course considerable scope for providing future Pacific Island food from oceanic pelagic tuna fisheries. However, this is no longer a matter of increasing total production, because WCPO tuna stocks are now more or less fully exploited. It is more about further "domesticating" or retaining more of the production of these primarily export-oriented fisheries, or of using the financial proceeds from these fisheries to finance other food sources. Different SPC members have different strategies in this regard.

university marine studies at the time, it was expected that the gender ratio of the coastal fisheries staff complement would inevitably rebalance and possibly even tip in the opposite direction by the 2020s, but that women would probably continue to need extra support and encouragement to enter fisheries science and programme leadership for some time after that.

## Aquaculture

It is difficult to fit aquaculture into a “then and now” format using SPC FAME work as a mirror on the sector because SPC did not have an aquaculture section in 1992. Regional-level support at the time came primarily from the FAO South Pacific Aquaculture Development Project (SPADP) based in Fiji, although it operated mainly through a relatively ad hoc set of activities based on national requests.

At the national level on the other hand, aquaculture has always been relatively strongly supported, and when I was working for Fiji, the national aquaculture budget was larger than the fisheries assessment and development budget. Aquaculture has also been the subject of a large number of regional reviews over the past few decades, with Lindsay et al. (2022) being the latest.

SPC had hosted a major aquaculture development activity in the early 1970s, as part of the UNDP South Pacific Islands Fisheries Development Agency (SPIFDA). According to governing council records in the SPC Library, SPIFDA had some serious management and communication problems with member countries, and UNDP did not renew the grant in 1973. However, during its three-year lifespan the

agency commissioned much significant research, including many aspects of aquaculture, such as culture and/or management of oysters, mussels, pearl shell, giant clam, trochus, mud crab, freshwater and marine prawns, mullet, milkfish and rabbitfish, and experiments aimed at enhancing natural populations of spiny lobster and turtles. Projects started by SPIFDA were the start of national aquaculture research facilities still operating in Fiji, New Caledonia and Palau (Adams and Dashwood, 1992).

Subsequently regional support for aquaculture took place through the FAO South Pacific Aquaculture Development Project managed by Hideyuki Tanaka through two FAO project cycles up to 1996. When SPADP closed, SPC was under considerable pressure from both FAO and member countries to take its place, although it was four years before funding could be found to do this because of the cynicism that had grown up around the prospects for Pacific Island aquaculture becoming sustainable, after several decades of donor and government investment (e.g. Uwate 1983). A new paradigm for SPC aquaculture support had to be found, and after discussion of potential modalities at the SPC 50th Anniversary Conference in Canberra (this was the Conference that changed the name of the South Pacific Commission to the Pacific Community<sup>10</sup>), AusAID provided initial funding for a new SPC aquaculture activity.

This new SPC aquaculture unit was to be concentrated not on providing countries with aquaculture development support, but in helping them to assess which of the many private sector aquaculture development proposals vying for their attention or seeking subsidies and concessions were likely to be economically, socially and environmentally feasible. It was felt that the most appropriate driver for aquaculture

<sup>10</sup> ... but kept the acronym “SPC” to refer to the Secretariat, as opposed to the collective membership.





development in the economy was the private sector, which could respond more nimbly to changes in costs and benefits than most governments. And it was felt that regional support was best concentrated in the area where most member countries' trade and foreign investment promoters seemed to have trouble making hard-headed decisions. So, the new SPC Aquaculture Section was set up in 2000 with the primary aim of providing economics-informed advice to member governments to help them judge if the (largely foreign) aquaculture investment projects that were being presented to them for approval would likely be more beneficial to the country than to the foreign investor, and that they would actually be economically and technically feasible.

In this initial aim we failed. Although there were some wild and woolly private-sector aquaculture proposals being floated around the region at the time, most SPC member governments were reluctant to seek external advice on such proposals, or perhaps they felt that SPC would not be able to respond quickly enough to satisfy other government agencies whose main aim was to reduce the difficulty of doing business by foreign investors, or in the fear that SPC advice would be negative and that investment opportunities would go elsewhere if sent for appraisal. And so, SPC's new aquaculture unit came to concentrate on its other aims – including helping countries to create a regulatory environment that would put aquaculture on a legally sound footing, to help establish better biosecurity for translocated aquatic species, and to generally support the development of best-practice national aquaculture development plans.

There was not a lot of *artisanal* aquaculture in the SPC region in 1992. Most of the aquaculture projects crossing the desks of Heads of Fisheries were commercial, and many of these were rather speculative. But some artisanal examples were the village-level (*Kappaphycus/Eucheuma*) seaweed farms being trialled in several countries based on initial growout studies in 1975 in Fiji (Singh et al. 1975) and 1977 in Kiribati (Russell 1982) and followed up for commercial development in the 1980s by Fiji, Solomon Islands, Kiribati and a few other SPC members.<sup>11</sup> In Fiji, there was considerable effort put into the development of artisanal tilapia farming with extension work supported by the USA Peace Corps using fry supplied by the Japan-funded government aquaculture research station at Nauruloulou. And International Center for Living Aquatic Resources Management (ICLARM) was helping establish village-based growout facilities for naturally produced aquarium fish fry, and hatchery-produced giant clams in the Solomons. Nauru had one of the few communities with a longstanding tradition of aquaculture, where milkfish fry was captured in the lagoon and transported to natural inland brackish lakes, particularly Buada, for growout (Spenneman 2002, R. Kun pers. comm.).

Each country has a different driver and a different story to tell about aquaculture. Again, most of these stories are not so much artisanal as commercial, from the black pearl farming in eastern Polynesia to the pond culture of live bait for the pole and line industry in Tarawa, and all seem to be affected by external factors more than the technical success of the culture process. When it came to fish farming for local food security, there was often no great competitive advantage to farming except in areas where wild fish are scarce – such as highland communities, and near overexploited reefs, or for domestic markets where fish prices were high.

But whatever the short-term or even medium-term difficulties, aquaculture is the way of the future if human populations keep expanding, because *wild* populations of currently fished species are definitely not expanding. At some point in the not-too-distant future Pacific Island EEZs will become valuable for more than just tuna.

## Conclusions:

### *Notable changes in the last 30 years*

The following by-no-means-exhaustive list of changes emerged from this quick personal review of coastal fisheries and aquaculture:

- *NGOs are now much more active, and not just in fisheries conservation but also in management* – particularly in the provision of support for community-based management. In 1992 the scarcity of NGOs with Pacific Island fisheries interests was remarked upon by global agencies and specialists visiting from other regions. This lack was usually put down to the fact that the Pacific Islands had organised much more support for themselves through regional institutions than other regions. But non-government services in support of coastal fisheries and ecosystem governance have expanded dramatically since then. Special mention must go to the Locally Managed Marine Area Network<sup>12</sup> as well as established international NGOs like the World Wide Fund for Nature and The Nature Conservancy.
- *Community-based artisanal fisheries management is now recognised as being normal, not exceptional nor a relic.* As mentioned earlier, Bob Johannes' 1981 book *Words of the Lagoon* played a big role in helping to establish the fact that community custodianship and traditional knowledge has a legitimate role to play in maintaining healthy artisanal fisheries. This carried an important message for governments, many of which were beginning to despair about the difficulty of ensuring their

<sup>11</sup> This however was hampered by a fluctuating world market price and major competition from lower-production and transport-cost countries like the Philippines, as well as the number of cyclones in Fiji.

<sup>12</sup> <https://lmmannetwork.org>

sustainability through direct action – through the kind of monitoring and management mechanisms being used in developed countries for commercial fisheries, and now in use in the Pacific Islands region for tuna fisheries. Devolved responsibility is really the only way forward for diffuse, non-commercial multispecies fisheries, especially in those areas where customary mechanisms are still in place.

- *Women's role in artisanal fishing is now quantified.* It may still not be quantified adequately, but in the early 1990s there was no quantitative information at all on the vast majority of women's fishing activity, as Dalzell et al. (1994, 1996) discovered when compiling their reviews of the status of coastal fisheries in the island region. The tide began to turn with the work of Patricia Tuara of the CFP Women's Fisheries Development Section, who began assessing the role of women in fisheries in several SPC member countries (eg Tuara, 1998). Later, in the 2000's Mecki Kronen and colleagues at the CFP Reef Fisheries Observatory carried out some intensive social participation studies at sites in almost every SPC island member country (see Kronen and Vunisea, 2009). The SPC *Women in Fisheries Information Bulletin*, which was first published in 1997, provides a very interesting chronicle of this emergence.<sup>13</sup>
- *Rapid assessment methodologies and indicators for identifying stocks needing action, and measuring the results of action, are becoming usable.* This was something high on the coastal fisheries wish-list in 1992 but seemed virtually unachievable at the time – at least for widescale application. Available methodologies required expenditure in

survey and monitoring that were beyond the capacity of most Pacific Island fisheries administrations.

- *Fundamental biological and ecological knowledge about reef fish and invertebrates has improved significantly.* We now know a lot more about longevity, recruitment, growth and the responses of populations and assemblages to exploitation. The rigorous management of fisheries involving dozens of species is still some way off, but progress has been significant.
- *The New Song is providing a long-sought regional framework for action in coastal, particularly community-based fisheries management, and progress is being measured.* The regional Coastal Fisheries Report Card now provides a mechanism that allows senior decision-makers to regularly review what is happening, at least at the regional aggregate level. And there is now an annual Regional Fisheries Ministers Meeting that allows national fisheries Ministers to discuss their coastal fisheries and aquaculture issues together – something that was rarely possible before 2020.
- *No-take MPAs and fishery management measures are no longer 'either/or' options.* The development of area-based management, the creation of demarcated areas that enable community-based management, the use of traditionally-founded *ra'ui/tabu/bul* temporary "fishery respite" closures and the rise of the Locally Managed Marine Area network have seen to that. There will always be disagreement between the ends of the belief spectrum ("is it better to put our scarce resources into completely protecting a few areas, or in trying to limit fishing impacts

<sup>13</sup> <https://coastfish.spc.int/en/publications/bulletins/women-in-fisheries>





across the entire area”), but constructive compromise seems to be more frequently achieved now than in 1992. And sometimes it is very constructive, although the latest version of the FAME Results Dashboard (<https://fameresults.org/>) suggests there is still a long way to go in scaling up effective coastal fisheries management.

- *Sharing information and experiences about coastal fisheries and aquaculture experiences between community and professional practitioners in different areas was identified as something needing strengthening, but does not appear to be particularly more advanced than in 1992.* Although the SPC Fisheries Information Section is producing excellent material and CFAP is increasingly bringing people together and documenting experiences, they were *already* producing strong output in 1992. It is excellent to see SPC still addressing the needs of an ever-evolving sector, but for several years this work was starved of resources. For example, the Heads of Fisheries meeting had been reduced to a two-year cycle and most of the coastal fisheries technical issues on the agenda had to be dropped entirely. For a while in the 2000s the annual number of opportunities for national coastal fisheries managers to get together at the regional level had dropped to less than one, while the number of tuna fisheries science and management meetings was expanding so much that we had to propose a “two-session rule” for WCPFC. In the 1980s and 90s, the Coastal Fisheries Programme used to run occasional major two-week workshop/conferences to bring national scientists and managers together and to document their advice and experience in a way that could be shared more widely. In fact, it was one such conference – the 1988 Inshore Fisheries Research Workshop – that was my first introduction to SPC. Bringing people together and documenting the results is resource-hungry and time-consuming, but it is essential if Pacific Island practitioners are to assist one another to progress. It is a personal view, but I have always felt that documenting, collating, publishing and disseminating both practical information and science is one of FAME’s core strengths and is something that SPC does better than any other regional agency. Perhaps the COVID pandemic experience has opened the door to more frequent dialogue through more cost-efficient virtual mechanisms, or perhaps even more resources need to be channelled in this direction.
- *The importance of marine spaces to Pacific Islanders is now globally recognised* – certainly much more so than it was in 1992. There was a long campaign by the CROP Marine Sector Working Group and by the Pacific Islands Forum and Pacific SIDS major groups at the UN to raise awareness about “large ocean developing states” through instruments like the Pacific Islands Regional Ocean Policy, and this also appears to have focussed global attention more specifically on watery issues that are important to the Pacific Islands. It is helping avoid the previous one-size-fits-all tendency for global

institutions, donors and big NGOs to assume that the problems and solutions for other oceans are the same as the problems and solutions for the western and central insular Pacific.

- *The direct value of subsistence fishing, and the indirect value of marine spaces, to small-island economies is now much better recognised.* In 1992 this was a plea to not just consider the value of commercial fisheries to the economy, as was mainly the case up until then, but for it to become clear just how valuable subsistence and artisanal fisheries are in nation-building. And to also recognise the role that marine spaces had in other sectors, particularly tourism. In large part this improvement has been due to the quantification of economic contributions of fisheries through the work of Bob Gillett and colleagues’ “Benefish” series (see Gillett 2016<sup>14</sup>).

Adams (1996) suggested several potential responses to the coastal fisheries issues that had been identified by SPC in the early 1990s. Most of the above points were on this wish-list. Progress on some of the other issues identified on the 1996 wish list is not so readily assessed, and information on whether they are implemented is too diffuse or unavailable for a quick review like this. These are mainly “research” items, but they may be worth mentioning:

- *Investigate to what extent small-island reef-fisheries depend on distant sources of recruitment, and the significance of “spillover” from reef MPAs for different resources.* This is something where considerable research has more recently been done. It would be interesting to review whether there are now definitive indications available that will be useful in Pacific Island fisheries practical conservation and management planning.
- *Map and estimate the area of coastal fishery habitat for different assemblages in each small island.* This would have been extremely useful for the kinds of broad-brush assessments we were doing in the early 1990s, particularly for sedentary species, to scale-up point observations to the whole island level. Remote sensing was in its infancy, and imagery was expensive. But the biggest stumbling block at the time was the fight for donor attention between different regional agencies. It seemed to be assumed that only one CROP agency could become the remote sensing analysis provider for the others.
- *Compile existing and new information on catch rates and yields of different tropical species under different levels of fishing pressure, from different gear, in different areas, to improve indicative baseline information on the way that stocks respond to exploitation. Make it widely available.* I don’t yet know how much of this has been achieved, or even whether it would still be considered useful. The coastal component of the EU-funded SPC PROCFish project had been originally designed to start this ball rolling but was

<sup>14</sup> A new Benefish update is expected in 2023.

subsequently redefined to concentrate on (relatively) quick snapshots at a few areas in each country rather than attempting the monumental task of setting up time-series monitoring and wide-area assessments.

With the benefit of 2022 hindsight, there were also some gaps in the 1996 list of needs that have since become obvious and are now being better addressed:

- *Provide predictions of the effects of climate change on artisanal fisheries and aquaculture* to assist SPC member countries and territories and communities to make informed decisions about adaptation or mitigation (and in the case of groupings of countries, information to assist in influencing the international community to reduce or avoid the global causes of warming)
  - Since around 2005, SPC has applied significant resources around climate change effects on fisheries, including the first major overview of the vulnerability of tropical Pacific fisheries and aquaculture to climate change (Bell et al. 2011), modelling predictions of climate change effects on the western and central Pacific Ocean (e.g. Nicol et al. 2022) and baseline assessments in a number of countries (e.g. Moore et al. 2012)
- Develop national and regional plans and policies to guide progress in coastal fisheries and aquaculture and to direct resources to the most important problems rather than being driven by crisis responses.
  - We did not consider this to be a priority issue at the time, but rather a mechanism to help address priority issues. However, some considered this to be a major omission. At the SPC level, it began to be addressed with the elevation of the Regional Technical Meeting on Fisheries (RTMF) to a more policy-oriented Heads of Fisheries (HoF) Meeting in 1999; a proposal to set up a regional Agreement on Coastal Fisheries Management (although this was not endorsed by HoF) and the development of a Strategic Plan for the Coastal Fisheries Programme in 2003, shortly after the arrival of SPC's first Planning Officer. Regional fisheries programme planning has of course gone from strength to strength since then, and national fisheries development plans and policies have proliferated, although some of these seem to have been driven by the need to give short-term donor projects something to.
- *Continually take into account the vulnerability of Pacific Island fisheries and aquaculture to market price changes.*
  - Fishery and aquaculture project development planners and banks often seem to assume that prices are predictable and downplay the risks, including the risk of flooding the market. Various Pacific Island marine products have fallen foul of this, including several that are important to the artisanal fishing and aquaculture communities such as black pearl, trochus shell,

“Eucheuma” (Kappaphycus) seaweed, and the tuna fisheries sector is certainly not immune. We often take natural resource limits and the danger of overfishing into account, or the dangers to mariculture of extreme weather events, but price forecasts in investment proposals – or at least the investment proposals that have come across my desk over the years – are usually optimistic. This is one of the reasons that regional fisheries development agencies need economists, and I was pleased to see this capacity added to the Coastal Fisheries and Aquaculture Programme several years ago. For a long time before that, fisheries economic advice had been considered the role of the Forum Fisheries Agency but FFA is focussed on commercial tuna fisheries.

- *Poaching:* I was going to make a new issue out of “blue boats” here, but the number of small vessels that were venturing far out of one specific province in one country in southeast Asia across the Pacific Islands region to plunder remote reefs appears to have peaked before 2020 and the problem solved primarily through diplomatic means. The ravaging of remote reefs has happened before (for example there was a major spike in harvesting of giant clams by South Asian longliners in the 1980s – also solved primarily by international dialogue, although this time involving CITES<sup>15</sup> at the importing end), and it will probably happen again. The SPC members closest to insular and mainland Asia have *always* been more vulnerable to poaching, including being at the forefront of live reef fish poaching in the 2000s. Illegal, Unregulated and/or Unreported (IUU) fishing had been seen as an oceanic commercial fisheries issue because the terminology grew out of the problems caused by vessels flying flags of convenience. But illegal fishing occurs at all levels, and the process of assisting coastal fishers to comply with government regulations or community rules has usually been grossly under-resourced. SPC now has a coastal fisheries MCS (monitoring, control and surveillance) support unit to help member countries address local compliance issues.

I won't attempt to predict how the national fisheries administrations and the SPC Coastal Fisheries and Aquaculture Programme might respond to all the points raised in these conclusions. There are already comprehensive planning systems in place whose job is to do that. My job was to look at what has changed in the last 30 years.

But I have been impressed. The net change is definitely for the better, and while there has been slower progress in the region that I would have hoped on some issues, there has been better progress on many more, including some that I would never have thought possible.

Regarding SPC's role in all of this, I think my only real note of caution would be about what appears to be the extreme reduction in coastal fisheries “development” functions. Even if the limits to exploitation have already been reached or



surpassed in most coastal fisheries, and even if any significant future expansion of local food or marine product export supply lies in freshwater aquaculture and mariculture, I think SPC coastal fisheries still needs to be able to provide advice, support and training on improving efficiency in the artisanal fishery value chain, whether that be in reducing fishing costs, in processing and preservation, in reducing wastage of fish, in marketing etc. Assisting artisanal fishers to get the most out of what they already have is going to become more and more important as resource sustainability limits tighten.

I asked a fairly rhetorical question at the start of this article: Has the management of coastal fisheries in the Pacific Islands developed an “amalgam of conventional approaches, including those where data are gathered according to sampling criteria to test hypotheses, and the less data-intensive approach advocated by Johannes” as predicted by Dalzell et al. (1996)? Given the expansion of community-based and co-management approaches, coupled with the intensification of research and compilation of knowledge, I think the answer is “yes”. We still have the data-intensive approach exemplified by the recent presentation to the 14th SPC Heads of Fisheries Meeting on “Building a sustainable approach to collection and use of coastal fisheries data for effective management” (Magron and Halford 2022), but we also have the burgeoning of community-based management approaches described in SPC et al. (2021).

## References

- Adams T.J.H. and Dashwood J. 1992. Research in the Pacific Islands on coastal fisheries - An SPC Perspective. Paper prepared for a Coordinators meeting of the Australian Centre for International Agricultural Research. [16] p. <https://purl.org/spc/digilib/doc/furz3>
- Adams T.J.H., Richards A., Dalzell P.J. and Bell L. 1995. Research on Fisheries in the Pacific Islands Region. In Proceedings of the SPC/FFA Workshop on the Management of Pacific Island Coastal Fisheries. ICFMaP Technical Document 12: 87-166. SPC, Noumea. <https://purl.org/spc/digilib/doc/2mk6p>
- Adams, T.J.H. 1996a. Institutional future of the SPC Coastal Fisheries Programme. Working Paper 5, 26<sup>th</sup> Regional Technical Meeting on Fisheries, Noumea, New Caledonia, 5 - 9 August 1996. 7 p. <https://purl.org/spc/digilib/doc/yw553>
- Adams, T.J.H. 1996b. Coastal Fisheries and Marine Development Issues for Small Islands. Paper presented at the Fisheries panel discussion of the IUCN World Conservation Congress Marine and Coastal Workshop, Montreal, Canada, 17-18 October 1996. Published on p 40-50 in M. J. Williams (ed) A roadmap for the future for fisheries and conservation. ICLARM Conference Proceedings 56. <https://purl.org/spc/digilib/doc/7wdao>
- Adams T., Bell J., and Labrosse P. 2001. Current status of aquaculture in the Pacific Islands. In R.P. Subasinghe, P. Bueno, M.J. Phillips, C. Hough, S.E. McGladdery and J.R. Arthur, eds. Aquaculture in the Third Millennium. Technical Proceedings of the Conference on Aquaculture in the Third Millennium, Bangkok, Thailand, 20-25 February 2000. NACA, Bangkok and FAO, Rome.
- Adams T., Friedman K., Kronen M., Pinca S., Ponia B., and Chapman L. 2008. Status report: Nearshore and reef fisheries and aquaculture. Noumea, New Caledonia: Secretariat of the Pacific Community. 37 p. <https://purl.org/spc/digilib/doc/66mrt>
- Anon. 1962. (Report of the 1<sup>st</sup> SPC) Fisheries Technical Meeting. Noumea, New Caledonia, 5th-13th February 1962. <https://purl.org/spc/digilib/doc/mjzth>
- Anon. 1996. Report of the 26<sup>th</sup> SPC Regional Technical Meeting on Fisheries. Noumea, New Caledonia, 5-9 August 1996. 100p <https://purl.org/spc/digilib/doc/34ff2>
- Anon. 2013. Status Report: Reef and Nearshore Fisheries and Aquaculture: Annex to Working Paper 1. SPC Heads of Fisheries Meeting, Noumea, New Caledonia, 4-8 March 2013, 8th. 45 p. <https://purl.org/spc/digilib/doc/ivpjz>
- Bell J.D. and Gervis M. 1999. New species for coastal aquaculture in the tropical Pacific - constraints, prospects and considerations. Aquaculture International 7:207-223
- Bell J.D., Johnson J.E. and Hobday A.J. 2011. Vulnerability of tropical Pacific fisheries and aquaculture to climate change. Noumea, New Caledonia: Secretariat of the Pacific Community. 925 p. <https://purl.org/spc/digilib/doc/en9j3>
- Crocombe R. 1994. Workshop overview. In Traditional marine tenure and sustainable management of marine resources in Asia and the Pacific, G. R. South, et al. (eds). Suva: International Ocean Institute-South Pacific, 291-300.
- Dalzell P.J. and Adams T.J.H. 1994. The status of Pacific Island Coastal Fisheries. Working Paper 8. 25th SPC Regional Technical Meeting on Fisheries, March 1994. South Pacific Commission, New Caledonia. <https://purl.org/spc/digilib/doc/b6jqx>
- Dalzell P.J., Adams T.J.H. and Polunin N.V.C. 1996. Coastal Fisheries of the Pacific Islands. Oceanography and Marine Biology: An Annual Review 34, 395-531 <https://purl.org/spc/digilib/doc/zc9yq>
- Gillett R. and Lightfoot C. 2002. The Contribution of Fisheries to the Economies of Pacific Island Countries. Pacific Studies Series, Asian Development Bank, World Bank, Forum Fisheries Agency, Secretariat of the Pacific Community, 218 p. <https://www.adb.org/publications/contribution-fisheries-economies-pacific-island-countries>
- Gillett R. 2016. Fisheries in the economies of Pacific Island countries and territories. Noumea, New Caledonia: Pacific Community. 684 p. <https://purl.org/spc/digilib/doc/pvyuo>

<sup>15</sup> Convention on International Trade in Endangered Species

- Gillett R. and Tauati M.I. 2018. Fisheries in the Pacific. Regional and national information. FAO Fisheries and Aquaculture Technical Paper No. 625. Apia, FAO. [https://gillettprastonassociates.com/?smd\\_process\\_download=1&download\\_id=81](https://gillettprastonassociates.com/?smd_process_download=1&download_id=81)
- Govan H. 2015. Preliminary review of public expenditure of the fisheries agencies of Pacific Island countries and territories: Policy, operational budget and staffing support for coastal fisheries. 25 p. <https://purl.org/spc/digilib/doc/43c9k>
- Hare S.R., Williams P.G., Castillo-Jordan C., Hamerton W.J., Scott R.D. and Pilling G.H. 2021. The western and central Pacific tuna fishery: 2020 overview and status of stocks. Tuna Fisheries Assessment Report no. 21. Noumea, New Caledonia: Pacific Community. 53 p. <https://purl.org/spc/digilib/doc/qkpa2>
- Lindsay S., Lindley R., Lam M. and Lassauce H. 2022. Assessment of the Aquaculture needs, priorities and future direction in the Pacific Islands Region. Information Paper 12, 14<sup>th</sup> SPC Heads of Fisheries Meeting, Noumea [https://www.spc.int/DigitalLibrary/Doc/FAME/Meetings/HOF/14/HoF14\\_IP12.pdf](https://www.spc.int/DigitalLibrary/Doc/FAME/Meetings/HOF/14/HoF14_IP12.pdf)
- Johannes R.E. 1981. Words of the Lagoon: Fishing and Marine Lore in the Palau District of Micronesia. 245 p. University of California Press, Berkeley [https://archive.org/details/bub\\_gb\\_TloVDfV7QLoC/page/n1/mode/2up](https://archive.org/details/bub_gb_TloVDfV7QLoC/page/n1/mode/2up)
- Johannes R.E. 1994. Design of tropical nearshore fisheries extension work beyond the 1990s. In Traditional marine tenure and sustainable management of marine resources in Asia and the Pacific, G. R. South, et al. (eds). Suva: International Ocean Institute-South Pacific, 162-74 in [https://www.researchgate.net/publication/259716670\\_The\\_Collected\\_Works\\_of\\_RE\\_Johannes\\_Publications\\_on\\_Marine\\_Traditional\\_Knowledge\\_and\\_Management](https://www.researchgate.net/publication/259716670_The_Collected_Works_of_RE_Johannes_Publications_on_Marine_Traditional_Knowledge_and_Management)
- Johannes R.E. 1998. The case for dataless marine resource management: Examples from tropical nearshore fisheries. Trends in Ecology and Evolution, 13, 243-246. in [https://www.researchgate.net/publication/259716670\\_The\\_Collected\\_Works\\_of\\_RE\\_Johannes\\_Publications\\_on\\_Marine\\_Traditional\\_Knowledge\\_and\\_Management](https://www.researchgate.net/publication/259716670_The_Collected_Works_of_RE_Johannes_Publications_on_Marine_Traditional_Knowledge_and_Management)
- Hampton J., Lewis A.D. and Williams P.G. 1999. The Western and Central Pacific Tuna Fishery: 1998 Overview and Status of Stocks. 39p. Tuna Fisheries Assessment Report / Secretariat of the Pacific Community. Oceanic Fisheries Programme <https://purl.org/spc/digilib/doc/oir89>
- Kearney R. 1981. A brief review of the state of the stocks of highly migratory species of fish in the Central and Western Pacific. 31p. Skipjack Survey and Assessment Programme, South Pacific Commission, Noumea. <https://purl.org/spc/digilib/doc/xqbfz>
- Kronen M. and Vunisea A. 2009. Fishing impact and food security - Gender differences in finfisheries across Pacific Island countries and cultural groups. SPC Women in Fisheries Information Bulletin 19:3-10. <https://purl.org/spc/digilib/doc/62p74>
- Magron F. and Halford A. 2022. Building a sustainable approach to collection and use of coastal fisheries data for effective management. Presentation to the 14<sup>th</sup> SPC Heads of Fisheries Meeting, SPC, Noumea. [https://www.spc.int/DigitalLibrary/Doc/FAME/Meetings/2022/2022/Day2\\_05\\_Sustainable\\_Approach\\_to\\_CF\\_data\\_collection.pptx](https://www.spc.int/DigitalLibrary/Doc/FAME/Meetings/2022/2022/Day2_05_Sustainable_Approach_to_CF_data_collection.pptx)
- Nicol S., Bell J., Johnson J. and Smith N. 2022. FAME's work programme on climate impacts on Pacific fisheries and ocean ecosystems. Working paper 4. 14<sup>th</sup> Heads of Fisheries Meeting, 14-17 June 2022. Noumea, New Caledonia: Pacific Community. 12 p. [https://www.spc.int/DigitalLibrary/Doc/FAME/Meetings/HOF/14/HoF14\\_WP4\\_EN.pdf](https://www.spc.int/DigitalLibrary/Doc/FAME/Meetings/HOF/14/HoF14_WP4_EN.pdf)
- Russell D.J. 1982. Introduction of *Eucheuma* to Fanning Atoll, Kiribati, for the purpose of mariculture. Micronesica 18, 35-44. <https://micronesica.org/sites/default/files/gracilariaandpolycavmenesesandabboto.pdf>
- Singh A., Booth W., Raj U., Zucher W.H. and Nielsen S.A. 1975. Investigation of marine plants: Progress report. School of Natural Resources, University of the South Pacific, Suva. 22p.
- SPC. 2015. A new song for coastal fisheries - pathways to change: The Noumea strategy. Noumea, New Caledonia: Pacific Community. 16 p. [https://www.spc.int/DigitalLibrary/Doc/FAME/Reports/Anon\\_2015\\_New\\_song\\_for\\_coastal\\_fisheries.pdf](https://www.spc.int/DigitalLibrary/Doc/FAME/Reports/Anon_2015_New_song_for_coastal_fisheries.pdf)
- SPC, LMMA and UOW. 2021. Scaling-up community-based fisheries management in the Pacific region [Information Paper]. Noumea, New Caledonia: Pacific Community. 4 p. <https://purl.org/spc/digilib/doc/cc937>
- SPC. 2022. Future of fisheries: Coastal fisheries report card 2022 <https://fame.spc.int/en/publications/roadmap-a-report-cards>
- Spennemann Dirk H.R. 2002. Traditional milkfish aquaculture in Nauru. Aquaculture International 10(6). DOI: 10.1023/A:1023900601000
- Tuara P. 1998. An assessment of the role of women in fisheries in the Republic of the Marshall Islands. Noumea: SPC Women's Fisheries Development Section. 31 p. <https://purl.org/spc/digilib/doc/te9gn>
- Uwate D.K.R. 1983. Aquaculture development: the Pacific way? [Background Paper 2]. Noumea, New Caledonia: South Pacific Commission. 15<sup>th</sup> Regional Technical Meeting on Fisheries, Noumea, New Caledonia, 1 - 5 August 1983. 7 p. <https://purl.org/spc/digilib/doc/rvkwr>