

Fisheries

Newsletter



Pacific
Community
Communauté
du Pacifique

171 | May–August 2023

ISSN: 0248-0735

SPC
activities



Regional
news



Feature
articles



FAME
Fisheries,
Aquaculture
and Marine
Ecosystems
Division

In this issue



SPC activities

- 3 Beyond the reef: A journey towards sustainable coastal fisheries
by Hugo Nguyen
- 7 Echoes of Oceania: The sound of successful community-based fisheries management resonates across the Pacific Islands
by the SPC CBFM team, Watisoni Lalavanua and Céline Muron
- 11 New legal guide to community-based fisheries management in the Pacific Islands is available online!
by Ariella D'Andrea, Solène Devez and Sofia O'Connor
- 12 The 16th campaign of the Pacific Tuna Tagging Programme starts soon!
by Aurélie Guillou



News from in and around the region

- 13 Engaging and hearing the voice of community-based fisheries civil society organisations: The Second Community-Based Fisheries Dialogue
by Afelee Falema Pita
- 18 Marshall Islands win the "Stop IUU Fishing" Meritorious Award
by Francisco Blaha
- 20 Reviewing the implementation of FAO's Small-Scale Fisheries Guidelines: Two Pacific Islands for the Too Big To Ignore Global Partnership's book
by Giulia Marchi, Ariella D'Andrea and Julia Nakamura



Feature articles

- 23 Review of fish fauna and recently conducted fisheries research in French Polynesia
by René Galzin, Morgan Antoine, Philippe Bacchet, Taiana Darius, Benoit Espiau, Mireille Harmelin-Vivien, Rakamaly Madi Moussa, Christophe Missélis, Georges Remoissenet, Vahine A. Rurua, Gilles Siu and Marguerite Taiariu
- 37 Knowledge and information gaps in fisheries management among indigenous communities in Solomon Islands
by George Leinga, Anouk Ride, Janet Saeni-Oeta and Peter Kenilorea
- 49 Towards improved governance, management and sustainability of the demersal line fishery in Tonga
by Brad Moore, Taaniela Fe'ao, Heilala Fifita, Matini Finau, Stu Hanchet, Makeleta Malimali, Siola'a Malimali, Andy McKenzie, Poasi Ngaluafe, Steve Parker, William Sokimi, Aleki Taumoepeau, Lavinia Vaipuna and Tu'ikolongahau Halafihi



Beyond the reef: A journey towards sustainable coastal fisheries

The Pacific Community has developed a training toolkit on nearshore fishing practices focusing on the more resilient pelagic species beyond the reef edge. The toolkit includes a written manual, a series of training videos entitled “Fish and Tips” and a photo exhibition to promote alternative livelihood options to Pacific Island fishing communities.



Watisoni and Stefani celebrating their first catch during the filming of Fish and Tips season 1. ©SPC

A pressing need to fish beyond the reef

In the past, Pacific Island populations were much smaller than they stand today. Recent population growth throughout the Pacific has led to the overfishing of fish and invertebrates on many islands. As a result, sustainable ways to harvest our *kai moana* (food) are needed. While doing so, we need to consider that those fisheries closest to shore, focused on reef fish, have always been easier to target and are therefore more likely to see their stock threatened. In this context, *Beyond the reef* invites us all to embark on a journey towards a sustainable future, through a careful blend of traditional knowledge and modern technology, to discover the many secrets to catching tuna, mahi mahi and other fish outside the reef.

Nearshore fishing

Nearshore fishing refers to catching fish beyond the edge of the reef and targeting the more resilient pelagic species that live there. It includes a wide range of fishing techniques, such as trolling, mid-water line fishing, vertical longlining and deep-water fishing. When done safely and smartly, using the benefits of fish aggregating devices (FADs), these techniques can help move fishing efforts away from coastal habitats and therefore reduce pressure on inshore fish species. For our generation and those to come, nearshore fishing methods not only provide a chance to diversify our catches and selling opportunities, but also the hope to restore balance in our inshore marine resources.





Gaffing a mahi mahi. @SPC



Traditional techniques with some very modern tricks

The art of fishing, along with the necessity of catching seafood, are key themes in our culture, traditions and conversations. With the help of Pacific master fishers, the Pacific Community (SPC) is re-introducing some fishing practices that have been used for centuries, modified only in terms of the materials used, and other traditional methods that have evolved based on experiences from elsewhere.

Drop-stone fishing is a good example of a fishing technique passed down through the generations. This method involves dropping bait and chum to a predetermined depth with the help of a simple stone. The stone serves as a temporary sinker before it is released so the bait hangs naturally in the water. Many people consider this method to be sustainable not only because it targets resilient species, but also because it uses readily available materials, such as leaves, stones or old clam shells.

Nearshore fishing

Nearshore fishing is when fish are caught beyond the edge of the reef. It includes using techniques such as drop-stone fishing, palu-ahi and many more!

Moving fishing efforts from coastal habitats to offshore may reduce pressure on inshore fish species and potentially allow their numbers to increase.



The nearshore zone starts from outside the reef or lagoon, and goes out to about 12 nm.

Fish aggregation devices improve fishing performance and sea safety.

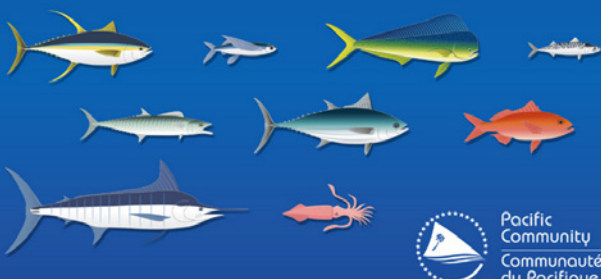


By fishing beyond the reef edge, you target the more resilient pelagic species, such as tuna, and leave the lagoon fish alone.



Which fish species?

Using these techniques, you can catch pelagic fish species, such as tuna, mahi mahi, wahoo, rainbow runner and mackerel.



Pacific Community
Communauté du Pacifique

Drop-stone fishing

Use a stone to drop the bait at your desired fishing depth and then let it sink so your bait hangs naturally in the water.



Place the baited hook on the leaf.



Place pieces of chum over the bait.



Fold the leaf over the bait and chum.



Place the package in a clam shell or on a stone.



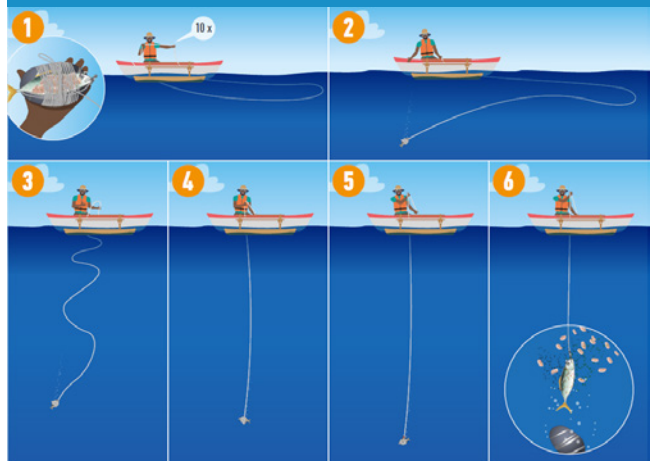
Take several steps of the leader line around the shell or stone to hold the package in place, and make the 3 last wraps over your thumb.



Form a loop and pass it twice around the 3 wraps. Pull on the end of the loop to tighten the whole package.



How to release the package?



A glimpse of "Beyond the reef", SPC's brand new exhibition on nearshore fishing techniques.

A multi-channel dissemination

The training toolkit on nearshore fishing methods was initially developed as a written manual, detailing nearly 20 fishing techniques, before being progressively adapted into a series of training videos and a photo exhibition. This multi-media learning adventure was captured regionally with the passion and talent of William Sokimi, Ian Bertram, Soni Lalavanua, Stephanie Sefeti and Kura Happ, showcasing the transmission of traditional knowledge from master fishers to eager learners. The resources will regularly accompany William Sokimi (SPC master fisher) on his trips to Pacific Island countries and territories to deliver local fishing training to coastal communities.

The training toolkit on nearshore fishing was produced under the governance of the Pacific-European Union Marine Partnership (PEUMP) programme,¹ the Sustainable Coastal Fisheries and Aquaculture for Pacific Livelihoods, Food and Economic Security (SCoFA)² and the Pacific Coastal Fisheries Management and Compliance (PaFMaC)³. It was produced with the financial support of the European Union, the Government of Sweden, the New Zealand Aid Programme, the Australian Government and the United States Agency for International Development (USAID).

Links for Fish and Tips:

Nearshore fishing techniques: A manual for community fishers in the Pacific Islands:

<https://www.spc.int/DigitalLibrary/Get/z3dwf>

Fish and Tips - YouTube playlist:

https://www.youtube.com/playlist?list=PLCq-WnF3Hdrg8ioa5uTQSIDRJ_LWZs6pt

The contents of this toolkit are the sole responsibility of SPC and do not necessarily reflect the views of the Government of the European Union, the Government of Sweden, the Government of New Zealand, the Government of Australia, or the Government of the United States.

For more information:

Hugo Nguyen

Information and Outreach Assistant Officer, SPC
hugon@spc.int



Ian and Kura preparing the gear for palu-ahi fishing. @SPC



William and Soni preparing a cannonball. @SPC

¹ <https://fame.spc.int/about/our-projects/peump>

² <https://fame.spc.int/about/our-projects/SCoFA>

³ <https://fame.spc.int/about/our-projects/PaFMaC>

Echoes of Oceania: The sound of successful community-based fisheries management resonates across the Pacific Islands

Access the platform
<https://cbfm.spc.int/>

Fishers in Papua New Guinea. Image: Elodie Van Lierde, ©SPC

A new platform to support community-based fisheries management practitioners in the Pacific Islands has been launched (<https://cbfm.spc.int/>). It aims to enhance the resilience of coastal fisheries by creating a space for effective knowledge sharing and trusted sources of information. Pacific Island communities are central to coastal fisheries management because they depend on marine resources for their livelihoods, cultural heritage and wellbeing. The people in these communities are also a rich source of traditional knowledge, which is essential for site-specific management, and this platform is built upon their experiences and stories.

What is community-based fisheries management?

Community-based fisheries management (CBFM) refers to management approaches that are driven by communities. By enabling communities to take the lead in managing their coastal fisheries resources, this style of management encompasses an ecosystem approach that will sustain livelihoods and ensure resilient island communities. Recognising that coastal resources are under increasing threat of overfishing, now exacerbated by climate change, Pacific Island countries and territories have agreed through regional and sub-regional policies to scale-up coastal fisheries management incorporating CBFM approaches.

Why an online portal on CBFM?

While the different CBFM approaches and activities applied by Pacific Island countries and territories are documented, information and tools are often scattered and not easily accessible. An online portal, Echoes of Oceania

supports the implementation of the *Pacific Framework for Action on Scaling up CBFM: 2021–2025*¹ by serving as a regional e-platform for CBFM in the Pacific.

Echoes of Oceania aims to assist governments, communities and other CBFM practitioners to easily access and share CBFM information and knowledge to enable them to make informed decisions about the management of coastal resources. It also raises the profile and understanding of CBFM in the Pacific region, and enhances capacity and knowledge on establishing and sustaining CBFM.

What does Echoes of Oceania stand for?

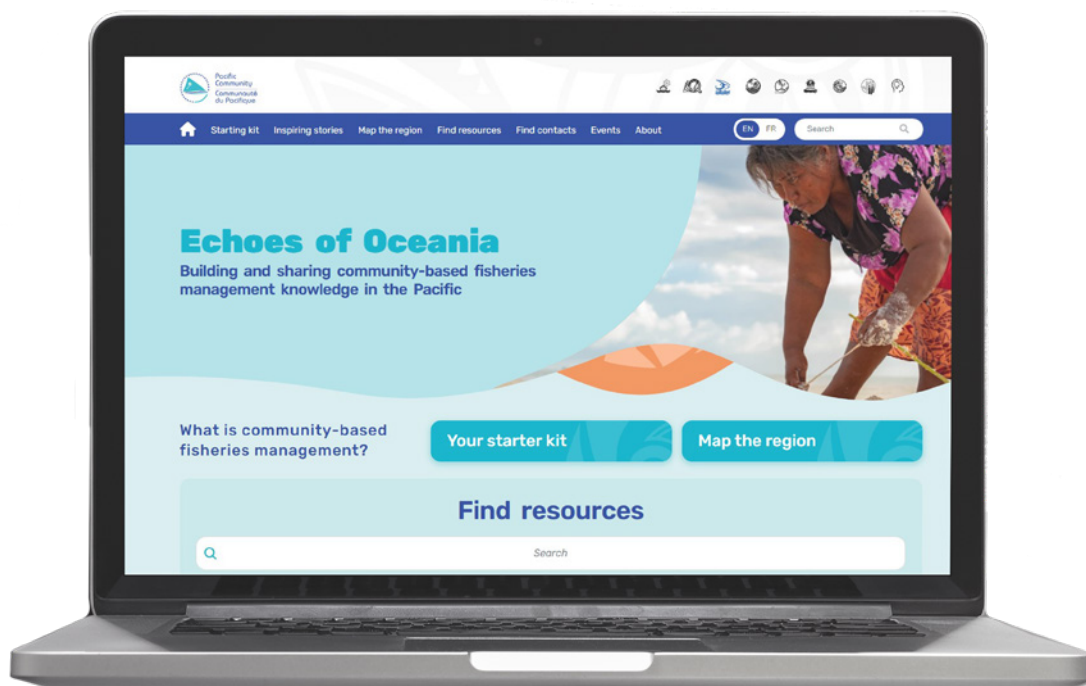
The peoples of Oceania echo a deep voice that carries all traditional knowledge and wisdom. The name “Echoes of Oceania” is also meant to evoke the idea of passing down knowledge and wisdom from one generation to the next. Just as, for example, a father teaches his daughter how to fish and care for the marine resources as a way of showing his deep love for his family.

¹ <https://purl.org/spc/digilib/doc/yr5yv>

Echoes of Oceania serves as a platform for sharing and preserving the knowledge and practices of CBFM in the Pacific region so that it may be passed on to future generations – the Pacific Way of managing coastal fisheries. The name represents the continuity and preservation of knowledge, culture and tradition in Pacific communities.

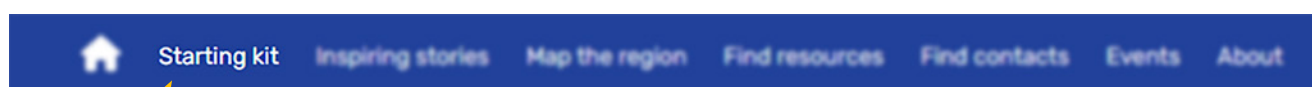
Who is it for?

It's for anyone involved in CBFM! Echoes of Oceania is designed to serve multiple audiences, including CBFM practitioners such as government agencies, fisheries officers, non-governmental organisations and civil society organisations, academic institutions, regional organisations, media, donors and students.



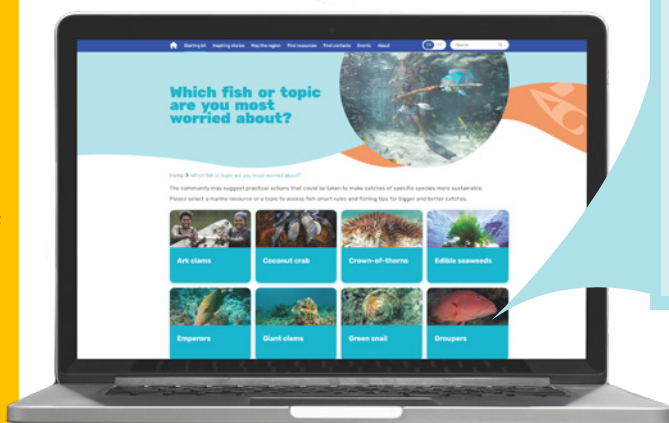
What does it contain?

The platform already has a lot of well-curated resources which are easy to find. It is organised into the following sections, here illustrated with screenshots from the portal:



Starting kit

This section details the main steps for starting a CBFM programme and practical solutions for managing your marine resources, such as the recommended fish smart rules for different species.



Fish smart rules

Clear restrictions

- A ban on gill nets which, especially if used on spawning aggregations, have been responsible for reducing the number of breeding fish.
- A ban on spear fishing at night, which has been responsible for removing many large fish from extensive areas of reef.



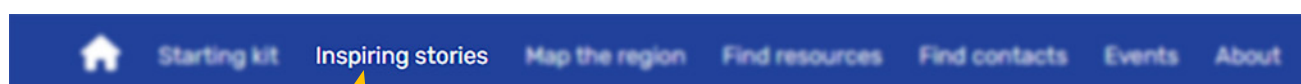
Tabu areas (Fish reserves)

- A ban on fishing in areas (sites) where spawning aggregations occur – which assumes that the community has some control over the spawning sites which may be some distance away.



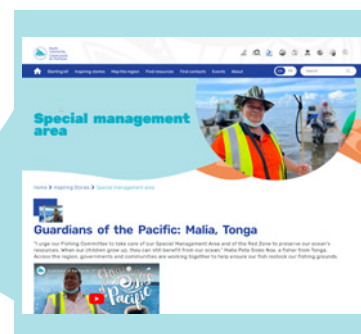
Temporary bans

- A ban on fishing during the peak of the spawning season, which may involve several short closures at monthly intervals as some species appear to aggregate at particular times in the spawn cycle.



Inspiring stories

Here you can find many inspirational stories and video testimonies, of people like Malia from Tonga who is part of the special management area committee. She explains what she does to support her community and preserve their fishing grounds.

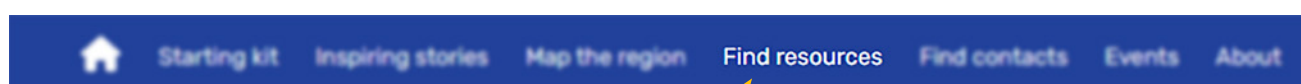


Map the region

You can map the region by country or by project.

The country profiles contain an overview of CBFM, including key indicators of the status of CBFM for each country, such as the number of communities already implementing CBFM. You can also find practical information for each Pacific Island country or territory, including:

- the legal framework for CBFM
- supporting policies
- main contacts
- useful links to related content
- associated websites where available

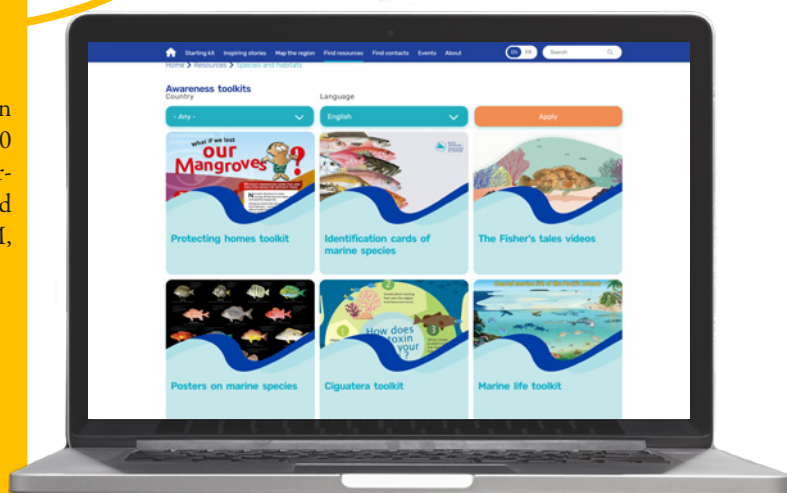


Find resources

CBFM specific resources

Our resource database, which is a curated collection from existing SPC databases, already has more than 500 documents relevant to CBFM and is now open to external contributions. You can use the search tool to find documents relevant to the implementation of CBFM, including:

- technical reports
- articles
- guides and manuals
- awareness tools and toolkits
- management plans

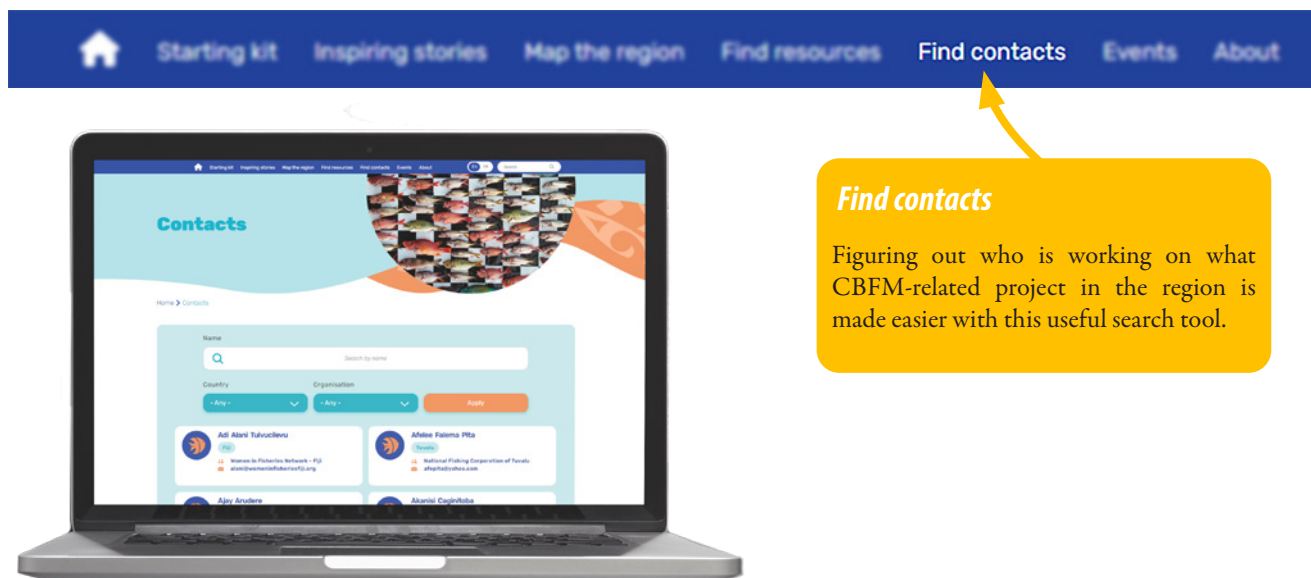


Structured for easy searching

The information is also structured to make it easier for you to find topic-centred resources. For example, if you are searching for species and habitat-related awareness tools, you will find nine awareness toolkits.

Accessibility

You can also filter by country and language – there are already search filters for 15 local languages used in the Pacific region in addition to English and French.



Acknowledgements and disclaimer

This platform was produced under the governance of the Pacific-European Union Marine Partnership programme, the Sustainable Coastal Fisheries and Aquaculture for Pacific Livelihoods, Food and Economic Security and the Pacific Coastal Fisheries Management and Compliance activities.

It was produced with the financial support of the European Union, the Government of Sweden, the New Zealand Aid Programme, the Australian Aid Programme and the United States Agency for International Development.

The contents of this platform do not necessarily reflect the views of the European Union, the Government of Sweden, the Government of New Zealand, the Government of Australia, or the Government of the United States.

How can you contribute?

The success of the platform very much depends on the participation of the people it serves. You can contribute by sharing relevant resources and information on CBFM in your country (current projects, testimonies, contacts, etc.). Please get in touch and send them to the SPC CBFM team at: cbfm@spc.int

For more information:

SPC CBFM team

cbfm@spc.int

Watisoni Lalavanua

Community-Based Fisheries Adviser, SPC
watisonil@spc.int

Céline Muron

Information and Outreach Officer, SPC
celinem@spc.int



New legal guide to community-based fisheries management in the Pacific Islands is available online!

Context

The new *Legal guide to enabling and strengthening coastal fisheries co-management in the Pacific*¹ was published in March 2023 to assist Pacific Island countries and territories (PICTs) in creating a legal space for local communities to manage marine areas and resources. The guide reviews legislation on community-based fisheries management (CBFM) in the Pacific and provides examples of legal frameworks formalising CBFM practices around the world.

The aspirations of PICTs for coastal fisheries are summarised in the goal of the *Pacific Framework for Action on Scaling up Community-based Fisheries Management: 2021–2025*,² which reads: “Coastal communities are empowered and supported as crucial for scaling up effective management to ensure sustainable coastal fisheries provide benefits to Pacific peoples in terms of food, nutrition, livelihood, culture and health” (page 2).³ To achieve this goal, the framework underscores that CBFM scaling up must be adequately supported in legislation.

About the guide

The *Legal guide* is for PICT fisheries managers, lawyers, policy makers and CBFM practitioners who are interested in exploring the interface between statutory law and traditional practices in order to facilitate scaling up of CBFM within their country or territory. It was prepared jointly by the Environmental Law Institute (ELI) and the Pacific Community (SPC), with New Zealand funding.

Through this guide, we hope to inspire PICTs and CBFM practitioners through current examples of legislation that illustrate how fisheries co-management works in different countries, bearing in mind that each legal reform must be carefully adapted to local needs and conditions. The guide also identifies the main principles for effective CBFM legislation and explores six main aspects of CBFM governance: area designation and boundaries; community rights and powers; CBFM planning; CBFM committees; monitoring and enforcement; and local by-laws.

¹ O'Connor S., D'Andrea A., Recio-Blanco X., Devez S. 2023. Legal guide to enabling and strengthening coastal fisheries co-management in the Pacific. Nouméa, New Caledonia: Pacific Community. 212 p. <https://purl.org/spc/digilib/doc/s5b7j>

² <https://purl.org/spc/digilib/doc/yr5yv>

³ The framework was endorsed by PICTs at the 13th SPC Heads of Fisheries Meeting and at the Second Regional Fisheries Ministers Meeting.

Next steps

The guide is intended as an educational toolbox to be used for training purposes. It brings together, in an unprecedented way, over 120 examples of legal provisions on CBFM taken from a selection of 26 laws and regulations from 15 PICTs and 19 laws and regulations from other world regions (Africa, Asia, Central and North America, and Europe). It also includes 12 sample provisions on CBFM that were drafted by the authors.

The *Legal guide* will be launched at the 6th Regional Technical Meeting on Coastal Fisheries and Aquaculture (RTMCFA6) in November 2023. The meeting will be an opportunity for SPC members to discuss their training needs on legal matters related to fisheries co-management and to request legal support for implementing their national strategy for scaling up CBFM.

For more information:

Ariella D'Andrea

Legal Adviser (Coastal Fisheries and Aquaculture), SPC
ariellad@spc.int

Solène Devez

Legal Research Assistant, SPC
solened@spc.int

Sofia O'Connor

Acting Director, Ocean Program, ELI
occonnor@eli.org



The 16th campaign of the Pacific Tuna Tagging Programme starts soon!

The Pacific Tuna Tagging Programme (PTTP) was launched in 2006 by the Pacific Community (SPC). After an initial phase focusing on the Papua New Guinea and Solomon Island economic exclusive zones (EEZs), the project now alternates every other year between Western Pacific (WP) cruises, targeting skipjack tuna, and Central Pacific (CP) cruises, oriented on bigeye tuna (BET) and yellowfin tuna (YFT). The main goal is to augment data collection for studies on tuna movements, exploitation rates and fish aggregating device (FAD) association dynamics. All this information is used for the assessment and management of tunas in the Pacific Ocean. In addition, as tagging cruises have progressed, experiments have been developed to collect more data, including archival tags to collect more precise data on movements and behaviour, injection of strontium chloride (SrCl_2) to study fish growth, and collection of organs (stomach, liver, gonads, etc.) to study tuna and associated species biology. To date, over 422,000 tuna have been tagged and released in the PTTP initial phase and the successive six WP cruises, and close to 58,000 tuna during the 15 CP cruises, as detailed in the figure below.

After the 2022 WP6 pole and line cruise that successfully released almost 17,000 tagged tuna in Solomon Island waters, the PTTP is planning a new CP tagging cruise (CP16). This 45-day cruise departed from Honolulu on 15 August 2023 (HI, USA). FV *Gutsy Lady 4*, chartered by SPC since

CP11 (2015), will again be the tagging platform manned by a crew of 10 people. SPC plans to tag and release a total of 4000 BET and YFT with yellow conventional tags, and 200 BET with white tags (fish with otoliths marked with SrCl_2). The boat team will target drifting FADs in a research area comprising the Line Islands (Kiribati), Palmyra and Jarvis Island EEZs, and the surrounding international waters. Access to these FADs has been facilitated by the good collaboration established between SPC, multiple commercial fishing companies and a satellite buoy provider.

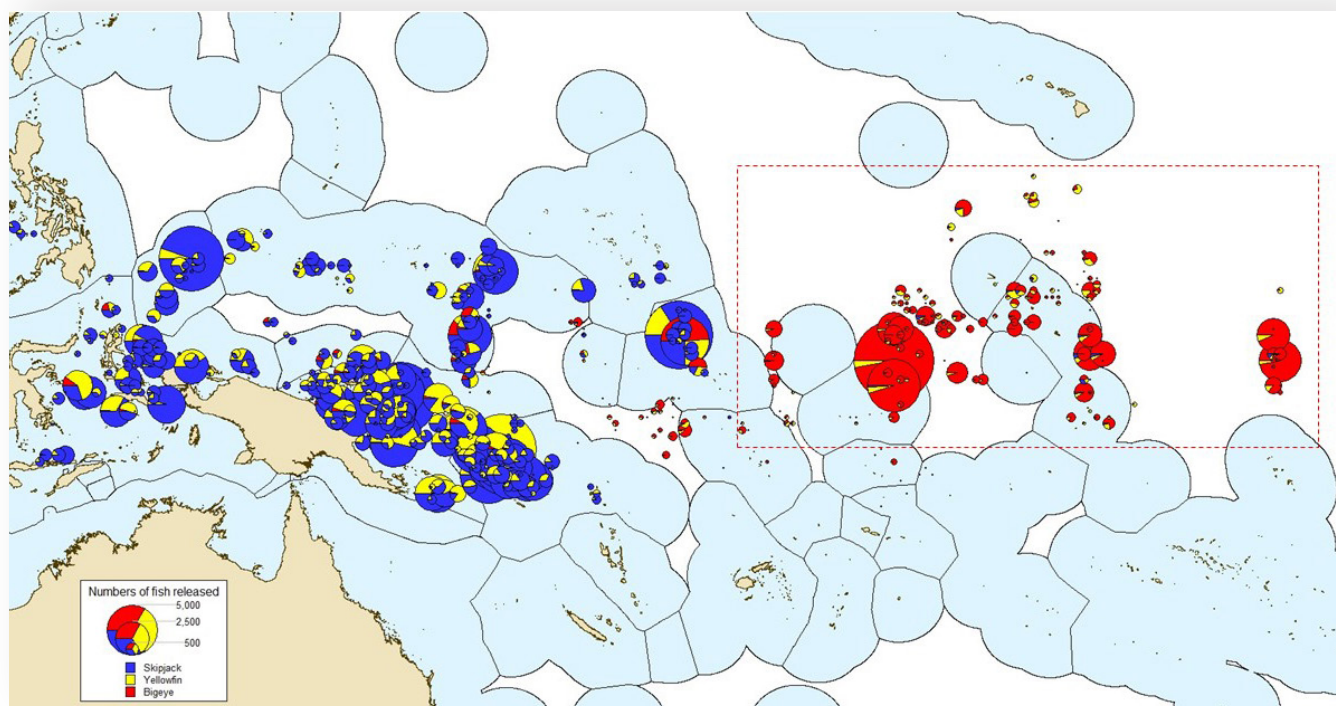
For this tagging programme to be successful, optimising tag recovery is a priority. Therefore, a promotional campaign has been launched among all the PTTP partners, including research institutes, country fisheries departments, fisheries observers, tag recovery officers and regional tuna canneries, etc. Posters with a reminder of the procedures and rewards have been distributed. The observers and managers of the tuna processing factories are responsible for passing on the information to the crews, stevedores and staff on the production lines.

For more information:

Aurélie Guillou

Senior Fisheries Technician, SPC

aurelieg@spc.int



Engaging and hearing the voice of community-based fisheries civil society organisations: The Second Community-Based Fisheries Dialogue

by Afelee Falema Pita – CBFD2 Convenor

What is the Community-Based Fisheries Dialogue?

In August 2020, the First Regional Fisheries Ministers Meeting (RFMM1) endorsed a regional mechanism aimed at enhancing the engagement of civil society organisations (CSOs) and other non-state actors (NSAs) (*Statement of Outcomes from the First Regional Fisheries Ministers Meeting*, paragraph 16)¹ to give effect to the Pacific Island Forum Leaders' decision made in September 2016 concerning coastal fisheries (*Forty-seventh Pacific Islands Forum Communiqué*, paragraph 10).² The new mechanism entails convening a two-day dialogue on community-based fisheries (CBF) within the Regional Technical Meeting on Coastal Fisheries and Aquaculture (RTMCFA). The dialogue, known as the Community-Based Fisheries Dialogue (CBFD), serves a primary objective: providing CSOs and other NSAs a regional platform to provide advice on key needs and issues associated with coastal fisheries resources across the Pacific Island region. This is done through the RTMCFA to the Heads of Fisheries to assist with informing regional Fisheries Ministers and Pacific Leaders about priority issues associated with the sustainable access and use of coastal fisheries resources. The CBFD also serves as an avenue for CSOs and NSAs to exchange experiences and lessons from community-based initiatives to strengthen efforts to maintain productive and healthy ecosystems and their associated fisheries resources, which are critical to the wellbeing of over 10,000 coastal communities in the Pacific Island countries and territories (PICTs) (Smith and Lalavanua 2020; Govan and Lalavanua, 2022).

The First Community-Based Fisheries Dialogue

The First Community-Based Fisheries Dialogue (CBFD1) focused on two agenda items. The first centred on establishing an appropriate administrative foundation for future CBFDs through consideration of a CBFD Terms of Reference (ToR). The Pacific Community (SPC) 14th Heads of Fisheries meeting (HoF14)³ considered and endorsed the agreed ToR, which includes the appointment of a Community-Based Fisheries Dialogue Convenor and Vice-Convenor to work with the SPC Division of Fisheries Aquaculture and Marine Ecosystems (FAME) and the

CBFD Advisory Group (CBFD-AG) in organising logistics for future CBFDs and the facilitation of CBFDs. The discussion then focused on the contributions of CSOs and NSAs to the implementation of the *Pacific Framework for Action on Scaling up Community-based Fisheries Management: 2021–2025*⁴ (Smith and Lalavanua 2021).



The Pacific Framework for Action on Scaling up Community-based Fisheries Management: 2021–2025

The Second Community-Based Fisheries Dialogue

This article aims to share the key standing agenda items and outcomes of the Second Community-Based Fisheries Dialogue (CBFD2). It also provides recommendations for improving and enhancing future CBFD sessions from the perspective of the CBFD2 Convenor.

CBFD2 was convened on 13 October 2022 at the SPC Headquarters in Noumea, New Caledonia as a meeting within the 5th SPC Regional Technical Meeting on Coastal Fisheries and Aquaculture (RTMCFA5). It was chaired by an independent Convenor selected by CSOs and NSAs. The dialogue was attended by at least 24 representatives (some attended in-person and others online) from CSO and NSA groups actively engaged in community-based fisheries in the Pacific. Representatives from government agencies and other partners attended the CBFD as observers. The Convenor and other delegates from Samoa, Fiji and Tuvalu unfortunately could not get on the scheduled flight from Nadi to Noumea as they did not have the required health insurance strictly enforced by the airline. Therefore, the dialogue was chaired virtually by the Convenor from the SPC conference room in Suva, Fiji.

¹ <https://purl.org/spc/digilib/doc/gpdzd>

² <https://www.forumsec.org/wp-content/uploads/2016/09/2016-Forum-Communiqué-Pohnpei-FSM-8-10-Sept.pdf>

³ <https://purl.org/spc/digilib/doc/xqqjn>

⁴ <https://purl.org/spc/digilib/doc/yr5yv>

Session 1: Engaging the voices of CSOs and NSAs

In this plenary session, “Engaging the Voices of CSOs and NSAs”, participants brainstormed and identified several important community-based fisheries issues common across the region. In brief, the main issues raised by participants were:

- a Lack of engagement of the private sector.
- b Lack of national selection processes for CBFD.
- c Funding is needed for a national-level selection process.
- d There has been a rapid expansion of community-based fisheries management (CBFM) efforts throughout the region, but no equivalent expansion of financial and technical resources (funding and capacity) to support CBFM actions at the community level.
- e Need for better co-management around coastal fisheries monitoring, control and surveillance (MCS) incorporating traditional management systems.
- f How the CBFD platform can help raise awareness of coastal fisheries management.
- g Small communities struggle to adopt and/or adapt to government-led CBF initiatives.
- h Communities need to be better informed of the potential impacts of deep-sea mining on coastal fisheries.
- i Incorporating traditional/local knowledge into coastal fisheries management.
- j More behavioural change campaigns supporting CBFM.
- k Recognising local leadership in CBFM
- l Document existing examples of effective CBFM.
- m Better management of beche-de-mer and maximisation of benefits to communities.
- n Lack of recognition and actions on fisheries offences by the judicial system.

Based on the list above, participants further identified the following top three priority issues:

- a The need for CSO/NSA representation at CBFDs (and other national-level dialogues on coastal fisheries) based on a transparent national selection process.
- b The need to accurately inform and build capacity of CSOs and NSAs on CBFM.

- c Better integration of traditional/local knowledge with modern/conventional science for effective coastal fisheries management.

The participants of CBFD2 also expressed their hopes and expectations for future CBFD processes. These included, among others:

- a Increased collaboration and support between communities and government agencies.
- b Integration of youth and technology into CBFM activities.
- c Inclusion of small-scale fishers from the private sector.
- d CBFD recommendations to be considered for adoption by higher-level decision-makers.
- e Genuine and representative two-way communication process that includes:
 - a process to be led by civil society with real financial support,
 - community feedback and issues must not be censored or modified,
 - report should reach Fisheries Ministers and Forum Leaders, and
 - resources and design should be focused on meaningfully engaging the grassroots communities in countries through national processes that respect the principles of Free Prior and Informed Consent and other key social safeguards.

Session 2: Hearing the voices: Community-based fisheries priorities

Through breakout groups in Session 2, “Hearing the Voices: Community-Based Fisheries Priorities”, participants discussed in detail the top three priority issues identified in Session 1, which are common in our region, and came up with the following ways to address or enhance them.

- a The need for CSO/NSA representation at CBFDs and other national-level dialogues on coastal fisheries based on a transparent national selection process:
 - Select several focal points responsible for facilitating the selection process.

Participants at the LMMA Workshop in PNG. Images: Watisoni Lalavanua, ©SPC



- Provide support on speaking, making interventions prior to meetings (which will require funding support for such in-country meetings) and provide capacity building for participants to engage in high-level dialogues.
 - Involve communities in defining who “suitable participants” are and what the principles for diversity and good representation are; consider whether a sub-committee of CSOs/NSAs should be set up in each PICT to identify “suitable participants”.
 - Enable communities to define the issues that need to be addressed by science.
- b** The need to accurately inform and build capacity of CSOs and NSAs on CBFM:
- Learn from the successes of CBFM in Fiji, Tonga and Samoa.
 - Access to better means of communication and support, and sustainable finance mechanisms for CBFM activities.
 - Need alternative livelihoods to compensate for time spent on CBFM activities.
 - Need an appropriate and usable framework for CBFM monitoring, evaluation and learning at the community level.
- c** Better integration of traditional/local knowledge with modern/conventional science for effective coastal fisheries management:
- Incorporate traditional/local knowledge and practices into CBFM, including by documenting them in plans so knowledge is not eroded or lost.
 - Fisheries agencies need to build trust with traditional knowledge bearers and community leaders.
 - Involving fishers’ local knowledge in evidence-based management is key.
 - Fish may be totems for particular cultural practices and fished despite fisheries regulations, so an exemption for cultural practices should be considered.

⁵ <https://purl.org/spc/digilib/doc/6aasm>

⁶ <https://purl.org/spc/digilib/doc/4jr7q>

Outcomes, actions, and reporting to HoF15 and RFMM3

One of the two main purposes of having the CBFD is to provide CSOs and other NSAs a regional platform to provide advice on key needs and issues associated with coastal fisheries resources across the Pacific Island region. This is done through the RTMCFA to the Heads of Fisheries to assist with informing regional Fisheries Ministers (through RFMMs) and Pacific leaders (through the Leaders Forum) about priority issues associated with the sustainable access and use of coastal fisheries resources.

At the end of CBFD2, the participants agreed to report three main recommendations to the RTMCFA for endorsement at the 15th SPC Heads of Fisheries Meeting (HoF15)⁵ and also by the Fisheries Ministers through the Fourth Regional Fisheries Ministers Meeting (RFMM4)⁶ and the Forum Leaders. The three recommendations include:

- a** CBFD2 requests HoF15 to encourage SPC member governments to initiate a national community-based fisheries dialogue to improve communication with CSOs/NSAs and better address their needs and concerns related to coastal fisheries management.
- b** CBFD2 requests HoF15 to recognise the emerging issue of deep-sea mining and its potential consequences for coastal fisheries, and requests governments to facilitate more independent research on deep-sea ecosystems before consideration is given to commercial deep-sea mining.
- c** CBFD requests HoF15 to encourage SPC members to increase operation budgets for CBFM within national and sub-national government agencies, and to develop appropriate financial mechanisms to directly support communities to more effectively manage their coastal resources.

Participants at CBFM scaling-up workshops in PNG and Solomon Islands. Images: Watisoni Lalavanua, ©SPC



The three recommendations were endorsed by HoF15 and were transmitted in full to the Fisheries Ministers as part of the SPC FAME HoF15 report to RFMM4. All three recommendations were recognised and endorsed by the Fisheries Ministers. Currently, SPC FAME is working on its Fisheries report to the Forum Leaders, which will include recommendations from CBFD2.

Future dialogues

Based on what actually transpired at CBFD2 as a consequence of the logistics, processes and issues discussed, the following observations and suggestions have been shared with SPC FAME and CBFD-AG to contribute to improving future dialogues:

- a The nomination and selection of representatives from CSOs in each country to attend the dialogue in person should be given to the local focal points who know more about their nominees and their contributions to the local communities in the development of CBF. In addition, the number of CSO representatives from each country should be increased to an appropriate level (at least more than one) to guarantee continued teamwork at the national level.
- b In order to share experiences and lessons learned by CSOs and NSAs from the region, a brief country report and update by their representatives on the status and progress of the communities in engaging in CBF developments would benefit everyone. This could be used to monitor the progress made by each country in implementing the issues discussed and agreed at the CBFD.

- c Efforts need to be made to appoint the Convenor and Vice Convenor as required under their ToRs. In the event that one of these roles is not fulfilled in time, a member of the Community-Based Fisheries Dialogue Advisory Group (CBFD-AG) from the same sub-region could be appointed as an interim Vice Convenor.
- d SPC FAME needs to establish a regional database on the status of CBFM in each country to enable it to accurately identify the CSOs that need direct assistance.
- e As there are vast differences in the level of formal establishment of CBF CSOs and other NSAs in the region, there is a need to ensure that the newly established CSOs are identified and given the opportunity for their voices to be heard both at the national level and at CBFDs. This will avoid domination by well-established NGOs with secured funding sources.
- f As a general rule, CBF issues identified for discussion at CBFDs should be, by nature, common and relevant to all countries across the region. In this regard, participants need to have the opportunity during the dialogue to deliberate on these issues among themselves, without the presence and participation of government officials as observers. This will give them the opportunity to express their views more openly and to refrain from continued dependence and reliance on the views and directions from government agencies. The presence of SPC FAME staff and the CBF Adviser during this closed session will serve the need of participants for any technical advice and information.
- g Providing the opportunity at CBFDs to explore and discuss potential and relevant programmes with secured sources of funding to assist CSOs to implement tangible projects and establish their national focal points is recommended. Whilst CBFD1 and CBFD2 have focussed on 'software' issues, we need to start looking at 'hardware' issues to translate what has been discussed and agreed at the CBFDs into realistic results on the ground.
- h The required contracts for the CBFD3 Convenor and Vice Convenor need to be completed and signed before the dialogue commences.

The key standing and general agenda items proposed for CBFD3 are summarised as follows:

- a Progress on actions taken by CSOs, NSAs and SPC members on the implementation of CBFD2 outcomes should continue to be the focus of CBFD3. In particular, implementation of the CBFD2 recommendations by governments needs to be closely monitored and reported to CBFD3.

CBFM workshop break-out group session in PNG.
Image: Watisoni Lalavanua, ©SPC



- b The arrangement for the meeting sessions to be held in plenary and breakout groups needs to continue with CBFD3.
- c The establishment of national focal points for CBF needs to be formalised to facilitate proper coordination of CSO participation at CBFDs and actions taken to implement CBFD outcomes.
- d ToRs for the CBFD process and CBFD-AG, Convenor and Vice Convenor roles need to be updated (if required) during the dialogue, taking into account lessons learned.
- e Specific programmes with secured funding to assist CSOs need to be explored and discussed at CBFD3.

Conclusion

Coastal fisheries play a fundamental role in sustaining the livelihoods, nutrition, health, cultures and economies of Pacific Island communities. It is crucial to prioritise the inclusion of voices from CSOs and other NSAs, which encompass local communities and fishers, prior to making any decisions pertaining to the sustainable access and utilisation of coastal resources and their surrounding ecosystems.

CBFD stands as a recognised regional platform through which CSOs and NSAs engaged in community-based fisheries across the Pacific region provide invaluable insights on critical regional coastal fisheries matters to their governmental counterparts. These counterparts include Heads of Fisheries, regional Fisheries Ministers and Forum Leaders. Although CBFD is still in its early stages, it has begun to effectively engage with and amplify the voice of CSOs and NSAs concerning the sustainable management of Pacific coastal fisheries.

Nevertheless, a prominent challenge faced by CBFD is the scarcity of funds required to sustain its ongoing operations. It is therefore crucial for bilateral donors and philanthropic organisations to offer their support to this regional mechanism. This support will ensure the enduring resonance of CSO voices, which encompass local communities and fishers, throughout the decision-making processes concerning regional coastal fisheries.

Acknowledgements

The author would like to convey his sincere thanks to participants from CSOs and NSAs from around the Pacific region for their active participation in CBFD2. Your continued commitment and dedication to achieving our common goals for the benefit of our respective communities is highly appreciated. It's been a pleasure and privilege to have the opportunity to work with staff of SPC FAME as secretariat for the CBFD. Your commitment and professional guidance have enabled us to successfully carry out CBFDs.

References

- Smith A. and Lalavanua W. 2021. First Community-Based Fisheries Dialogue at the Fourth Regional Technical Meeting on Coastal Fisheries and Aquaculture. SPC Fisheries Newsletter 166:18–20. <https://purl.org/spc/digilib/doc/2az99>
- Govan H. and Lalavanua W. 2022. The “Pacific Way” of coastal fisheries management: Status and progress of community-based fisheries management. SPC Fisheries Newsletter 169:33–47. <https://purl.org/spc/digilib/doc/svtsz>

For more information about CBFD:

Watisoni Lalavanua

Community Based Fisheries Adviser, SPC
[watisonil@spc.int](mailto:watsonil@spc.int)

Marshall Islands win the “Stop IUU Fishing” Meritorious Award

Francisco Blaha¹

At a ceremony during the 7th Global Fisheries Enforcement Training Workshop (7GFETW) in Halifax, Canada, the International Fisheries Monitoring, Control and Surveillance Network (IMCSN) recognised the Marshall Islands Marine Resources Authority (MIMRA) for its world-class port state measures (PSM), designed to control operations in Majuro, Marshall Islands, the world’s busiest tuna transshipment port.

The award recognises the excellence of the systems in place, the work of fisheries officers of the MIMRA’s Oceanic and Industrial Affairs Division, and MIMRA’s outstanding level of transparency and mutually beneficial collaboration with technology providers.

The award was given this year during the first in-person workshop since 2019. It not only recognises the long-term collaborations and leading role that the Republic of the Marshall Islands (RMI) has with regional fisheries institutions involved in monitoring, control and surveillance, such as the Forum Fisheries Agency (FFA) and IMCSN (where MIMRA’s Director, Mr Glen Joseph, serves as vice chair), but also at the bilateral level with many partners such as Thailand’s Department of Fisheries and the New Zealand

Ministry of Foreign Affairs and Trade (NZ MFAT), which has supported my work as long-term fisheries advisor working with MIMRA’s Oceanic Division operations since 2018.

Glen Joseph was at the awards ceremony to receive the prize, along with MIMRA’s Chief Fisheries Officer Beau Bigler, and I was honoured to be invited to the stage with them.

Glen synthesised it very well during the ceremony, saying: “This award and recognition is a testament that despite our small administration and limited technical and financial capacity, it can be done with the right networks and tools available in the region”, and that the award is recognition of “the good hard work, cooperation and collaboration over the years of the officers in MIMRA’s Oceanic Division with other agencies in the Majuro port as a major transshipment hub in the world”.

Other aspects recognised by the award relate to the leadership that MIMRA provides in the region in terms of supporting a rights-based management approach to the world’s largest tuna fishery and ensuring robust, efficient and effective collaboration amongst all other member countries and



From left to right : IMCSN Chair Garry Orr, MIMRA’s Director Glen Joseph, Independent Fisheries Officer Francisco Blaha, MIMRA’s Chief Fisheries Officer Beau Bigler and IMCSN Director Mark Young.

¹ Independent Fisheries Adviser. franciscoblaha@mac.com – <http://www.franciscoblaha.info/>

territories of FFA, The Parties to the Nauru Agreement and the Pacific Community.

MIMRA has sustained for years a regional focus to promote uniform and transparent monitoring, control and surveillance (MCS), using innovative and cutting-edge IT solutions, including electronic monitoring and reporting, and providing practical and effective training across a wide range of MCS functions with the support of regional and extra-regional partners.

One of the outcomes of the workshop is a forthcoming collaboration under a South-South cooperation agreement, with officers from the six member countries of the West Central Gulf of Guinea Regional Monitoring, Control and Surveillance Centre invited to be seconded as part of MIMRA's MCS operation team for a month.

No doubt, MIMRA's work in terms of PSM is remarkable for a small administration; every one of the over 700 fishing and carrier vessels that come to Majuro in an average year (including RMI-flagged ones) goes through a risk assessment that creates what we call an "Arriving Vessel Intelligence Report" (AVIR).

This AVIR is an intelligence analysis and risk determination tool that allows for the identification of risks in three different categories corresponding to three steps in the analysis, including (i) identity – whether the vessel is who it says it is, (ii) manoeuvring – the vessel's activity and operations and whether these were adequately reported, and (iii) licensing – whether the vessel is allowed to be in the location it was. The risk analysis is focused on fishing vessels to assess the legality of the catch and on carriers' activities not directly related to transshipments.

With this information, the team of five officers maintains a 100% inspection rate for all incoming vessels, including fishing and carrier vessels, and port use is conditional on receiving formal authorisation by an MIMRA officer. Port use will be delayed when information regarding a vessel's activities is not forthcoming or no clear explanation is given.

In case of identified noncompliance and potentially illegal behaviour, port use is not granted, and the officers oversee the seizing of evidence, including master/captain vessel's documents and catch, gear and vessel.

In addition, a description of the PSM system, the status and precise details of all incoming, present and outgoing vessels are freely accessible on the MIMRA website.² No other country in the western and central Pacific Ocean boasts this level of professionalism and transparency.

Needless to say, the training and efficiency of the boarding officers are fundamental to MIMRA's responsibilities as a responsible Port State, and all the capacity building and development of the required systems have been some of the

many focuses of the collaboration between NZ MFAT and MIMRA – and with around 100 days a year in Majuro, a big part of my personal life since 2017.

I've said many times that working with MIMRA in Majuro has been, so far, one of the highlights of my consultancy career, at both the professional and personal level. MIMRA has always welcomed me as part of the team, and I consider my colleagues there more as friends than as people I work with. In addition, I will always be very grateful to NZ MFAT for the trust they have shown in us and for their vision of the benefits of working with neighbouring countries on long-term commitments.

And this latter aspect is fundamental. Fisheries work is about people and not just technology. The first step to fostering collaboration is trust, which can only be built with time and joint work.

The prize that MIMRA was awarded is a testament to its people's hard work and determination, from the management to the boarding officers, and we all should celebrate their success and also the open invitation they made during the award ceremony: "Come to Majuro, work with us and let us learn from each other."



MIMA's fisheries officer on his way to carry out on-board checks.
©Francisco Blaha

² <https://www.rmimra.com/index.php/about-us/oceanic-industrial-affairs/port-entry>

Reviewing the implementation of FAO's Small-Scale Fisheries Guidelines: Two Pacific Islands for the Too Big To Ignore Global Partnership's book

When Voluntary Guidelines for Securing Sustainable Small-scale Fisheries were being drafted through an extensive participatory consultation process more than 10 years ago, the Pacific Island nations gave their input. Now, with the forthcoming 10th anniversary of the adoption of the guidelines by the Committee on Fisheries of the Food and Agriculture Organization of the United Nations (FAO), it is time to assess how they are being implemented. An initiative by the Too Big To Ignore Global Partnership for Small-Scale Fisheries Research (TBTFI), aimed at assessing the guidelines' implementation globally, has included Tonga and Samoa among the countries reviewed.



Squid fishing in Tonga. Image: William Sokimi, ©SPC

In 2024, the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries ([SSF Guidelines](#)), adopted by FAO's Committee on Fisheries, will mark their 10th anniversary. The guidelines play an important role in shaping debate over how policies and legislation should provide for sustainable small-scale fisheries. The SSF Guidelines shed light on the significant contributions and importance of such fisheries to the local economy, and they frame legal safeguards for protecting the livelihoods of small-scale fishers and their communities. The SSF Guidelines also recognise these fishers as professional workers, acknowledge the role of women in small-scale fisheries, and provide guidance for addressing the effects of climate change on small-scale fisheries (FAO 2015). A long participatory process supported the development of the SSF Guidelines, involving more than 4000

stakeholders, including small-scale fishers, regional and civil society organisations, researchers, fish workers and government representatives (Jentoft et al. 2015). This process strengthened the legitimacy and normative authority of the SSF Guidelines, which are anchored on international human rights standards and promote both the human rights-based approach and the ecosystem approach to fisheries (Nakamura 2022).

As FAO members, Pacific Island countries and territories endorsed the initiative and actively participated in the process, along with other countries worldwide. In 2012, FAO and the Pacific Community (SPC) organised a regional stakeholder consultation focusing on the specific context and needs of Pacific Islands (FAO/SPC 2012). The stakeholders' input and



Fishers in Samoa. Image: David Kirkland, ©SPC

recommendations addressed key issues for small-scale fisheries of the Pacific, which suffer from geographical remoteness and are challenged by population growth and climate change. Specific topics raised included the customary rights system and women's participation in decision-making processes. Such issues were later reflected in the SSF Guidelines' final text, which incorporated, inter alia, the governance of tenure, the promotion of gender equality, and the consideration of climate change and disaster risk.

Since the endorsement of the SSF Guidelines in 2014, countries and various entities have been actively working to monitor, assess and promote their implementation at both national and local levels. TBTI, a network of over 400 contributing members from 81 countries, has been gathering information to draw a global picture of how the SSF Guidelines are being implemented, with TBTI members contributing to the assessment for various countries. The contributions are part of an eBook entitled *Unlocking Legal and Policy Frameworks for Small-Scale Fisheries: Global Illustrations* (Chuenpagdee et al. 2020).

Tonga and Samoa are among the countries already reviewed.¹ For that, SPC collaborated with two interns from the University of California College of the Law San Francisco along with partners from FAO and the ministries in charge of fisheries in the two nations. Together, they assessed the implementation of the principles and recommendations for sustainable small-scale fisheries that were internationally agreed in the SSF Guidelines, including the rights of coastal fishers and fish workers. Relevant legislation and policies were surveyed, including the Tongan and Samoan Fisheries Management Acts, respectively adopted in 2002 and 2016, and their regulations, the *Tonga Fisheries Sector Plan 2016–2024* and *National Fisheries Policy 2018*, and the *Fisheries and Aquaculture Policy 2022–2032* for Samoa.

The goal of the policy and legal reviews for the two countries was to assess the extent to which each of them adhered to the core provisions of the SSF Guidelines, including responsible fish trade, small vessel registration and safety, co-management and access to marine resources, for the protection of Pacific coastal fishers' rights and livelihoods.² Overall,

¹ The eBook chapter for Tonga is available at: http://toobigtoignore.net/wp-content/uploads/2023/02/Legal-analysis-e-book_Tonga_s.pdf (D'Andrea A., Devez S., Von Rotz M., Tauati M. and Malimali S. 2023. Unlocking legal and policy frameworks for small-scale fisheries in Tonga. In Kerezi V., Nakamura J., El Halimi M. and Chuenpagdee R. (Eds.) *Unlocking Legal and Policy Frameworks for Small-Scale Fisheries: Global Illustrations*. TBTI Global Publication Series, St. John's, NL, Canada). The eBook chapter on Samoa will soon be available at: <http://toobigtoignore.net/unlocking-legal-and-policy-frameworks-for-ssf-global-illustrations/>

² A more in-depth analysis of human rights implementation in coastal fisheries and aquaculture legislation is found in Graham and D'Andrea 2021.

both countries have successfully implemented most of the core provisions. However, there is room for improvement and some topics could be considered with a more specific focus on small-scale fisheries (Von Rotz et al. 2022). Also, both countries would benefit from strengthening small-scale fishers' labour and social rights, as well as securing legal protection of women in small-scale fisheries.

Given the importance of small-scale coastal fisheries to local economies in Pacific Islands (Gillett and Tauati 2018), over the past decade three regional policies have been adopted to raise the profile of Pacific coastal fisheries and ensure sustainable and equitable management of marine resources.³ A comparative analysis shows that human rights, which are strong in the SSF Guidelines, are not explicitly mentioned under the Noumea Strategy (Song et al. 2017). However, Pacific regional policies firmly take a human rights approach by promoting fisheries co-management and a clear definition of user rights, considering gender and social inclusion in participatory management, and protecting livelihoods and food security (Graham and D'Andrea 2021).

The TBTI initiative is open to other countries' reviews, and SPC is willing to collaborate with Pacific Island nations to assess their legislation through the lens of regional policies and to identify opportunities for adequate implementation of international law, including the SSF Guidelines, in the Pacific context.

References

- Chuenpagdee R., Nakamura J., El Hamini M. and Kerezi V. 2020. Why legal and policy analysis? In Kerezi V., Nakamura J., El Halimi M. and Chuenpagdee R. (Eds.) *Unlocking Legal and Policy Frameworks for Small-Scale Fisheries: Global Illustrations*. TBTI Global Publication Series, St. John's, NL, Canada. Available at: http://toobigtoignore.net/wp-content/uploads/2020/11/Legal-e-book_Intro-chapter.pdf
- FAO/SPC 2012. Report of the FAO/SPC Pacific Islands Regional Consultation on the Development of Guidelines for Securing Sustainable Small-Scale Fisheries. Noumea, New Caledonia, 12–14 June 2012. Available at: <https://www.fao.org/3/i3063e/i3063e.pdf>
- Gillett R. and Tauati M.I. 2018. Fisheries of the Pacific Islands – Regional and national information. Apia, Samoa: FAO. Available at: <https://www.fao.org/documents/card/es/c/I9297EN/>
- Graham A. and D'Andrea A. 2021. Gender and human rights in coastal fisheries and aquaculture: A comparative analysis of legislation in Fiji, Kiribati, Samoa, Solomon Islands, Tonga and Vanuatu. Noumea, New Caledonia: Pacific Community. 108 p. Available at: <https://purl.org/spc/digilib/doc/zz6mn>
- Jentoft S., Franz N., Barragán Paladines M.J. and Chuenpagdee R. 2015. TBTI “SSF Guidelines Cluster”: Implementation of the SSF Guidelines. Too Big To Ignore. Available at: <http://toobigtoignore.net/wp-content/uploads/2015/02/SSF-Guidelines-cluster-Concept-note.pdf>
- Nakamura J. 2022. Legal Reflections on the Small-Scale Fisheries Guidelines: Building a Global Safety Net for Small-Scale Fisheries. *The International Journal of Marine and Coastal Law* 37 (2022) 3172. Available at: https://strathprints.strath.ac.uk/79226/7/Nakamura_IJMCL_2022_Legal_reflections_on_the_small_scale_fisheries_guidelines_building_a_global.pdf
- Song A.M., Cohen P.J. and Morrison T.H. 2017. Policies in harmony? Does the New Song agree with the Small-Scale Fisheries Guidelines? SPC Traditional Marine Resource Management and Knowledge Information Bulletin 38:26–36. Available at: <https://purl.org/spc/digilib/doc/gnew4>
- Von Rotz M., D'Andrea A. and Devez S. 2022. Empowering communities in Tonga to protect marine resources and secure livelihoods: A case study for the Too Big To Ignore Global Partnership on small-scale fisheries. SPC Women in Fisheries Information Bulletin #35. Available at: <https://coastfish.spc.int/en/publications/bulletins/women-in-fisheries/536>

For more information

Giulia Marchi

Juris Doctor Candidate at the University of California College of the Law, San Francisco
marchi@uclawsf.edu

Ariella D'Andrea

SPC Legal Adviser (Coastal Fisheries and Aquaculture)
ariellad@spc.int (corresponding author)

Julia Nakamura

FAO Legal Officer
julia.nakamura@fao.org

³ A new song for coastal fisheries – pathways to change: The Noumea Strategy, 2015 (<https://purl.org/spc/digilib/doc/b8hvs>); the Future of Fisheries: A Regional Roadmap for Sustainable Pacific Fisheries, 2015 (<https://purl.org/spc/digilib/doc/xnc9f>); and the Pacific Framework for Action for Scaling up Community-based Fisheries Management 2021–2025 (<https://purl.org/spc/digilib/doc/yr5yv>).

Review of fish fauna and recently conducted fisheries research in French Polynesia

René Galzin,^{1*} Morgan Antoine,¹ Philippe Bacchet,² Taiana Darius,³ Benoit Espiau,¹ Mireille Harmelin-Vivien,⁴ Rakamaly Madi Moussa,⁵ Christophe Missélis,⁶ Georges Remoissenet,^{7,8} Vahine A. Rurua,⁸ Gilles Siu¹ and Marguerite Taiariu⁹

Abstract

To date, 1301 fish species have been recorded within French Polynesia's 4,541,204-km² exclusive economic zone (EEZ), and from the territory's 14,690 km² of inland waters. Most species were found within the Society Islands, which have been more closely studied, than in the Austral Islands, Tuamotu Archipelago, Marquesas Islands and Gambier Islands, in that order. Of the 1038 species of reef fish that inhabit the lagoons and top 60 m of the outer reef slopes of French Polynesia, the faunal lists from the western part of the EEZ show a transition between the fish of the continental Pacific in the west and the island Pacific to the east. Fish in the Austral Islands (in the south) show affinities with faunal lists of the cold zones of the coral Pacific. Finally, in the Marquesas, fish species are abundant and highly endemic. A total of 27 species inhabit the freshwater areas of French Polynesia. Three types of fisheries are practised in French Polynesia: deep-sea fisheries up to the boundaries of French Polynesia's EEZ, coastal fisheries and lagoon fisheries. Subsistence fishing is ubiquitous, despite the widespread occurrence of ciguatera. Fishing grounds are well managed,

with a return in some places to ancestral practices, such as *rahui*, although there is a lack of fisheries monitoring in resource management. Going forward, it is essential that subsistence fisheries resources are fully protected and that deep-water fish management is promoted. Over 500 undersea mountains, rising to depths of less than 3000 m, have been discovered in French Polynesian waters, and these too will need to be properly managed.

Keywords:

French Polynesia, Pacific Ocean, marine and freshwater fish, biodiversity, fisheries management

French Polynesia

French Polynesia extends from 7°S to 28°S and from 134°W to 155°W, and is made up of 124 islands (41 high islands and 83 atolls) in five distinct island groups: the Austral Islands, Gambier Islands, Marquesas Islands, Tuamotu Archipelago and Society Islands (Fig. 1, Table 1). French Polynesia's population as of 2017 was 275,918, with most people (75%) living on Tahiti and Moorea (Table 1).

Table 1. The main island groups of French Polynesia and their population.

	French Polynesia	Austral Islands	Marquesas Islands	Society Islands	Tuamotu Archipelago	Gambier Islands
Total no. of islands and (no. of inhabited islands)	124 (75)	10 (5)	13 (6)	14 (12)	76 (47)	11 (5)
High islands	41	9	13	9	0	10
Atolls	83	1	0	5	76	1
Dry land surface area in km ²	3472	145	1049	1596	621	61
Total length of rivers in km	9961	465	5268	4194	0	34
Population (2017 census)	275,918	6965	9346	242,726	16,881 (combined)	

Sources: <https://www.legifrance.gouv.fr/loda/id/JORFTEXT000036196054>; <https://www.ispf.pf>; Galzin et al. in press

¹ Université Paris Sciences & Lettres, EPHE-UPVD-CNRS USR 3278, CRILOBE, Moorea, French Polynesia

² BP 2720, 98713 Papeete, Tahiti, Polynésie française. bacchetphil@mail.pf

³ Umr 241 EIO, Institut Louis Malardé, BP 30, 98713 Papeete, Tahiti, French Polynesia. tdarius@ilm.pf

⁴ Université Aix-Marseille, Université de Toulon, CNRS-IRD, MIO UM 110, Marseille, France. mireille.harmelin@mio.osupytheas.fr

⁵ Department of Agriculture, BP 100, 98713 Pirae, Tahiti, French Polynesia. rakamaly.madimoussa@administration.gov.pf

⁶ BP 3409, 98728 Temae, Moorea-Maiao, Polynésie française. christophe.misselis@gmail.com

⁷ Direction des ressources marine (Marine Resources Department), BP 20, 98713 Fare Ute, Tahiti, French Polynesia. georges.remoissenet@administration.gov.pf

⁸ Centre International de Recherche Archéologique sur la Polynésie (CIRAP) (International Archaeology Research Centre on French Polynesia), Université de la Polynésie française, BP 6570, 98702 Faa'a, French Polynesia. vahineahuura@gmail.com

⁹ Direction des ressources marine, BP 20, 98713 Fare Ute, Tahiti, Polynésie française, PSL Research University, Centre de ressources pour les Rahui, UAR 3278 EPHE-UPVD-CNRS, CRILOBE BP 1013, 98729 Papeetoi, Moorea, French Polynesia. marguerite.taiariui@gmail.fr

* Author for correspondence: galzin@univ-perp.fr

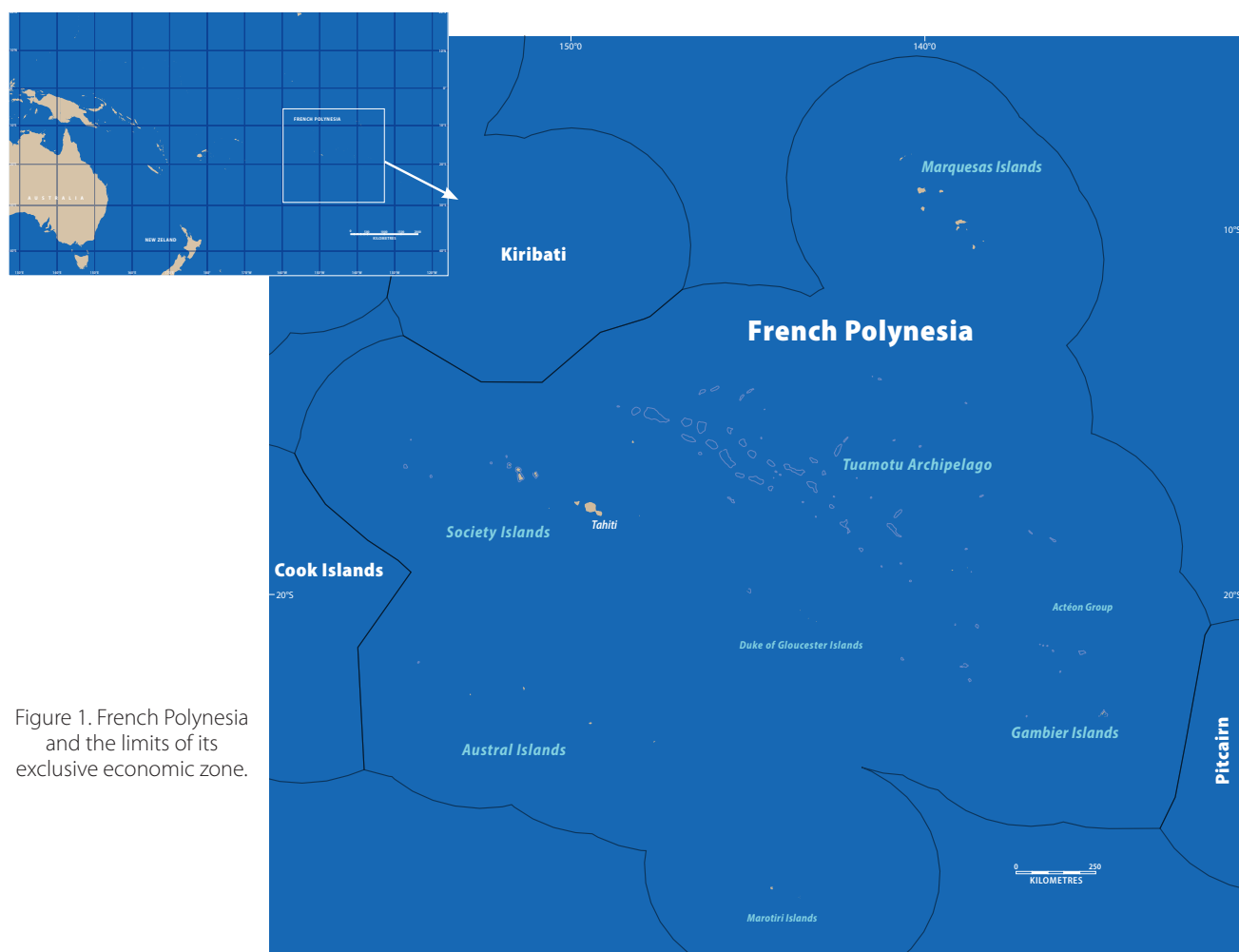


Figure 1. French Polynesia and the limits of its exclusive economic zone.

French Polynesia's economic exclusive economic zone (EEZ) has a total surface area of 4,541,204 km²,¹⁰ only 3472 km² consists of dry land (Table 1). Inland waters make up 14,890 km² and include 13 high island lagoons and 78 atoll lagoons, plus lakes and rivers. French Polynesia has 509 seamounts, counting only those that are at depths of less than 3000 m, generally located in alignment with island groups (Jean Marius et al. 2020). There are no rivers on the atolls, but there are 9961 linear kilometres of rivers that flow on the high islands. Lake Vaihiria (less than 500 km²) on Tahiti is French Polynesia's largest lake.

French Polynesia has a wet, maritime, tropical climate marked by average annual air temperatures ranging from 26°C to over 27°C, and high humidity due to rainfall in excess of 1350 mm per year. There are two major seasons in the year: the southern summer from November to April with higher temperatures and wetter weather, and the southern winter from May to October with lower temperatures and humidity (Laurent and Maamaatuaiahutapu 2019).

¹⁰ See: <https://maritimelimits.gouv.fr/>

¹¹ See: <http://www.criobe.pf/en/home/>

¹² See: <https://www.moorea.berkeley.edu/>

Marine and freshwater fish biodiversity

Fish research in French Polynesia began with the collecting expeditions of the 18th and 19th centuries, and continuing into the early 20th century, consisting mainly of descriptions of species. Starting around 1950, basic research began on fish ecology, population and settlement (Siu et al. 2017). Since the 1950s, several institutions have been set up in French Polynesia. The French Pacific Island Territory Medical Research Institute (now the Louis Malardé Institute) opened in 1949 and included a research programme on a disease now known as ciguatera. The Mother-of-Pearl and Fisheries Department (currently the Marine Resources Department, or DRM) was set up in 1957, followed by the Overseas Scientific and Technical Research Office in 1964, which is now known as the Development Research Institute (IRD). A branch of the National Natural History Museum (MNHN) and the School of Advanced Applied Social Studies (EPHE) was established in 1971, and is currently known as the Island Environmental Research Centre and Observatory (CRIOBE).¹¹ This occurred one year before the establishment of the National Centre for Ocean Use, currently known as the French Institute for Research in Marine Use (IFREMER) and 10 years before the Richard B. Gump South Pacific Research Station was established by the University of California at Berkeley in 1981.¹²

The French University of the South Pacific, established in 1987, was divided in two in 1999, becoming the University of French Polynesia and the University of New Caledonia.

All of the aforementioned institutions have contributed towards identifying fish in various Pacific Islands. These faunal lists were supplemented by studies on historical collections found in various countries' national museums (Froese and Pauly 2016; Pruvost et al. 2016). Barcodes were established for French Polynesian fish by two research stations on Moorea: CRILOBE and Gump (Hubert et al. 2010, 2014; Delrieu-Trotin et al. 2019). Ever since late last century, freshwater fish research in French Polynesia has mainly been conducted by MNHN. Books by Bagnis et al. (1972), Randall (2005), Keith et al. (2013) and Bacchet (2021) are the most commonly used for identifying French Polynesian fish.

The latest published list (Siu et al. 2017) contains 1301 fish species in French Polynesia's EEZ (Table 2). The Society Islands group has the greatest fish diversity (915 species), although it has also been the most closely studied island group (Table 3). The number of fish species in the four other islands groups is 738 species in the Austral Islands, 637 species in the Tuamotu Archipelago, 636 in the Marquesas Islands and 579 in the Gambier Islands (Table 3). The island group with the highest endemism rate for fish is the Marquesas Islands (25.8%) and the lowest the Tuamotu Archipelago (3.3%) (Table 3). At the scale of the Pacific Ocean, the third highest endemism rate is in the Marquesas Islands (13.5% of fish species) after the Hawaii group at 20% and Easter Island at 25% (Planes et al. 2016). Among the 155 families recorded in the entire French Polynesian EEZ (Siu et al. 2017), three contain over 70 species, namely the Gobiidae (147), Labridae (87) and Muraenidae (72).

Table 2. Distribution of French Polynesia's 1301 fish species.

No. of families	No. of species	No. of shallow marine species (depth <60 m)**	No. of deep-sea species (depth >60 m)*	No. of pelagic species	No. of freshwater species
155	1301	1048	174	52	27

* Species that prefer to live in depths below 60 m.

** Species that prefer to live in depths above 60 m.

Source: Siu et al. 2017

Net fishing in Raivavae, Austral Islands, French Polynesia. ©Philippe Bacchet



Table 3. Number of fish species and rate of endemism across the French Polynesian archipelagos (Siu et al. 2017).

	Austral Islands	Gambier Islands	Marquesas Islands	Society Islands	Tuamotu Archipelago
Total no. of species	738	579	636	915	637
Number of endemic species	109	28	164	167	21
% endemic species	14.8%	4.8%	25.8%	18.2%	3.3%

Marine fish

In French Polynesia, little is known about the spatial distribution of pelagic species, both in terms of biodiversity (52 species, see Table 2) and biomass. However, it seems that the southern (Austral Islands) and northern (Marquesas Islands) areas are potentially the most productive for offshore fishing. Nine Scombridae species pass through the area; the most commonly eaten are yellowfin tuna (*Thunnus albacares*), albacore (*Thunnus alalunga*) and bigeye (*Thunnus obesus*). Of the 174 deep-sea species (*paru* in Tahitian), a complete inventory of potentially high-value species, with regard to their ciguatera-free status, has yet to be made, as is the case with species found around French Polynesia's seamounts.

Of the 1038 species of reef fish that inhabit the lagoons and top 60 m of the outer reef slopes, the faunal lists from the western part of the area show a transition between the fish of the continental Pacific in the west, and the island Pacific in the east. Fish in the Austral Islands in the south show similarities with the faunal lists of cold zones of the Pacific. In the Marquesas to the north, fish are abundant and highly endemic. Within individual reefs, fish settlement on

the outer slopes is different to that within lagoons, with fish numbers and diversity depending on the size of lagoons (Connell and Sousa 1983; Planes et al. 2012). Over 80% of the reef fish species belong to only 20 families, 12 of which are too small to be eaten (Galzin and Harmelin-Vivien 2002). One out of two reef fish species do not grow longer than 10 cm (Fig. 2).

Freshwater fish

Studies of freshwater fish in French Polynesia are relatively recent (Schmidt 1927; Fowler 1932; Seurat 1934). River fauna has been documented in Keith et al. (2013). The list of river fish currently includes 24 native species: 13 Gobiidae, 3 Anguillidae, 2 Ophichthidae, Syngnathidae and Kuhliidae species, and 1 each from the Kraemeriidae and Eleotridae families (Virgile Mazel, Ichthyo-Pacific consultant; pers. corresp.). Of the 11 fish species introduced over time, only tilapia (*Oreochromis mossambicus*) and two species of Poeciliidae have become permanently acclimatised (Keith 2002). Of the 27 species living in freshwater, 8 are endemic to French Polynesia (29.6%), and 5 live only in the Marquesas.

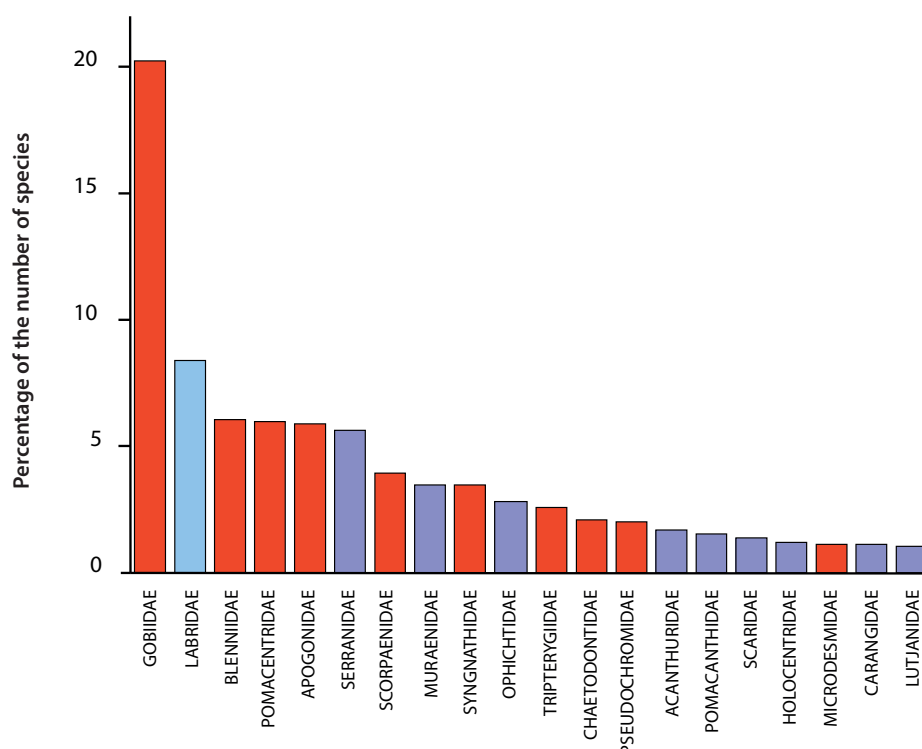


Figure 2. Among coral reef fish, 81% of species belong to 20 families in which 50% reach an adult length of less than 10 cm (red bars).

Social aspects

Fisheries

There are three types of fisheries in French Polynesia, named for management purposes: *deep-sea fisheries* carried out by tuna longline vessels operating as far out to sea as French Polynesia's EEZ boundaries; 2) *coastal fisheries* where boats up to 30 feet are used, operating up to 20 nm from islands; and 3) *lagoon fisheries* conducted in lagoons and along outer reef slopes.

Pelagic deep-sea resources

Pelagic deep-sea resources started being fished in French Polynesia in 1988 when the first fishing agreements were negotiated with Japanese and Korean longline fleets targeting bigeye tuna in the northern part of the EEZ

around the Marquesas Islands. French Polynesia's longline fleet was developed in the early 1990s with the arrival of 25-m longline vessels. A massive programme was carried out with tax concessions from 1998 to 2004. The current longline fleet consists of 13-m to 25-m vessels, all based out of the Papeete fishing harbour, and targeting pelagic species essentially for the fresh market (99% of production). After reaching a high of 75 vessels in 2004, the active fleet gradually declined to 69 vessels by 2019. Fishing effort stands at slightly over 17 million hooks deployed in 2019,¹³ with the fleet mainly targeting yellowfin tuna between latitudes 10°S and 20°S. By 2019, commercial production had reached 6600 t (Table 4), with the albacore catch accounting for 3392 t (51.4%) of the total production compared with yellow fin at 1309 t (19.8%) and bigeye at 935 t (14.2%).¹⁴ One-third of production was for export, mainly to North America.

Table 4. Commercial production by species (live weight in tonnes) for longline deep-sea fishing in 2019 in French Polynesia.

Scientific name	Common name	Catch (in tonnes)
<i>Thunnus alalunga</i>	Albacore	3392
<i>Thunnus albacares</i>	Yellowfin	1309
<i>Thunnus obesus</i>	Bigeye	935
<i>Makaira nigricans</i>	Blue marlin	274
<i>Acanthocybium solandri</i>	Wahoo	228
<i>Xiphias gladius</i>	Swordfish	168
<i>Lampris guttatus</i>	Opah	108
<i>Kajikia audax</i>	Striped marlin	88
<i>Coryphaena hippurus</i>	Mahi mahi (dolphinfish)	73
<i>Katsuwonus pelamis</i>	Skipjack	14
<i>Istiompax indica</i>	Black marlin	11
Total		6600

Source: <http://www.ressources-marines.gov.pf/cdi/bulletin-statistique/2019>

¹³ See: <http://www.ressources-marines.gov.pf/cdi/bulletin-statistique/2019>

¹⁴ See: <http://www.ressources-marines.gov.pf/cdi/bulletin-statistique/2019>





Tikehau, Tuamotu Archipelago French Polynesia. After collecting fishes inside one of the large fish traps of the lagoon, fishers create numerous *tui* (strings of fish) that will be sent to the fish market of Papeete. ©Philippe Bacchet

Coastal fisheries

Traditional, small-scale coastal fisheries operate alongside deep-sea fisheries, mainly for domestic markets and local consumption. There are two types of iconic French Polynesian vessels: *bonitiers*, which are set up for pole-and-line skipjack fishing, and *poti marara*, which target small and large pelagic fish plus certain demersal and lagoon species. *Bonitiers* range in size from 10 m to 13 m, while *poti marara* range from 6 m to 10 m. *Poti marara* fishing methods consist of harpooning mahi mahi (*Coryphaena hippurus*) and catching flying fish (Exocoetidae) with scoop nets. *Bonitiers* are disappearing from the islands, with only

33 operational vessels among the five island groups as of 2019; they are being replaced by *poti marara* (340 vessels in the same year). About 80% of the coastal fleet is based in the Society Islands, with only 8% of the fleet based in the Tuamotu Archipelago and Gambier Islands, 7% in the Marquesas Islands and 5% in the Austral Islands.¹⁵ In 2019, coastal fisheries production reached 2224 t, with yellowfin and skipjack being the two main species caught (Table 5). It should be noted that approximately 120 fish aggregating devices have been deployed and maintained by the Marine Resource Department of the main islands and atolls of all five island groups.

Table 5. Commercial production by species (live weight in tonnes) and by island group for coastal fisheries in French Polynesia, 2019.¹⁶

	Catch live weight (in tonnes)					Total
	Austral Islands	Windward Society Islands	Leeward Society Islands	Marquesas Islands	Tuamotu Archipelago and Gambier Islands (combined)	
<i>Thunnus albacares</i>	26	388	224	174	31	843
<i>Katsuwonus pelamis</i>	1	275	85	15	20	396
<i>Thunnus alalunga</i>	3	172	82	23	5	285
Billfish	3	171	85	2	15	276
<i>Coryphaena hippurus</i>	8	115	47	5	39	214
<i>Acanthocybium solandri</i>	18	19	10	42	4	93
<i>Paru</i> *	4	6	2	49	7	68
Other pelagic fish	1	11	1	13	0	26
<i>Thunnus obesus</i>	0	6	3	3	2	14
<i>Cypselurus simus</i>	1	7	1	0	0	9
Total	65	1170	540	326	123	2224

*Fish living near the sea floor at depths below 100 m (Ponsonnet 2004).

¹⁵ See: <http://www.ressources-marines.gov.pf/cdi/bulletin-statistique/2019>

¹⁶ See: <http://www.ressources-marines.gov.pf/cdi/bulletin-statistique/>

Lagoon fisheries

These can be defined as all operations involving the harvesting of natural resources in the lagoons, on the outer slopes of reefs, or off the coasts of islands without reefs up to depths of 100 m. Although only scant statistics are available on lagoon products, overall production was estimated (in 2008) at approximately 4300 t and does not appear to have changed much since then (Table 6). Production apparently consisted of approximately 80% lagoon fish, 15% small pelagic fish – mainly the bigeye scad or *ature* (*Selar crumenophthalmus*), and the mackerel scad or *operu* (*Decapterus* sp.) – and 5% “seafood” (molluscs, echinoderms and crustaceans). Tahiti has the largest lagoon fishery, with a yearly production of approximately 1000 t. Such a production volume is, however, insufficient for supplying the entire island’s population. Therefore, fish are “imported” from atolls in the western Tuamotu islands, where for over 40 years fish have been reared on a commercial scale in fish pens. In 2019, 679 t of fish were “exported” to Tahiti, mainly from Rangiroa (90 t), Arutua (67 t), Kaukura (41 t), and Manihi and Tikehau combined (34 t).

Freshwater fisheries

The most regularly caught freshwater fish are post-larval fish from two species of Gobiidae (*Sicyopterus lagocephalus* and *Sicyopterus pugnans*) when they return to settle in rivers after a larval stage of several weeks in seawater (Marquet

1986). Traditional fishing for gobies, which is partly subsistence and partly commercial fishing, is monitored by the Marine Resource Department. *Kublia malo*, a species that eats insects on the surface, is the only freshwater fish that could potentially be caught by fly fishing in the rivers. Some experts believe that tilapia production could possibly reach 100 t per year (Gillett 2016).

Subsistence fishing

The share of production from subsistence fishing comes essentially from coastal leisure fishing and lagoon fisheries, both of which make a major contribution to protein intake, particularly on islands that are less well serviced by sea freight. Total coastal subsistence fisheries production in French Polynesia in 2014 was estimated to be 2350 t (Gillett 2016). Half of French Polynesia’s population lives on Tahiti and purchases fish from the Papeete market, fishmongers or roadside sales (*tu i’a*). Subsistence fishing for local consumption is a means of providing food security and ensures that short economic circuits are maintained. Along with *fa’a’apu* (individual garden) maintenance, subsistence fishing remains outside of export circuits. In French Polynesia, everyone is a potential fisher from a very young age. The population is currently transitioning from consuming lagoon fish to deep-sea fish (e.g. tuna, mahi mahi, marlin). In French Polynesia, fish are eaten fresh by the local population or frozen for export. The lowest-income families are improving their living standards through subsistence

Table 6. Annual production (in tonnes) of fish by three types of fisheries and aquaculture in French Polynesia.

Type of fishery	Deep-sea fisheries	Coastal fisheries	Lagoon fisheries	Aquaculture
Year	2019	2019	2008	2019
Production (in tonnes)	6600	2220	4300	23

Source: <http://www.ressources-marines.gov.pf/cdi/bulletin-statistique/2019>

Skipjack (*Katsuwomus pelamis*) at the fish market of Papeete, French Polynesia. ©Philippe Bacchet



fishing and growing crops for personal consumption, including 72% of seafood (Gillett 2016). Farmers and fishers, for example, and outer islanders (Marquesas Islands and Austral Islands), cover half their food needs through self-consumption. In the South Pacific, fish consumption ranges from 21 kg/person/year in Papua New Guinea to 111 kg/person/year on Tuvalu. In French Polynesia, fish consumption is 70 kg/person/year on average, half of which is deep-sea fish. Consumption is highest in the Tuamotu Archipelago at 150 kg/person/year (Gillett 2016) (Table 7).

Aquaculture

In Polynesia, only the ancient Hawaiians farmed mullet and milkfish extensively in fenced natural ponds. Milkfish, or *pati* (*Chanos chanos*), might have been farmed in brackish water lagoons or *kopara* ponds (cyanobacteria mats) in the Tuamotu Archipelago and Society Islands. The traditional *rahui* system, an ancestral natural resource management model (Bambridge 2016), could be seen as an extensive aquaculture system when used for sustainable *pati* farming in a *kopara* lagoon complex as still practised on Maiao and Niau islands. In the 1950s, tilapia (*Oreochromis mossambicus*) was introduced, leading to the first modern aquaculture trials for the species. During the 1970s and 1980s, attempts to develop fish farming for coastal and deep-sea fisheries bait (gobies and milkfish) were unsuccessful. In the late 1980s, IFREMER launched (unsuccessfully) marine fish-farming trials by fattening Carangidae and breeding the camouflage grouper (*Epinephelus polyphekadion*) along with imported species such as European seabass (*Dicentrarchus labrax*), common dolphinfish (*Coryphaena hippurus*) and barramundi (*Lates calcarifer*). In the early 1990s, the ecofriendly post-larval capture and culture technique was also trialled by the Aquaculture and Marine Business Development Agency (EVAAM) and CRIOBE for the aquarium market under

export farming projects. In the late 1990s, EVAAM set up a family-style fish farming programme based on catching fish on fringing reefs. A post-larval capture and culture technique – specific to the biological and environmental characteristics of *Chanos chanos* – was developed as a pilot study by the Marine Resources Department but has yet to involve private project development.

Following the multicriteria pre-selection of potential fish-farming species in 2000, the Marine Resources Department produced six-finger threadfin (*Polydactylus sexfilis*) and orbicular batfish or *paraha peue* (*Platax orbicularis*) larvae before focusing on the second species with the assistance of IFREMER in 2006 in order to produce methodology guidelines. Annual production of *Platax orbicularis* on three farms has now reached 23 t but has suffered from massive die-off when juveniles are transferred from the hatchery to the lagoon due to a pathogenic bacterium, *Tenacibaculum maritimum*, known to infect some 20 host species around the globe.

Health considerations

As in many tropical seas, the major public health issue related to fish consumption is ciguatera, a kind of food poisoning. It results from eating fish and invertebrates from a coral environment contaminated by powerful neurotoxins known as ciguatoxins. The disease's main causal agent is a benthic dinoflagellate belonging to the genera *Gambierdiscus* and *Fukuyoa*, which are remarkably diverse in their morphology and molecular structure (21 known species so far) and widely distributed geographically (Chinain et al. 2019, 2020, 2021a). While quite under-reported, the number of fish poisoning cases remains stable throughout French Polynesia, although it varies greatly from one island group to another or even from one island to another.¹⁷ According to the 2019 census (Fig. 3), carnivorous fish were more frequently associated with ciguatera cases. As in other Pacific Island countries,

Table 7. Fish intake per person per year in a selection of Pacific Island countries and territories, and the main French Polynesian island groups.

Fish consumption in kg/person/year in some Pacific Island countries and in the main island groups of French Polynesia	French Polynesia	New Caledonia	Wallis and Futuna	Papua New Guinea	Tuvalu	Global average
	70	26	75	21	111	16
	Austral Islands	Marquesas Islands	Tuamotu Archipelago and Gambier Islands	Tahiti (non-urban areas)	Society Islands w/o Tahiti	
	44	22	150	19	44	

Source: Gillett 2016

¹⁷ See: www.ciguatera.pf

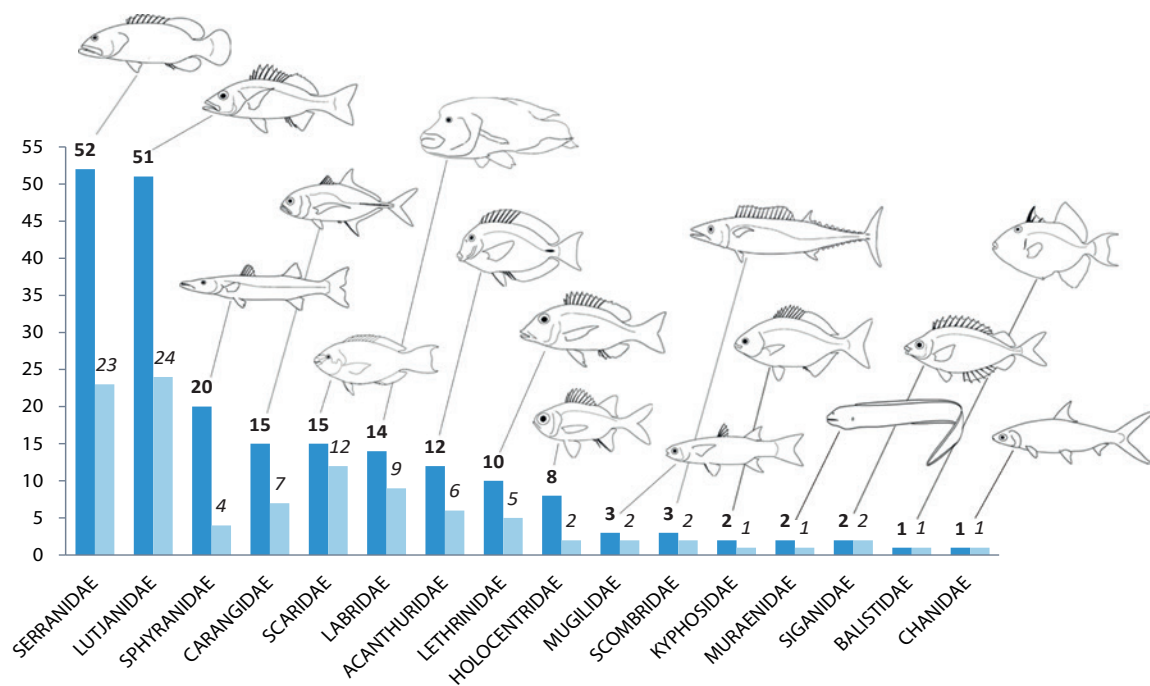


Figure 3. Fish families involved in ciguatera cases reported in 2019 (dark blue: number of cases; light blue: number of toxic events). Source: © Louis Malardé Institute website (www.ciguatera.pf), Chinain et al. 2019

however, herbivorous fish are also a risk factor (Chinain et al. 2021b). There is so far no conclusive evidence that size and/or weight are reliable indicators of the ciguatera hazard of a fish. Toxicity appears more related to a given species and/or site. Currently, the best strategy for assessing the ciguatera risk is to qualitatively and quantitatively screen ciguatoxins in seafood products to evaluate the prevalence of ciguatoxic specimens (FAO and WHO 2020).

Among the parasites found in lagoon fish, a few cases of anisakiasis have been recorded among certain patients but this has not been truly quantified and studied. Heavy metal poisoning was studied in 2013 under the leadership of the Health Department (Lutringer 2013). Mercury rates in pelagic fish have been monitored since 1999 in French Polynesia by the Rural Development Department. Total average mercury concentration in tuna is 0.3 µg/g, irrespective of species. Fish with a high mercury content (> 0.5 µg/g) include opah (*Lampris guttatus*), marlin (Istiophoridae), swordfish (*Xiphias gladius*) and shark. In traditional times, French Polynesians believed that pregnant women and young children should not eat marlin or swordfish, indicating that the problem has been known for several generations. Heavy metal contamination in lagoon fish is very low, at approximately 0.05 µg/g.

Heritage or cultural aspect

Fishing has been a ubiquitous social activity throughout French Polynesia's history (Carrier 2007). In traditional times, there were two important sea gods: Rua-Hatu,

equivalent to the Greek god Neptune, and Tino Rua who had a man's torso and a swordfish tail (Henry 1988; Torrente 2012). Before fishing trips, a ceremony was held around a *puna* stone for specific fish species. The *puna i'a*, or stonefish, was carved out of stone measuring approximately 30 cm or more and placed on a platform overlooking a beach and the most fish-rich and frequently visited bays to attract fish (Ottino 2006). Such collective ceremonies were abandoned before the arrival of Europeans and replaced by individual rites, in which each fishing family had its own *puna i'a* displayed on a rock facing their fishing grounds.

Fishers have long since abandoned these notions related to the sanctity or *mana* (supernatural forces) of the fish stones to focus on actual fishing techniques. As a result, these seafaring people developed fishing gear that is still used today, such as the mother-of-pearl lure for catching skipjack or the wooden hook for catching oilfish or *uravena* (*Ruvettus pretiosus*). Rearing fish in a pen is also very old, with the earliest pens made with coral blocks (Echinard 1972). Fishing with stones is also an old fishing method (Constant and Vonnick 1981) still in use today, although mainly for entertaining tourists.

In French Polynesia and other island groups within Polynesia, the effects of the stars on agriculture and fishing have always been important. The *tarena* lunar calendar was grounded in the experience of people in ancient times and is still used by French Polynesian fishers and farmers. Daily fishing information from the calendar is broadcast every evening on local television before the news. The calendar is based on the role played by the Pleiades constellation (Matari'i i Ni'a and



Traditional fish traps in the lagoon of Anaa, Tuamotu Archipelago, French Polynesia. ©Philippe Bacchet

Matari'i i Raro) and lunar cycles in farming and fishing. The moon's position in the sky particularly helps to predict the various lagoon species' behaviour and the most appropriate fishing techniques to be used.

Protection issues

Threats

The main threats to French Polynesia's fisheries are the varying effects of climate change, which is the case for all Pacific Islands (Jenkins et al. 2011; Kingsford and Watson 2011). Effects include ocean acidification, which is the most concerning for French Polynesia. In this country, where coral is king, seawater acidification may have consequences on the construction of reefs, which are the habitats where fish hide, feed and breed. Reef fish spend their initial phases (eggs and larvae) in seawater and so acidification may affect species' ontogenetic development. Once they are back in coastal waters, both freshwater and marine fish larvae, post-larvae and juveniles suffer from the consequences of disruptive developments in coastal areas, which have been abandoned to developers' greed, resulting in urban sprawl and tourism and coastal development. Freshwater fish in French Polynesia are at risk from several threats, including dams, roads and habitat damage; disruptive sand and gravel quarrying are the most serious of these.

Protection

French Polynesia has jurisdiction over the management of aquatic areas and related resources, and several regulatory instruments have been adopted in French Polynesia for this purpose. The Environmental Code, for example, provides for protecting certain areas and species. The Planning Code provides a basis for developing and implementing maritime area management plans. Laws govern fishing and public

seafloor land occupation. The main territorial government departments responsible for managing aquatic areas are the Department of the Environment, Urban Planning Department, Marine Resources Department and Lands Department.

Area management

The first natural land and marine areas in French Polynesia to be listed for protection was in 1952. There are now over 30 protected natural areas under the environmental code, namely listed sites, regulated fishing areas, traditional *rahui*, areas regulated by a maritime area management plan, biosphere reserves (UNESCO status), restricted defence areas and educational marine areas for which the French Polynesian Council of Ministers recently applied for a trademark in September 2021. The territory's Council of Ministers listed the entire EEZ as a marine managed area under Order 507 of 3 April 2018 (Te Tainui Atea). As such, seven policy management guidelines were jointly defined by French Polynesia and France for effectively conserving natural marine heritage features and ecosystem functions, and developing sustainable businesses. The listing reinforces a number of measures previously taken by French Polynesia such as developing an exclusively local deep-sea fishing fleet in 1996. The marine managed area has yet, however, to be recognised by the international community. In addition, there are no wetlands in French Polynesia (as defined by RAMSAR) that have stringent legal protection under the country's environmental code.

Species management

Internationally, species of concern have been listed by the International Union for Conservation of Nature (IUCN) Red List and the Convention on International Trade in

Endangered Species (CITES). In French Polynesia, the environmental code defines a list of protected species divided into two categories: Class A, which includes vulnerable or endangered species; and Class B, which includes rare or special-case species. Protected species have fairly robust protection as their use for any purpose is prohibited, be it possession, transport, destruction, sale, import, export or photography. Manta rays (*Mobula* spp.) are Class A, and all sharks are Class B species (shark fishing has been illegal throughout French Polynesia since 2012).

Laws also enable some species to be protected from fishing by regulations defining legal size and length limits, closed seasons and/or fishing quotas. So far, only one freshwater fish has been regulated, *Kuhlia malo*, locally known as *nato*. The regulatory catch size for the species is 12 cm, and it is prohibited to catch, sell, transport or possess it from November to February.

Apart from these, no other fish species is specifically protected in French Polynesia. Other fish would, however, deserve to be considered due to their status, such as the freshwater fish *Lentipes rubrofasciatus* (Keith and Mennesson 2019), the humphead wrasse (*Cheilinus undulatus*), giant grouper (*Epinephelus lanceolatus*) and two seahorses (*Hippocampus histrix* and *H. trimaculatus*), both of which are considered endangered by IUCN and listed in CITES Appendix 2.

Stock management

Some regulated fishing areas can be used for managing stocks of fish such as juvenile Gobiidae (locally known as *ina'a*) and *Selar crumenophthalmus* (locally known as *ature*) by banning high-impact fishing gear such as nets and beach seines, respectively.

French Polynesia wishes to maintain free access to the sea and its resources for all French Polynesians and seeks to develop sustainable fisheries. In order to do so, it must reconcile conflicting claims in an area the size of Europe and manage 1300 fish species inhabiting all environment types. Some of these species are important for subsistence, tourism and the economy. Authorities must consequently manage their maritime area appropriately.

Fish research front

2020 Literature review (fish – French Polynesia)

In 2020, a search based on two key terms – fish and French Polynesia – returned 56 scientific publications, 79% of which were written by researchers working in French Polynesia. Topics included the Anthropocene¹⁸ and climate change (18%), fish behaviour (15%), fish physiology (14%), fisheries

¹⁸ The period of time during which human activities have had an environmental impact on the Earth; it is regarded as a distinct geological age.
Source: <https://www.merriam-webster.com/dictionary/Anthropocene>

Reef fish inside a fish trap in the lagoon of Toau, Tuamotu Archipelago, French Polynesia. ©Philippe Bacchet



resilience (13%), ciguatera (9%) and systematics (6%), followed by genetics, parasites, economics and management, freshwater fish and aquaculture at 5% each. The lack of scientific literature on deep-sea fish is noteworthy.

Basic research in French Polynesia is currently carried out by researchers from around the world, in part because French Polynesia has access to a large amount of high-quality published scientific results for making useful comparisons.

Being internationally attractive, it benefits both French and foreign researchers working in French Polynesia (French National Scientific Research Centre, CRIOBE, EPHE, IFREMER, IRD, MNHN and universities, and others). Such quality basic research is then built upon by development research conducted in concert with the territory's government departments (Marine Resources, Research and Environmental Research departments), with the private sector and regional bodies, such as the Pacific Community (SPC), Western and Central Pacific Fisheries Commission and Inter-American Tropical Tuna Commission, and other entities. Funding for such research is raised by researchers under various national and international tenders. Funds from mainland France are allocated every year to country/territory framework programmes, and European funds are assigned through tender-based programmes managed by the SPC. The Labex Corail premier-quality laboratory was set up under the Future Investment (Investissement d'avenir) Programme in 2012 and works on coral-related issues (and, therefore, coral fish) with all four universities in the French overseas territories (Caribbean, New Caledonia, French Polynesia and Reunion Island), CNRS, School of Advanced Applied Social Studies (EPHE), IFREMER and IRD.

What are the benefits of basic fish research?

Basic research must always precede development research and be attentive to a country's needs and objectives. Three research avenues could be pursued in the third decade of this century. When the ambitions of French Polynesia, which wishes to have the largest managed marine area in the world, are considered, however, it should be emphasised that the territory currently lacks qualified staff who are able to manage the area and its resources.

The first research area involves fish settlement in freshwater areas, lagoons and the ocean. These are affected by natural fluctuations and adjustments in the various communities within ecosystems. The world is, however, undergoing climate change, which will interfere with community adjustments in populations that, on certain islands of French Polynesia, must also cope with their entry into the Anthropocene. French Polynesia can, however, be proud of having reliable databases on freshwater and

lagoon populations, and efforts to preserve the databases long-term must be pursued. For freshwater fish, the greatest danger appears to be disappearing habitats in certain places, especially in coastal areas, which, in the long run, may hamper or prevent species' migration from freshwater to the ocean.

Lagoon fish are also sensitive to the quality of the habitat at a time when coral has suffered heavily from increased seawater temperatures. By observing three species pairs (*Acanthaster* and coral, coral and seaweed, and seaweed and herbivorous fish [Viviani et al. 2019]) over the coming decades, it may be possible to better predict which fish species will continue to be abundant in the islands. By continuing to monitor population resilience issues in these waters, the role of herbivorous fish, climate change and entry into the Anthropocene, French Polynesia may be in a leading position to work on climate change and its consequences in the Pacific.

The second research area involves monitoring fish populations deep on the outer slopes of the islands. These fish, locally known as *paru*, have not been closely studied in French Polynesia. Technological advances now make it possible to know them better. They continue to be ciguatera-free and, unlike fish living in coral higher up in the water column, perhaps less susceptible to climate change.

The third research area involves the study of fish settlements on seamounts. Little or no research has been done on these populations, which may be environmentally and economically important in the future. French Polynesia, therefore, needs to improve its knowledge, management and protection of such fish populations.

Outlook and conclusion

In this first quarter century of the millennium, French Polynesia has the capacity required to play a role in South Pacific geopolitics. Caught between China and the United States vying for hegemony, French Polynesia, in association with France, Europe, Australia, Japan and other countries, may demonstrate that a different model for society and development is possible in the Pacific. During his recent visit to the territory, French President Emmanuel Macron praised the ocean protection and sustainable fisheries management system French Polynesia appeared prepared to set up and encouraged the territory to continue in this direction. Because of its location and surface area in the middle of the South Pacific, and the quality and quantity of knowledge that has been acquired, the country will undoubtedly be in a position to spearhead efforts to monitor the effects of climate change on the environment and the life it contains.

References

- Bacchet P., Zysman T. and Lefèvre Y. 2021. Guide des poissons de Tahiti et ses îles. 5e édit. Tahiti, French Polynesia: Au vent des îles. 646 p.
- Bagnis R., Mazelier P., Bennett J. and Christian E. 1972. Poissons de Polynésie. Les Éditions du Pacifique, Tahiti. 368 p.
- Bambridge T. 2016. The law of rahui in the Society Islands. p. 119–134. In: T. Bambridge (ed.). The Rahui: legal pluralism in Polynesian traditional management of resources and territories. Canberra, Australia: ANU Press, Volume 47-1.
- Carlier C. 2007. La pêche dans les sociétés préhistoriques polynésiennes ; analyses d'hameçons et étude ethno-archéologique. Rapport de mission, GDR 2834. 74 p.
- Chinain M., Gatti C.M., Roue M. and Darius H.T. 2019. Ciguatera poisoning in French Polynesia: Insights into the novel trends of an ancient disease. *New Microbes and New Infections* 31:100565. <https://doi.org/10.1016/j.nmni.2019.100565>
- Chinain M., Gatti C.M., Roue M. and Darius H.T. 2020. Ciguatera-causing dinoflagellates in the genera Gambierdiscus and Fukuyoa: Distribution, ecophysiology and toxicology. p. 405–457. In: Subba Rao D.V. (ed.). *Dinoflagellates: Morphology, Life History and Ecological Significance*. New York, USA: The Nova Science Publishers, Inc. <https://www.novapublishers.com/wp-content/uploads/2020/08/978-1-53617-888-3.pdf>
- Chinain M., Gatti C.M., Darius H.T., Quod J.P. and Tester P.A. 2021a. Ciguatera poisonings: A global review of occurrences and trends. *Harmful Algae* 102:101873. <https://doi.org/10.1016/j.hal.2020.101873>
- Chinain M., Gatti C.M., Martin-Yken H., Roue M. and Darius H.T. 2021b. Ciguatera poisoning: An increasing burden for Pacific islands communities in light of climate change? p. 369–428. In: Botana L.M., Louzao M.C. and Vilarino N. (eds). *Climate change and marine and freshwater toxins*, 2nd edition. Berlin/Munich/Boston: De Gruyter. <https://doi.org/10.1515/9783110625738-010>
- Connell J.H. and Sousa W.P. 1983. On the evidence needed to judge ecological stability or persistence. *American Naturalist* 121(6):789–884.
- Constant R.T. and Vonnick B. 1981. Pêche aux cailloux à Bora-Bora. p. 277–282. In: *Journal de la Société des océanistes*, n°72–73, tome 37. La pêche traditionnelle en Océanie.
- Conte E. and Molle G. 2014. Reinvestigating a key site for Polynesian prehistory: New results from the Hane dune site, Ua Huka (Marquesas). *Archaeology in Oceania* 49:121–136.
- Delrieu-Trottin E., Williams J.T., Pitassy D., Driskell A., Hubert N., Viviani J., Cribb T.H., Espiau B., Galzin R., Kulbicki M., Lison de Loma T., Meyer C., Mourier J., Mou-Tham G., Parravicini V., Plantard P., Sasal P., Siu G., Tolou N., Veuille M., Weight L. and Planes S. 2019. A DNA barcode reference library of French Polynesian shore fishes. *Scientific Data*, 6:114.
- Echinard M. 1972. La pêche dans le lagon en Polynésie par le système des parcs à poissons. p. 345–363. In: *Journal de la Société des Océanistes*, n°37, tome 28.
- FAO (Food and Agriculture Organization of the United Nations) and WHO (World Health Organization). 2020. Report of the expert meeting on ciguatera poisoning. p. 19–23. Report of the Expert Meeting on Ciguatera Poisoning, 19–23 November 2018. Rome, Italy: Food and Agriculture Organization of the United Nations. <https://doi.org/10.4060/ca8817en>
- Fowler H.W. 1932. Freshwater fishes from the Marquesas and Society Islands. *Occasional Papers Bernice P. Bishop Museum* 9(25):1–11.
- Froese R. and Pauly D. (eds). 2016. FishBase, world wide web electronic publication. www.fishbase.org. version (October 2016)
- Galzin R. and Harmelin-Vivien M. 2002. Écologie des poissons des récifs coralliens. *Océanis* 26(3): 465–495.
- Gillett R.E. 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>
- Henry T. 1988. Tahiti aux temps anciens. *Société des Océanistes*, publication n°1. Musée de l'Homme : 427.
- Hubert N., Espiau B., Meyers C. and Planes S. 2014. Identifying the ichthyoplankton of a coral reef using DNA barcodes. *Molecular Ecology Resources* 15(1):57–67. I.F. 7.432 (Q1).
- Hubert N., Delrieu-Trottin E., Irissou J.O., Meyer C. and Planes S. 2010. Identifying coral reef fish larvae through DNA barcoding: A test case with the families Acanthuridae and Holocentridae. *Molecular Phylogenetics and Evolution* 55:1195–1203.
- Jenkins K. M., Kingsford R.T., Closs G.P., Wolffenden B.J., Matthaei C.D. and Hay S.E. 2011. Climate change and freshwater ecosystems in Oceania: an assessment of vulnerability and adaptation opportunities. *Pacific Conservation Biology* 17(3):201–219.
- Kahn J. 2012. Coastal Occupation at the GS-1 Site, Cook's Bay, Mo'orea, Society Islands. *Journal of Pacific Archaeology* 3(2):52–61.

- Keith P. 2002. Revue des introductions de poissons et de crustacés décapodes d'eau douce en Polynésie française. *Bulletin Français de la Pêche et la Pisciculture* 364:147–160.
- Keith P., Marquet G., Gerbeaux P., Vigneux E. and Lord C. 2013. Poissons et crustacés d'eau douce de Polynésie. Taxonomie, écologie, biologie et gestion. Société française d'Ichtyologie. 282 p.
- Keith P. and Mennesson M. 2019. Threatened fish: *Lentipes rubrofasciatus* Maugé, Marquet & Laboute, 1992 (Gobiidae). *Cybiu* 43(2):123–124.
- Kingsford R.T. and Watson J.E. 2011. Climate change in Oceania. A synthesis of biodiversity impacts and adaptations. *Pacific Conservation Biology* 17(3):270–284.
- Kirch P.V., Conte E., Sharp W. and Nickelsen C. 2010. The Onemea Site (Taravai Island, Mangareva) and the human colonization of Southeastern Polynesia. *Archaeology in Oceania* 45:66–79.
- Kirch P.V., Hather J.G. and Horrocks M. 2017. Archaeobotanical assemblages from Tangatatau Rockshelter. p. 157–173. In: Kirch P.V. (ed). Tangatatau Rock shelter: the evolution of an Eastern Polynesian Socio-ecosystem, *Monumenta Archaeologica* 40, UCLA Cotsen Institute of Archaeology Press.
- Laurent V. and Maamaatuaiahutapu K. 2019. Atlas climatologique de la Polynésie française. Éditions Multipress, Papeete, Tahiti. 232 p.
- Lutringer D. 2013. Consommation de poissons du large et risque lié à l'exposition au méthylmercure en Polynésie française, état des lieux et recommandations. Rapport Direction de la santé PF : 83 p. et 4 Annexes. <http://www.service-public.pf/dsp/wp-content/uploads/sites/12/2019/07/Mercure-Rapport-final.pdf>
- Marquet G. 1986. Les Ina'a de Tahiti-Moorea, juvéniles de Gobiidae du genre *Sicyopterus*. *Bulletin de la Société des Études Océaniques* 20(2):41–45
- Ottino P. 2006. Archéologie chez les Taïpi : Hatiheu, un projet partagé aux îles Marquises. Edition Au Vent des Îles, Papeete. 175 p.
- Planes S., Bacchet P., Delrieu-Trottin E., Kulbicki M., Lison de Loma T., Mou-Tham G., Siu G., Williams J. and Galzin R. 2016. Les poissons côtiers des Marquises. p. 259–286. In: Galzin R., Duron S.-D. and Meyer J.-Y. (eds). Biodiversité terrestre et marine des îles Marquises, Polynésie française.
- Planes S., Lecchini D., Mellin C., Garcia-Charton J., Harmelin-Vivien M., Kulbicki M., Mou-Tham G. and Galzin R. 2012. Environmental determinants of coral reef fish diversity across several French Polynesian atolls. *CRAS C.R. Biologie* 335:417–423.
- Ponsonnet C. 2004. Les poissons démersaux de Polynésie française : les parus. Documents du Programme ZEPOLYF n°8. Université de la Polynésie française, Tahiti, Polynésie française. 45 p.
- Pruvost P., Causse R. and Murail J.F. 2016. GICIM relational database for management of MNHN fish collection. Museum National d'Histoire Naturelle. <https://science.mnhn.fr/institution/mnhn/collection/ic:item:search/form>.
- Randall J.E. 2005. Reef and Shore Fishes of the South Pacific – New Caledonia to Tahiti and the Pitcairn Islands. Honolulu, USA: University of Hawai'i Press. 707 p.
- Schmidt J. 1927. Poissons d'eau douce de Tahiti. *Bulletin de la Société des Études Océaniques* 20:278–279.
- Seurat L.G. 1934. La faune et le peuplement de la Polynésie Française. *Mémoires de la Société de Biogéographie* 4:41–74.
- Siu G., Bacchet P., Bernardi G., Brooks A.J., Carlot J., Causse R., Claudet J., Clua E., Delrieu-Trottin E., Espiau B., Harmelin-Vivien M., Keith P., Lecchini D., Madi-Moussa R., Parravicini V., Planes S., Ponsonnet C., Randall J.E., Sasal P., Taquet M., Williams J.T. and Galzin R. 2017. Shore fishes of French Polynesia. *Cybiu* 41(3):245–278.
- Torrente F. 2012. Buveurs de Mers, Mangeurs de Terres. p. 256–260. In : Histoire des guerriers de l'atoll de Anaa, archipel des Tuamotu. Ed. Te Pito o te Fenua, Papeete.
- Viviani J., Moritz C., Parravicini V., Lecchini D., Siu G., Galzin R. and Viriot L. 2019. Synchrony patterns reveal different degrees of trophic guild vulnerability after disturbances in a coral reef fish community. *Diversity and Distributions* 25(8):1210–1221. <https://doi.org10.1111/ddi.12931>

Internet sources used

<http://www.ciguatera.pf>
<http://www.mooreabiocode.org>
<http://www.ressources-marines.gov.pf/cdi/bulletin-statistique/>
<https://limitesmaritimes.gouv.fr/>
<https://www.criobe.pf/>
<https://www.insee.fr/fr/information/2008466>
<https://www.ispf.pf/>
<https://www.moorea.berkeley.edu/>
<https://www.observatoire-des-territoires.gouv.fr/superficie>

Knowledge and information gaps in fisheries management among indigenous communities in Solomon Islands

George Leinga,¹ Anouk Ride,² Janet Saeni-Oeta² and Peter Kenilorea³

Abstract

The recent proliferation of research on fisheries and coastal management in the Pacific region has been integrated to inform agreements at national and regional levels to promote community-based fisheries management (CBFM). However, it appears that this information is not reaching the grassroots to the same extent as indigenous people often note having knowledge gaps that impede management of their resources. This research paper presents a summary of two sets of data, namely 1) expressions of interest from communities to the national fisheries ministry for information and awareness, and 2) questions related to coastal resources management asked by community members to provincial and national government staff. The findings present fisheries-related knowledge gaps per geographic region and characterise the specific types of knowledge gaps impeding CBFM. From this understanding we can assess which types of information have not reached certain communities in Solomon Islands, and how CBFM awareness can be designed more appropriately for different communities to help them better understand CBFM activities. Our data indicate that policy and practice to date have not always translated into community members understanding the principles of fisheries management, life cycles of key species, and laws and regulations regarding their own fisheries. This assessment can inform scientists, government officials, non-governmental organisations (NGOs) and others on the knowledge and information gaps in communities so that interventions can be framed accordingly.

Introduction

Prior to the introduction of community-based fisheries management (CBFM) in Solomon Islands, communities practised traditional marine resource management methods, such as making specific sites *taboo* (forbidden to fish or harvest), to allow for species and habitats to regenerate. This traditional tenure system of managing marine resources depends on the interests of the community or tribe, and local tribal leaders play key facilitative roles.

The traditional marine tenure system paved the way for the establishment of CBFM, with the concept revolving around the traditional management tenures of local areas. Now, local leaders in management are supported in a more effective way by the Ministry of Fisheries and Marine Resources (MFMR), which provides knowledge about law and species biology to help communities to develop management plans for their coastal areas. Unlike the traditional tenure system, the CBFM strategy involves the Solomon Islands government, in cooperation with its development partners, to support awareness, reach and documentation of CBFM across the nine provinces of Solomon Islands. Currently, other partners supporting CBFM implementation in Solomon Islands are World Wildlife Fund (WWF), The Nature Conservancy (TNC), Mekem Strong Solomon Islands Fisheries (MSSIF), WorldFish, Pacific Regional Oceanscape Program for Economic Resilience (PROPER) and the Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECDM). A national CBFM strategy was developed in line with other existing MFMR policies, including the *Solomon Islands National Fisheries Policy 2019–2029* and *Solomon Islands National Ocean Policy (SINOP) 2018*, which will assist with the scaling up of CBFM across the country.

The existing CBFM strategy fits the local context but is also costly to implement given the geographical locations of communities spread across more than 300 inhabited islands and the limited government funding to scale up its implementation. Operating under MFMR, the CBFM unit, tasked with supporting CBFM, consists of seven staff (of which two are seconded officers from World Fish Solomon Islands). CBFM staff work closely with 21 Provincial Fisheries Officers (PFOs) based in the provinces to deliver CBFM outcomes.

Rather than having regular government funding for activities, the rolling out of the CBFM strategy is made possible through funding from partners and projects such as MSSIF, PROPER, WorldFish, the Japanese International Cooperation Agency (JICA), World Bank and funding from the Solomon Islands government for staff costs.

¹ Senior Research Analyst for CBFM in Solomon Islands, WorldFish Solomon Islands

² WorldFish Solomon Islands

³ Ministry of Fisheries and Marine Resource Management, Solomon Islands

* Author for correspondence: g.leinga@cgiar.org

This paper presents a summary of the expressions of interest (EOIs) from communities to government and the commonly asked questions in field activities conducted on CBFM. The objective is to identify the areas of support communities need most and their level of understanding on CBFM through analysis of commonly asked questions. Findings on both topics will assist in scaling up of CBFM activities in Solomon Islands to ensure communities are fully equipped with the knowledge to manage their resources more effectively.

Data used are those available from MFMR and World Fish on EOIs submitted by communities and the frequently asked questions recorded by MFMR and WorldFish staff on CBFM field reports. The data on EOIs, available from MFMR, are from 2012–2022, and data on commonly asked questions were obtained from four field trips during 2020–2022.

Methods

Data analysis for this paper was done in two parts. An analysis of EOIs from communities was first conducted, followed by analysis of the type of questions commonly asked by communities during face-to-face sessions between government staff and community members on CBFM in the community.

The EOI data were gathered and analysed over a 10-year period from 2012 to 2022. Over that period, MFMR received requests for support on CBFM activities from communities spread across the nine provinces.

Submitting an EOI for support to MFMR is a channel through which communities request the assistance they need, and these requests are documented. EOIs are done orally for communities located in Guadalcanal and others nearby. CBFM staff assist communities with their EOI requests by carrying out awareness programmes on CBFM, which generate interest, as well as face-to-face meetings to assist with formulating and reviewing their management plans. EOIs are usually submitted after communities receive information on CBFM, and sometimes as a result of learning from other communities practising CBFM.

Data on the commonly asked questions were gathered from four provinces in Solomon Islands: Malaita, Isabel, Temotu and Western Province. Temotu and Isabel were listed in *Community Based Fisheries Management in Solomon Islands: Provincial Snapshots 2022* as having gaps in terms of CBFM and being priority sites for assistance with CBFM following recommendations from PFOs to include these areas. Isabel is the longest island, and Temotu is the most remote province in the country, being situated on the border with Vanuatu. Western Province and Malaita are included in the data sample due to the rolling out of awareness activities there by WorldFish and PFOs, although most activities have been carried out in Malaita, the most populous province.

The recorded questions were grouped into relevant categories and the number of questions in each category was counted, as presented in the figures below. Some questions were categorised into more than one category; for example, questions on logging were also categorised under marine pollution because of its effects on rivers and marine areas. Findings were also discussed with project staff and supported by previous findings from reports such as the *Community Based Fisheries Management in Solomon Islands: Provincial Snapshots 2022*.

The age and gender of community participants who asked questions were not recorded, but data are available on the communities/villages where the questions were collected. The majority of these communities were targeted for CBFM awareness as there were no previous interventions or CBFM activities reaching them.

Findings

Presented below are findings from the analysis of the EOIs to MFMR and the commonly asked questions by communities. Some communities have not previously received awareness on CBFM, and their questions are not a reflection of the effectiveness of awareness but of reach of information. In Malaita for instance, where CBFM activities are widespread, there is wider recognition of the need to manage their resources, even though some communities have experienced overharvesting of resources. In Temotu Province, questions triggered by CBFM awareness were more related to compliance and regulations. Awareness led them to realise that resources will become scarce if they are not properly managed and the law is not followed.

1. Requests to MFMR for information

EOIs submitted by province

Figure 1 below shows EOIs by province in the period 2012–2022. Malaita Province had the highest number of EOIs, while Makira Province had the lowest, with only one EOI received. This is unlikely to reflect the interest level of communities, but instead the reach of CBFM services and engagement of CBFM officers in the province. According to *Community Based Fisheries Management in Solomon Islands: Provincial Snapshots 2022*, CBFM awareness initiatives reached more than 80 communities in Malaita Province between 2020 and 2023. These communities were beneficiaries of project activities by MFMR, the Pacific European Union Marine Partnership (PEUMP) project, Enhancing Livelihoods while Governing Marine Resources in the Pacific Island Countries (Swebdio Livelihoods) project, and Australian Centre for International Agricultural Research (ACIAR) Pathways 1 and Pathways 2 projects. These interventions, all operating in Malaita Province, have led to increasing awareness of CBFM as well as the provision of funding opportunities for CBFM activities by the Provin-

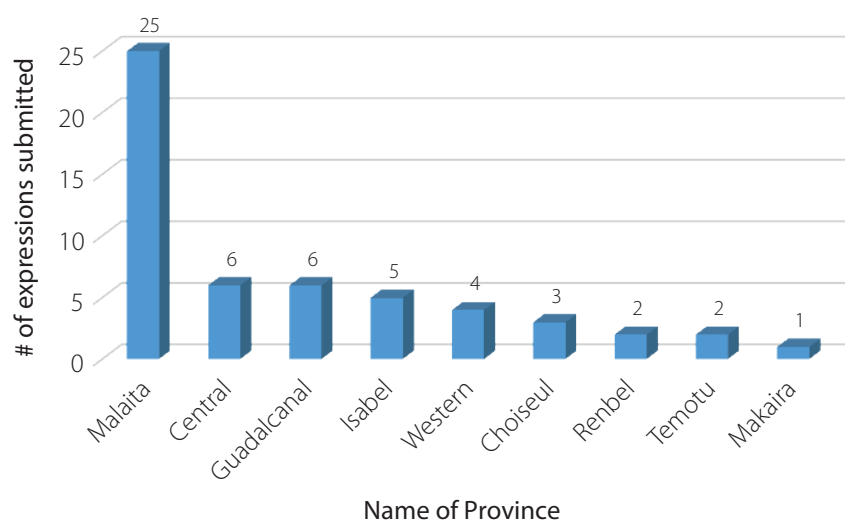


Figure 1. Origin of EOs from communities to MFMR 2012–2022

cial Fisheries Office and others in the communities. With four provincial fisheries staff, the Malaita Provincial Fisheries Office is well resourced compared to other provinces that may have one or two. Other projects related to livelihoods, such as those led by World Vision Solomon Islands and Save the Children in parts of Malaita, have also influenced communities cooperating on joint activities and may have contributed to realisation of the benefits of supporting initiatives such as CBFM. Further, PFO and WorldFish staff report that the realisation by communities in Malaita that their coastal resources are decreasing or becoming scarce led to many leaders submitting EOIs for assistance on community-based resource management (CBRM) activities.

With funding support from partners, CBFM activities are currently ongoing in the other eight provinces in Solomon Islands. However, identifying gaps and reach remains challenging given the various projects and organisations involved in CBFM activities in different ways, and lack of coordination and sharing of data across agencies.

Even though the CBRM strategy is set by the national government, funding to support activities does not directly come from the government's core budget and may follow priorities of international non-governmental organisations (NGOs) or donor-driven projects. For example, Western Province has several communities practising CBFM in part due to projects by environmental NGOs targeting manage-

ment activities either concerning key species under threat, such as turtles and dugongs, or coral reefs as part of region-wide coral conservation efforts.

Another example is Guadalcanal Province which has widespread reach in terms of CBFM, in part due to its proximity to Honiara, the capital city. However, CBRM is currently constrained by lack of transport for the two provincial government officers to access CBFM communities. Challenges in transport, other resources and reach may influence where EOIs originate from, despite participation in harvests and interest in assistance by community members.

Provincial constituencies submitting EOIs

Table 1 below reveals that in the period 2012–2022, 21 out of 50 constituencies across the nine provinces submitted EOIs to MFMR for assistance on CBFM and related activities. Malaita Province still recorded the highest number of EOIs, with 10 expressions received from communities in Small Malaita constituency.⁴ The higher number of EOIs submitted by people in this area is due to a recognition of overharvesting in seven communities in South Malaita and the need to manage their resources. This is evident in the type of issues the community want to address based on their EOIs. Interestingly, two communities, Paleohao and Mehuilo, submitted two expressions each.

⁴ These communities include Paelohao, Mehuilo, Rota, Fanalei, Malau, Houna'asi, Waimarau and Heruiesi.

Table 1. Provincial constituencies submitting EOIs 2012–2022

Name of province	Constituency	Number of EOIs submitted
Central Province	Ngella	5
Central Province	Savo/Russell	1
Choiseul Province	North East Choiseul	3
Guadalcanal Province	West Guadalcanal	4
Guadalcanal Province	East Guadalcanal	2
Isabel Province	Gao/Bugotu	3
Isabel Province	Hograno/Kia/Havulei	1
Isabel Province	Maringe/Kokota	1
Makira Province	Ulawa/Ugi	1
Malaita Province	East AreAre	2
Malaita Province	West Kwaio	1
Malaita Province	East Kwaio	1
Malaita Province	North Malaita	5
Malaita Province	Small Malaita	10
Malaita Province	West Kwara'ae	3
Malaita Province	West AreAre	3
Rennell Bellona Province	Rennell Bellona	2
Temotu Province	Temotu Nende	1
Temotu Province	Temotu Vattu	1
Western Province	Marovo	3
Western Province	North Vella La Vella	1

Types of requests by communities through EOIs

Figure 2 shows that 57 communities across the nine provinces requested awareness on CBFM and training. These requests mainly centred on scoping and assessment of identified sites for management, training on development of management plans, and registering of existing management sites to become a Marine Protected Area (MPA). The high requests for CBFM are driven by awareness and the realisation of the importance of managing their coastal resources. The communities also explained why they were requesting CBFM awareness and training in their communities. Some of these reasons were: overharvesting of aquatic species; reduction in the number of aquatic species; use of unwanted fishing practices; and interest, as well as the community's own intention, to manage the resources in their area.

There are also communities that are already practising some form of CBFM but have gaps in knowledge on how to fully manage and look after the resources available in their management site. For example, community members may not understand the lifecycle of key species they use for food (such as reef fish), or to sell for income (such as *beche-de-mer*), or may be facing adverse consequences of habitat degradation, such as through logging or overuse of mangrove wood for fires. As a result, they requested training to help them manage their resources in a more effective way.

The request for awareness on logging and mining impacts on the environment was received from communities in the Rennell Bellona Province. Rennell Bellona Province in Solomon Islands is known for bauxite mining operated by the Indonesian firm Bintang Mining Company Ltd and a Chinese firm, World Link Mining Ltd. Logging and mining appear to have adversely affected the productivity of land, freshwater and marine species (Puia 2021).

Additionally, Vatilau community in Big Ngella has requested the establishment of a fisheries centre in their community to support fish trading activities, which they have previously engaged in without proper fisheries facilities. *Community Based*

Fisheries Management in Solomon Islands: Provincial Snapshots 2022 highlights that Central Province has only one fish market located in the provincial headquarters in Tulagi but lacks storage facilities for fishermen to store fish, and fishermen usually travel to Honiara with cooler boxes to sell fish at the Honiara Central Market. The lack of proper storage facilities in the province may be the reason for the Vatilau community's request for fish storage facilities to be installed in their community. The other request is from Hatara community in Marau in East Guadalcanal requesting the re-opening of the Marau fisheries centre after it ceased operation.

Gender and EOI formulation

It is evident from the EOIs in the period 2012–2022 that men took the lead in conducting community and tribal meetings to discuss options to manage their coastal resources. The meeting minutes from the community discussions attached to the EOIs clearly state this. This is common across all areas which had EOIs submitted to MFMR. Additionally, men are the signatories and listed as points of contacts in the majority of the EOIs received. This is not surprising given that female chieftainship is very rare, and political leaders in Solomon Islands are mostly men. For instance, in 2023, only four out of 50 Members of Parliament are women. Data from 2020 indicated that 68% of CBFM fisheries committees had men as the majority of members (Gomese and Eriksson 2020). Even in Guadalcanal and Isabel Provinces, which have matrilineal land inheritance, men still dominate decisions, at least as is recorded in representation at and facilitation of major meetings.

Nevertheless, it was also evident that even though females were not assigned leadership roles in the management of resources, they were part of the meetings conducted and even listed as members in the proposed CBFM committees. This means that women's voices were considered in some way, and they contribute to managing coastal resources in their community. Both men and women generally harvest aquatic foods and species in Solomon Islands, with one study estimating 50% of coastal catch is taken by women (Olha 2015).

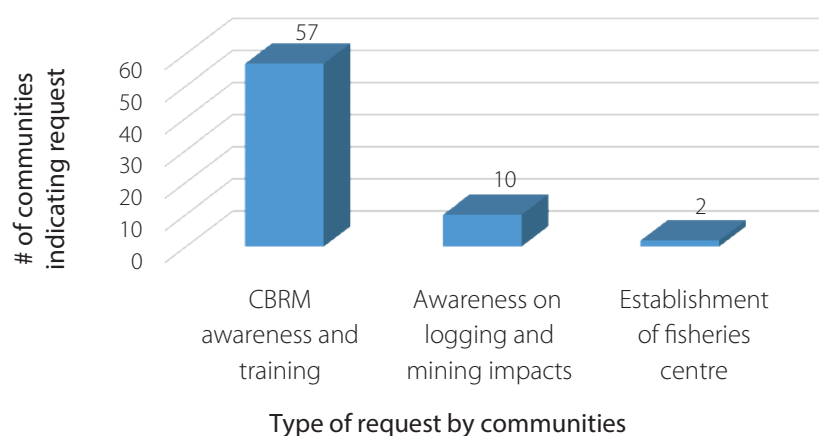


Figure 2. Indicated topics of interest for government assistance

A study of gender and social inclusion across Solomon Islands, Kiribati and Vanuatu found that even after participatory analysis of who should be involved in CBFM and improvements in representation of women and youth, women remained the minority in all 17 areas studied (Ride et al. 2023). These statistics indicate Solomon Islands has some CBFM committees with equal numbers of men and women, but most have more male members and committee chairs are men.

II. Knowledge gaps

A total of 95 questions were recorded in field activities in Isabel Province. The questions came from 13 villages⁵ across the province.

Frequently asked questions in Isabel

As depicted in Figure 3, most of the questions focused on knowledge gaps concerning marine species, CBRM, and compliance and regulations. The majority of the questions on marine species were around the different types of species and their roles in coastal ecosystems. Similarly, the question, “why the Ministry of Fisheries doesn’t allow the killing of the two dangerous species, crocodile and sharks?” was also asked in Oroba in Isabel. Other typical questions about species included, “how long does it takes before a turtle is mature/an adult?” and “is king fish a fast growing species?”

While conservation and management were not new concepts, as some communities have been practising traditional restrictions on fishing in their areas, the awareness conducted on CBFM triggered more questions about the processes they need to take to practise CBFM in their coastal areas. For example, one commonly asked question was, “what are the processes/steps of conserving a particular site?”

Questions were also raised on complying with fisheries regulations and policies; for example, one important question asked was: “We have the national fisheries laws, but why did the fisheries team do not come earlier to inform us? It has been there since 2015–2018 but only now your team came

down to the communities to do awareness about these important laws. Why?”

Frequently asked questions in Malaita

In Malaita Province, a total of 78 questions were recorded in face-to-face activities involving MFMR and/or WorldFish staff and communities. The questions came from 23 communities⁶ in Malaita.

The two most common types of questions asked in Malaita were on CBRM and fisheries regulations and compliance (Figure 4). As mentioned above, widespread awareness of CBRM in Malaita has led to recognition of the need to manage their declining resources. Hence, there were more questions and EOIs focused on starting up or strengthening CBFM. As for compliance and regulations, questions were raised around issues such as why is MFMR enforcing bans on some sea resources such as *beche-de-mer*. Recognising the decline of some coastal resources, questions on compliance/regulations often sought to investigate the effectiveness of plans to manage their resources. In addition, communities in Malaita have experienced land and aquatic system degradation caused by logging activities, leading to more questions being raised around compliance. For example, there was a question raised in Foubaba village asking: “Why allow bad activities like logging or Bina harbour cannery to enter our land? We are not aware of their negative impacts.”

The questions on marine species were closely linked to fish aggregating devices (FADs), which have been popular in Malaita as an alternative fishing site to areas closed to fish-

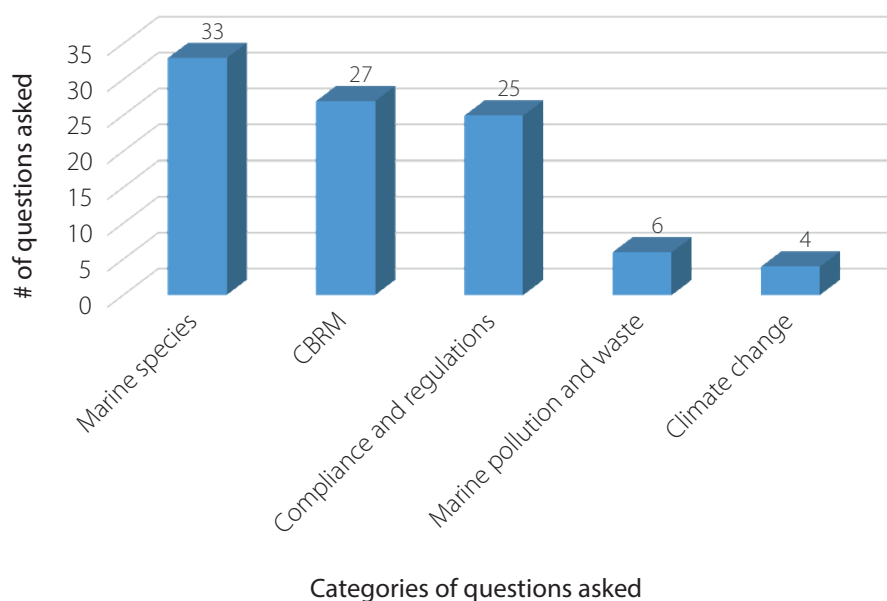


Figure 3. Frequently asked questions in Isabel Province (n = 95)

⁵ Oroba, Phutukhora, Poro, Lingho, Huali, Hukamoto, Rasa, Tanade, Horara, Nagholau, Ole, Loghutu and Sigana.

⁶ Arabala, Radesifolomae, Lilisiana, Ambu, Dala South, Buma, Gwaunaru'u, Fiu, Talakali, Dala North, Bu'usi, Kwa'a/Oneone, Foubaba, Anoano, Gwale, Buma Station, Kwabu, Sinafolo, Sinasu, To'a'e, Bina, Kwalitutu and Takwasae.

ing under CBFM. FADs play an important role in managing resources in that they make fishing activities easier while at the same time contributing to resource management and income. For example, in North Malaita, tuna catch from FADs is usually sold for income, and reef fish harvested from reefs is for family consumption. Similarly, in North Malaita questions related to corals were raised as these are often harvested for powder, commonly known as lime, for betel nut chewing and for building sea walls. They are also cleared to facilitate passage for canoes and used for building artificial islands. Another interesting marine species question commonly asked in the provinces, including Malaita, is why does MFMR enforce a law to protect crocodiles and sharks as they are dangerous species that can threaten people at times.

CBFM is becoming an important approach for various communities in Malaita. Based on unpublished trip reports from various visits to 76 communities in north, south, east, central and western regions of Malaita from 2020 to 2022, these communities reported experiencing a rapid decline in marine resources. They also reported that traditional management of reefs had been carried out in the past but had not been enforced for a while.⁷ These communities indicated that the CBFM awareness programme offered more insight into the status of their marine environment and resources, and underlined the urgency for them to undertake CBFM. Others reported that communities who fail to implement CBFM will face adverse consequences in the future.

Several questions on regulations and compliance were around the effectiveness of enforcement of laws and regulations on fisheries. CBFM in some contexts is enforced by community members themselves, but in sites of diversity and migration, cooperation across groups may be less attainable, and there is always the risk a community manages its resources well but is subject to poaching from outsiders. In such cases, police or fisheries staff may be called to back up enforcement. Therefore, the “shadow of the law”, the effects of laws on human behaviour based on expectations the law will be enforced, can support CBFM compliance. If signals are sent that CBFM is backed up by local authorities in cases of infringement, this can have a deterrent effect, although responses can vary depending on the individuals and institutions involved (Birks 2010).

Frequently asked questions in Temotu

A total of 77 questions were recorded in Temotu Province. The questions came from 13 communities⁸ in this province.

In Temotu, the most common type of question asked was around compliance with fisheries laws and regulations, as shown in Figure 5. Most of the questions sought to investigate the type of penalties that could be imposed if people breached the regulations imposed by MFMR, and how they could report them to the Provincial Fisheries Office. Questions were also raised on why MFMR enforced species-specific regula-

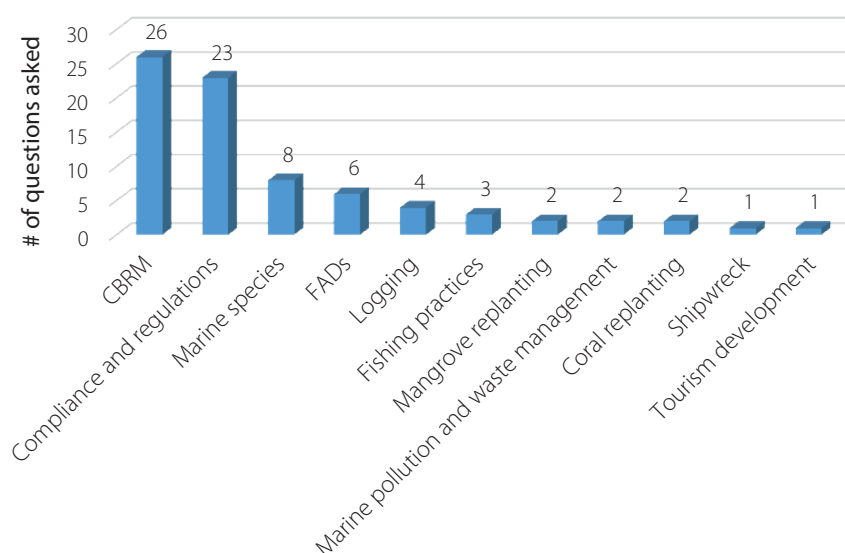


Figure 4. Frequently asked questions in Malaita Province (n = 78)

⁷ According to reports given to PFO and WorldFish, some indicated over a decade, while others said more than a decade.

⁸ Nea, Lavaka, Buma, Emua, Murivai, Peu, Lale, Vano, Nukapu, Matema, Nifiloli, Pileni and Ngauwa.

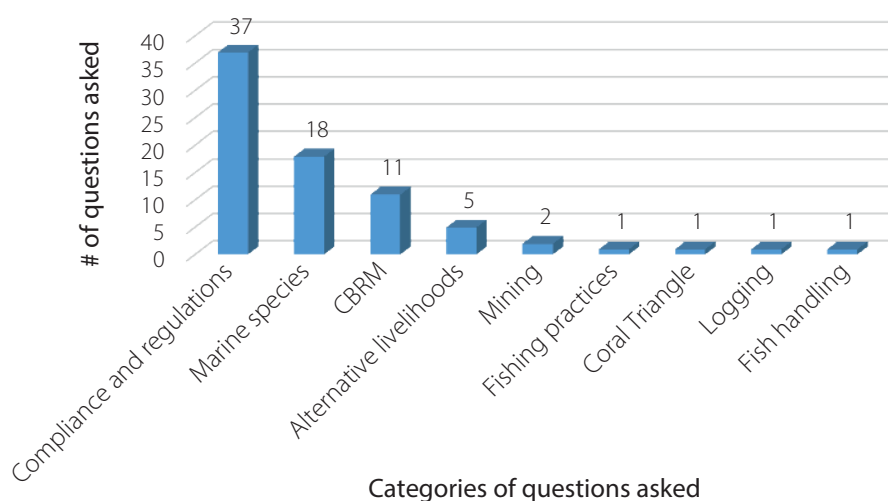


Figure 5. Frequently asked questions in Temotu (n = 77)

tions. For example, one question asked was: “Sharks and crocodiles are natural killers, why are the fisheries regulations restricting people from harvesting them?” Questions regarding breach of marine regulations were asked in all of the communities in Temotu Province, similar to Malaita Province, reflecting people’s concern with enforcement and also the lack of reach of information about relevant laws.

The other set of common questions asked was on marine species. Most communities asked questions on how marine species reproduce and the roles they play in the marine ecosystem. The marine species asked about included clamshell, *beche-de-mer*, fish, shark, crocodile and seaweed. These marine species are the main source of income for households, and at the same time many are also used for household consumption. For example, in some villages in Vanikoro, women are often involved in the drying of clamshells as this is the only source of income. Given that it can take several days to travel by ship from Temotu to the nation’s capital Honiara, the drying of clamshell and fish by women means they can make products that can then be taken to Honiara for sale.

CBRM is the third area most often asked about. This is because most communities in Temotu Province received CBFM information in 2022 compared to little reach in previous years. Also, based on information provided by the Lata-based PFO, almost all communities in the province are still practising traditional management of their reefs.

Interestingly, a few questions were asked about the possibility of providing livelihood alternatives for communities whilst they manage their marine resources. For example, Ngauwa community in Reef Islands raised questions on the possibility of accessing projects to help them venture into seaweed

farming. In addition, communities in Vanikoro and Ngauwa in the Reef Islands requested fish handling training to assist with improving existing methods of food processing.

Frequently asked questions in Solomon Islands

Figure 6 shows the commonly asked questions from Isabel, Malaita, Temotu and Western Province. In Western Province only eight questions were recorded. Due to the limited number of questions gathered from Western Province, and because they came from only one community, comparisons with other provinces are not possible.

In summary, of all the frequently asked questions from the four provinces, the most common related to compliance and regulations, followed by CBFM and marine species. These three top categories indicate that communities have an interest in the importance of managing coastal resources, as well as the consequences of breaching the regulations. In line with that, communities have some understanding of the types of marine species and their importance, as well as gaps in their knowledge about species.

Within the marine pollution and waste management category of questions were concerns about rubbish or chemical disposal into the sea and queries regarding laws to control waste disposal into the sea. Some of the marine pollution questions covered the impacts of logging activities on coastal habitats, such as through increased sediment runoff into waterways and coastal areas, and the penalties that could be implemented to minimise such harmful impacts on marine life. The ranking of pollution and waste management as fourth most common question category indicates this area is of growing concern for several communities.

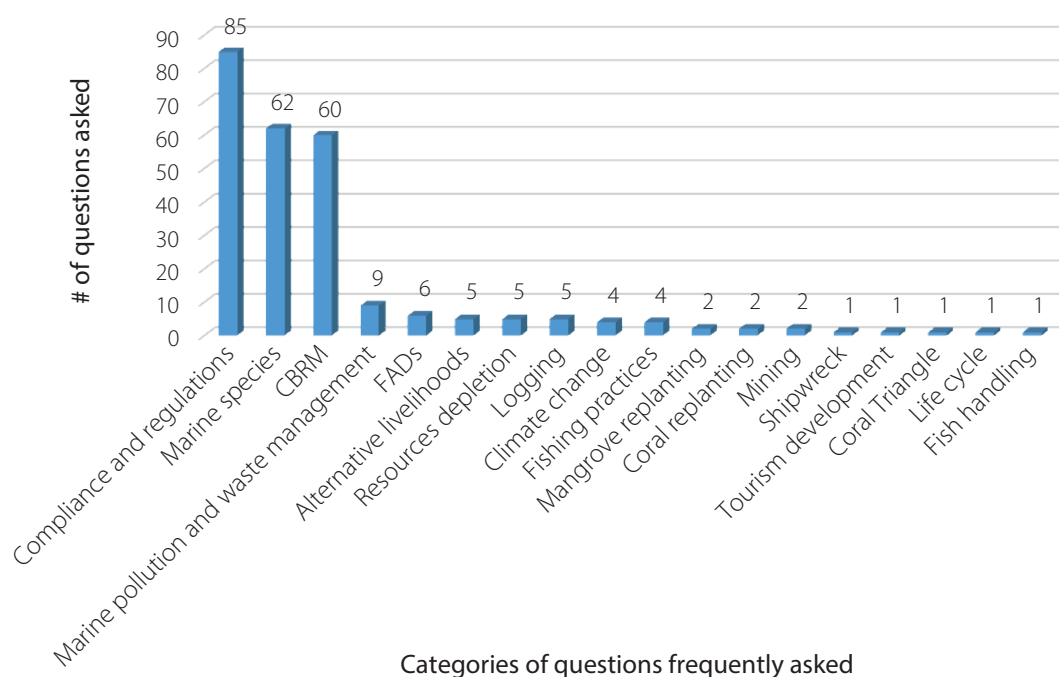


Figure 6. Overall frequently asked questions in Solomon Islands (n = 258)

In the past, communities have received assistance with FADs to help catch fish while protecting their coastal areas. Most questions regarding FADs came from Malaita and focused on whether their communities could continue to be provided with FADs as an alternative while they manage fish in their coastal area.

Questions on alternative livelihoods were raised to obtain information on options such as seaweed, pearl farming and fish handling training to support income as well as food security practices as many communities are located far from markets to sell their marine products. An example of this type of question is: “Are there any alternative projects like seaweed, pearl farming that will support communities to earn income to support their families?”

Questions on climate change were raised in Malaita. There is a realisation that climate change is slowly becoming a threat to coastlines and the habitats that exist within them. Hence, questions were raised seeking alternatives to assist with addressing climate change, for example: “Is there any activity the Ministry can provide support for against climate change so that it doesn’t really affect our corals and mangroves?”

Fishing practice questions were raised to get clarification on why certain methods of fishing have been restricted, for example: “The use of magnet net is the main fishing net used

in most of the communities visited. It is the most efficient fishing method that generates income for families. Why is the government banning its use?” In addition, questions were raised seeking to gain an insight into available sustainable fishing methods.

Questions concerning mangrove and coral replanting were raised following the realisation that mangroves and corals have started to decline in some areas due to mangroves being cut down for firewood and for building houses. Thus, community members asked whether training on mangrove and coral replanting could be provided to assist with managing coral and mangrove restoration in their area. Similar to logging impacts, questions were raised concerning the threats of mining in the sea and how mining impacts the sea and ocean.

Further questions included: the potential fine that could be imposed on the owner of a vessel that accidentally wrecked in a protected area; the development process that should be taken into account when developing a tourism site (in Malaita); and what the Coral Triangle Initiative (CTI) is as this was included in the CBFM presentation.⁹

As shown in Figure 6, the most frequently asked questions concerned compliance and regulations. Table 2 lists the most common types of questions asked about compliance and regulations.

⁹ CTI was mentioned by PFOs to explain that Solomon Islands has high marine biodiversity and thus is part of the CTI to look after our marine resources and fisheries.

Table 2. Sample of questions commonly asked on compliance and regulations

Commonly asked questions about compliance and regulations
What is the recommended harvesting size for trochus shell?
If coastal marine environments are damaged by logging pollution, do fisheries have laws to impose penalties?
How effective is the law enforcement regarding the catch on sea turtles since poaching is still common in some communities?
What kind of species monitoring do you do to ensure that there is compliance of the Fisheries Regulation and how effective is it? How can monitoring be done for the prohibited species? E.g. turtle
What do we do so international ban on crocodile harvesting will be open?
Why is MFMR not doing anything to arrest locals and Asians that are involved in the illegal harvest and trading of bêche-de-mer?
Is the fisheries regulation enforced effectively; if someone harvests and breaks the regulation, will they be charged for real?
In the fisheries regulation presentation, why are there two types of punishment for an offender, either the offender pays the fine and or goes to prison?
Crocodiles are wild animals that harm people. Why is our government still regulating crocodiles?

The types of marine species most commonly asked about in the question sessions included crocodiles, beche-de-mer, sharks, corals and clamshells.

Table 3. Types of marine species commonly asked about

Type of species commonly asked about	Ranking	Reasons for asking
Crocodile	1	Threat to some communities (crocodile attack)
Beche-de-mer	1	Source of income to many communities (highly valuable in sales)
Shark	1	Threat to some communities (shark attack)
Coral	2	Concern about protecting corals
Clamshell	2	Source of income to some communities (highly valuable in sales)

Below is a sample of questions asked about CBFM and how to implement it at the community level. Often community members needed support to think through how to organise CBFM and develop their plans and activities.

Table 4. Sample of questions asked about CBFM

Commonly asked questions about CBFM
What are the processes/steps of conserving a particular site?
What is the requirement for CBFM in the community?
Conservation work should be considered all around our island. How can we apply for management activities so that we can control our harvest?
We have tried to do conservation in the past but it was unsuccessful, how do we start or where do we go for further support?
Fish is a migratory species, what assurances does a taboo area give to communities in the sense that fish will always be there in taboo areas?
Are there any alternative livelihoods for communities who want to pursue CBFM?
We communities have traditional ecological knowledge (TEK) and traditional fishing practices. Is there any legal process to support communities to deal with poachers while we are implementing management?
Do communities need to sit together to talk about managing their resources?
For CBFM, how can people in communities work together so people can respect our custom taboo that we enforce?
CBFM covers which part of sea?

Main considerations resulting from analysis of EOIs and frequently asked questions

Importance of (upwards) communication channels for support

Communities are able to make requests to MFMR for support by way of EOIs to help them manage their resources, and most EOIs submitted by communities request support relating to CBFM. In addition to the tangible interventions and activities that have come from the roll out of the CBFM programme, a significant impact is the elevated recognition of communities' responsibility as resource owners of their coastal marine resources. There are many cases of people using resources without providing sufficient time or opportunity for recovery or regeneration, ultimately resulting in a decline of resources. In some cases, communities have experienced decreasing stocks but are unsure of the causes of the decline and what actions should be taken.

Importance of addressing knowledge and information gaps

The frequently asked questions by communities reveal a clear gap in local understanding of management and marine species, as well as policies by the national government to regulate marine resources. Understanding patterns in the frequently asked questions provides guidance on ways forward to improve the design of CBFM activities, which could range from actions that ensure communities are empowered to implement CBFM to actions that ensure basic knowledge on topics such as spawning, rubbish disposal, importance of habitats and the role of key species such as mangrove trees in ecosystems (Laumani M. 2023, personal communication¹⁰). While communities are knowledge holders, it is also key that adequate knowledge and information feeds into local management decision-making. Understanding ecology and biology can help communities consider measures in their management plans, such as when to open and close their managed areas as a means to, for example, ensure spawning activities are not disturbed.

Clarifying pathways to improve compliance

In terms of compliance with regulations, our findings reveal that communities have less knowledge on the policies that are regulated by the government to safeguard marine resources. Most often, communities practise CBFM with little to no knowledge of national policies and legislation, such as the *Fisheries Management Act 2015*. The findings on the frequently asked questions on compliance and regulations highlight to policy makers and MFMR the critical need to bring policies to the grassroots level through CBFM.

Recognising and addressing possible reluctance to CBFM

Overall, our findings reveal high motivation amongst communities to pursue CBFM, with some already implementing it. However, there also exists persisting doubts among some communities about whether CBFM is effective. While some communities were initially prompted to implement CBFM after awareness sessions, there was some reluctance to follow through due to local scepticism about whether compliance could be achieved in remote communities due to distance from responsible government agencies. Another concern was that restrictive measures, perhaps necessary for recovery of declining species stocks, would impinge on their primary source of livelihood. Thus, introducing the idea of CBFM can be a challenge if no consideration is given to livelihood alternatives.

Conclusions

This study identified significant knowledge gaps in indigenous communities and also evidence of their interest in CBFM. Data on EOIs indicate that where CBFM awareness is conducted, communities often request follow up support in relation to CBFM, such as further awareness, training and support to set up local management of coastal areas. EOIs more or less follow investment by government and stakeholders in awareness initiatives. Malaita, a province in which multiple CBFM-related projects are being implemented, recorded high levels of interest and engagement by communities, although other factors such as food insecurity and scarcity also likely influenced interest.

Data on questions asked in face-to-face activities were collected in some communities, with the data sample involving mostly communities that have never experienced CBFM support before. These data reveal gaps in both CBFM and enforcement-related policies that exist at the national level but have never reached the grassroots level and how this impacts local knowledge. Commonly asked questions were around how to implement fisheries management, life cycles and other key features of marine species, and laws and regulations (their rationale and details). The latter two categories of questions were often interrelated; there were many questions about banned species and overharvested species. There was also some questioning of who should have rights and jurisdictions over species as CBFM policy gives rights to coastal communities to manage their resources. In doing so, however, they must operate within the bounds of law that prohibit harvesting of crocodiles and assert other species-specific rules. The commonality of questions aimed at understanding fisheries laws and regulations indicates fisheries awareness has not reached a level desirable for compliance, and enforcement may lag as a result.

¹⁰ Personal conversation with M. Laumani, CBFM Officer, Ministry of Fisheries and Marine Resources, 7 August 2023.

While there is more attention paid to indigenous knowledge in fisheries, there is a lack of research into what people already know, do not know and need to know in order to be agents of sustainable management of coastal resources. It is hoped that this research will prompt others to collect and analyse questions of concern held by indigenous people and, through this process, identify critical gaps in knowledge and respond in a way that can build CBFM across Solomon Islands.

Acknowledgements

We thank the following contributors who all participated in data collection and who invaluable contributed to this paper: Faye Siot, Margareth Batalofo, Meshach Sukulu, Priscilla Pitakaka, Mark Seda, Alfred Davidson and Malakia Malasy. The research was made possible with support from the Australian government, through an Australian Centre for International Agriculture Research funded project (ACIAR FIS-2020-172).

References

- Birks K.S. 2010. Why the Shadow of the Law is Important for Economists. *New Zealand Economic Papers* 46(1). <https://doi.org/10.2139/ssrn.1627807>
- Gomese R. and Eriksson H. 2020. Follow the Fish. *WorldFish*. <https://digitalarchive.worldfishcenter.org/handle/20.500.12348/4371>
- Ministry of Fisheries and Marine Resources/WorldFish. 2022. Community Based Fisheries Management in Solomon Islands: Provincial Snapshots 2022. Edited by J. Saeni Oeta. Ministry of Fisheries and Marine Resources/WorldFish.
- Olha K. 2015. Gender, Fisher, Trader, Processor: Towards Gender-Equitable Fisheries Management and Development in Solomon Islands. <https://documents1.worldbank.org/curated/en/467721468187800125/pdf/98279-WP-P146728-Box385353B-PUBLIC-ACS.pdf>
- Personal Conversation, Laumani M. CBFM officer, Ministry of Fisheries and Marine Resources, 7 August 2023
- Puia M. 2021. They failed us: how mining and logging devastated a Pacific Island in a decade. *The Guardian*, 30 May 2021. <https://www.theguardian.com/world/2021/may/31/they-failed-us-how-mining-and-logging-devastated-a-pacific-island-in-a-decade>
- Ride A., Delisle A., Steenbergen D., Eriksson H., Sukulu M., Siot F., Malverus V., Neihapi P., Nikiari B., Tioti R., Uriam T. and Gomese C. 2023. Balancing the Canoe: reconciling community-based fisheries management with gender and social inclusion in Pacific Islands. Unpublished journal article draft.

Towards improved governance, management and sustainability of the demersal line fishery in Tonga

Brad Moore,^{1*} Taaniela Fe'ao,² Heilala Fifita,³ Matini Finau,⁴ Stu Hanchet,¹ Makeleta Malimali,⁴ Siola'a Malimali,⁴ Andy McKenzie,¹ Poasi Ngaluafu,⁴ Steve Parker,¹ William Sokimi,⁵ Aleki Taumoepeau,¹ Lavinia Vaipuna⁴ and Tu'ikolongahau Halafih^{4,5}

In June 2023, activities of the New Zealand Ministry of Foreign Affairs and Trade funded project 'Improved governance, management and sustainability of the demersal line fishery in Tonga' were completed. In this article, we provide an outline of the project, summarising key highlights achieved and some of the key challenges experienced during the project's eight-year lifespan.



History and context

Deepwater demersal fish species are an important fisheries resource in many Pacific Island countries and territories (PICTs). In Tonga, a fishery for deepwater demersal fish species has operated since the early 1980s following surveys by the Food and Agriculture Organization of the United Nations (FAO) and the Pacific Community (SPC; then the South Pacific Commission) that showed commercial quantities of fish existed in Tongan waters. The fishery exploits a multi-species assemblage of deepwater snappers (Lutjanidae), emperors (Lethrinidae) and groupers (Serranidae) for export and domestic consumption. The fishery is a valuable source of income, livelihood and social well-being to the people of Tonga.

The snapper, emperor and grouper species harvested in the fishery have moderate to high vulnerabilities to fishing as they are fairly long lived (with several species capable of living for over 40 years and as long as 56 years in the case of giant ruby snapper), slow growing, and mature late in life (Halafih 2015; Wakefield et al. 2015, 2020). As such, they need careful management to avoid overexploitation. However, the fishery has been characterised by cycles of 'boom-and-bust', where periods of large catches and intense exploitation are followed by periods of low catches and stock recovery. Since its inception, the fishery expanded rapidly to over 600 tonnes (t) in 1987, but subsequently declined to about 100 t during the 1990s. A second smaller expansion occurred, peaking at 250 t in 2002. Since 2005, annual landings have fluctuated between 100–200 t (Figure 1, left).

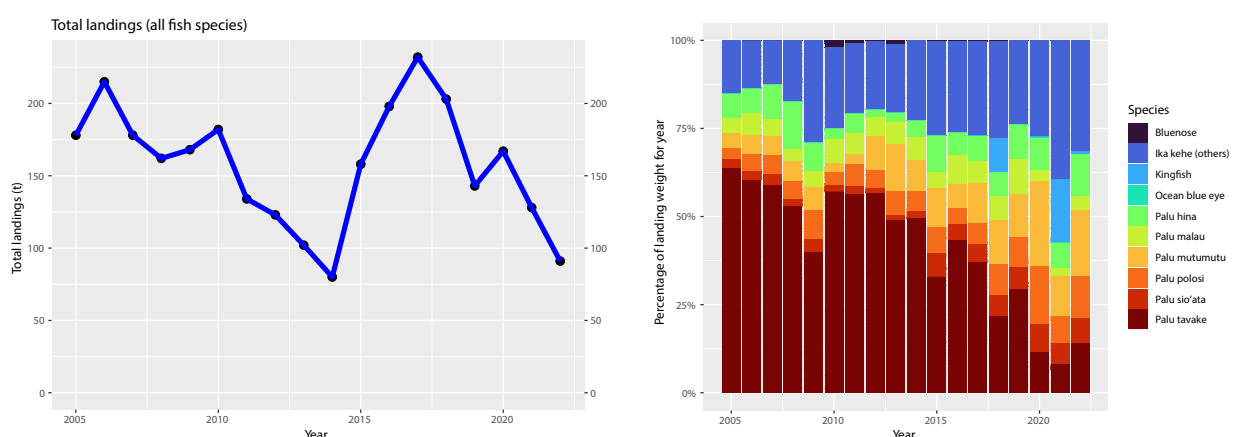


Figure 1. Left: Total landings (all species) of the Tonga deepwater demersal fishery, 2005–2022. Right: Catches of key species by proportion, 2005–2022.

¹ National Institute of Water and Atmospheric Research Ltd (NIWA), New Zealand

² Tonga National Fisheries Council, Tonga

³ Fafine Tonga 'o Ngatai, Tonga

⁴ Ministry of Fisheries, Tonga

⁵ Pacific Community (SPC), New Caledonia

* Author for correspondence: Bradley.Moore@niwa.co.nz

Changes in species composition over time are also evident. In the early years of the fishery, catches were dominated by eight-bar grouper (*Hyporthodus octofasciatus*; Mohuafi) and crimson jobfish (*Pristipomoides filamentosus*; Palu hina), but the proportion of these species in the catch has since declined (Halafihi 2015). Catches of flametail snapper (*Etelis coruscans*; Palu tavake) (Figure 2), the main target species for export, generally exceeded 50% of total landings between 2005–2014 but have steadily declined since 2010 and comprised just 10–15% of total landings between 2020–2022 (Figure 1, right). These declines were in part due to a decrease in flametail snapper biomass, changes in market preferences, and a lack of investment and confidence in the fishing sector. In parallel, fishers have avoided catching flametail snapper due to the closure of the export fishery from 2020 onwards resulting from the COVID-19 pandemic. There has also been a reliance on a single export market (Hawaii), underscoring the need for diversification of target species and improved marketing.

Project initialisation

In 2015, with funding from New Zealand's Ministry of Foreign Affairs and Trade (MFAT), the Tongan Ministry of Fisheries (MoF) and New Zealand's National Institute of

Water and Atmospheric Research Ltd (NIWA), along with the Tongan National Fisheries Council (NFC) and SPC, implemented the 'Improved governance, management and sustainability of the demersal line fishery in Tonga' project (hereafter the Project). The Project had three long-term outcomes designed to facilitate an ongoing, well-managed and sustainable line fishery for deepwater fish species in Tonga:

- Increased revenue and business confidence.
- Improved governance and robust decision-making.
- Biologically sustainable fishery established.

Project structure and governance

The Project was initially implemented in 2015 as a five-year, two-phase activity. However, due to the impacts associated with COVID-19 and the Hunga-Tonga Hunga-Hā'apai (HTHH) eruption in 2022, the Project was extended to June 2023. Phase 1 (2015–2016) of the project was dedicated to understanding the fishery; identifying entry points for change; and developing, agreeing on and embedding key management measures designed to limit the over-exploitation of flametail snapper and other species in the deepwater fish assemblage. Phase 2 (2017–2023) was dedicated to implementation.



Figure 2. MoF staff sampling flametail snapper at Tui'matamoana Wharf, Tongatapu. ©NIWA / Rebekah Parsons-King

The Project was overseen by a Project Management Group (PMG), which comprised representatives from each of the four partner organisations (MoF, NIWA, NFC and SPC) as well as representatives from key stakeholder groups, including Tongan deepwater line fishers, the Fafine Tonga 'o Ngatai Women in Fisheries Group and New Zealand's Ministry of Primary Industries (MPI). The PMG met multiple times in each year throughout the Project, either in-person or online via MS Teams, to discuss project progress, review activities and outputs, and prioritise next steps. MFAT staff based at the New Zealand High Commission, Nuku'alofa, also regularly attended PMG meetings, greatly strengthening the links between the donor and implementing agencies.

Increasing revenue and business confidence

To increase revenue and business confidence the Project:

- Conducted preliminary bioeconomic analyses of the deepwater fishery in Phase 1 to provide baseline information at the start of the Project (James 2016). In Phase 2, revised bioeconomic analyses were completed with updated cost information to evaluate the effect of diversifying the fishery (Mardle 2021). Results from these analyses stressed the importance of conservative catch limits, suggested the fishery can sustain a maximum fleet size of around 15 vessels, and highlighted the need for diversification of species caught in the fishery and markets.
- Increased diversity of catches through training fishers in deepwater squid, loligo squid, small pelagic and mini longline fishing gears, and provided sets of these gears to the NFC (see boxed text on 'Fishery diversification'). In addition, the Project explored diversifying the fishery to fish for bluenose (*Hyperoglyphe antarctica*) following the observation of good catches in the south of Tonga's exclusive economic zone (EEZ) during surveys conducted under the AusAID-funded, SPC-implemented 'Pacific Fisheries for Food Security' programme. Fisheries-dependent surveys recorded low catch rates around Tongatapu and Ha'apai, suggesting the majority of fish biomass was in the south, and thus only accessible to the largest vessels that could travel the furthest. As such, bluenose was not considered to be an equitable diversification option for the fleet.
- Provided a one-off payment to licensed deepwater fishers to allow for vessel repairs/improvements to enhance the efficiency of their business operations and maintain consistent product supply for markets.
- Provided training to fish processors and vendors in fish handling and processing to improve marketability of catch, reduce product wastage and maximise economic return.
- Provided training in accounting and business practices to increase revenue and business confidence.

- Invested in the development of a local market for deep-water squid through marketing campaigns, promotions and competitions, and public tastings.

An original objective of the Project was to develop alternative export markets for deepwater fish species to reduce the reliance on the single Hawaiian export market. Alternative markets were initially canvassed in Australia and New Zealand. However, with the onset of COVID-19, the maintenance of domestic food security became a priority, and thus this objective was put on hold. Discussions with alternative markets have since resumed.

Improving governance and robust decision-making

To improve governance of the fishery and ensure robust decision-making, the Project:

- Convened regular meetings between stakeholders to facilitate collegiality among stakeholder groups and to improve understanding of the needs and desires of the different stakeholders. In-person meetings were held approximately quarterly, with meetings held more regularly with the shift to online meetings during COVID-19.
- Supported the development of the NFC Strategic Plan 2021–2025 (NFC 2021).
- Developed harvest control rules and embedded these within the Deepwater Fishery Management Plan (DFMP) to ensure transparent decision-making. The most significant of these include adoption of a total allowable catch (TAC) of 200 t for the deepwater demersal fish assemblage, adoption of a species-specific TAC of 86 t for flametail snapper and adoption of a minimum size limit of 48 cm fork length (FL) for flametail snapper. The minimum size limit can be considered a 'move-on' rule in that it mandates that undersized flametail should comprise no more than 20% of total flametail catch per trip (effectively encouraging fishers to fish elsewhere if they are catching undersized flametail snapper).
- Developed and provided training in the *tongafish* R package, which allows for the generation of semi-automated reports from logbook and port sampling data via SPC's Tuna Fisheries Data Management System (TUFMAN 2) to enable regular monitoring of fishery performance against DFMP objectives.
- Provided scientific and bioeconomic advice and assisted with the development of monitoring and evaluation criteria for the 2017–2019 and 2020–2023 DFMPs.
- Supported mid- and full-term reviews of the 2017–2019 and 2020–2023 DFMPs, in collaboration with New Zealand's MPI.

Biologically sustainable fishery established

Over the course of the Project, a number of initiatives were undertaken to improve biological sustainability of the fishery. These included:

- ◆ Supporting monitoring of catch volumes and the size of landed fish, as well as the collection of otoliths from flametail snapper for estimating fish age and exploring the effects of climate cycles on growth (in collaboration with the University of Adelaide).
- ◆ Undertaking regular descriptive analyses to understand recent trends in the fishery, such as changes associated with COVID-19 (McKenzie 2016, 2020; McKenzie et al. 2023).
- ◆ Undertaking regular stock assessments of flametail snapper. The most recent assessment was conducted in June 2023 using data to the end of 2022. This assessment estimated that flametail spawning stock biomass (SSB) had increased from approximately 25% of unfished biomass in 2018 to 31% of unfished biomass in 2022 and will continue to rebuild should annual catches remain at or below 50 t (McKenzie 2023).
- ◆ Developing a Spatial Population Model of the fishery to determine whether there had been spatial patterns in the flametail snapper depletion. As expected, the model predicted higher levels of depletion around the main fishing ports in Tongatapu, Ha'apai and Vava'u, and lower levels of depletion further south and north.
- ◆ Increasing diversity of catches through training in deepwater squid, loligo squid, small pelagic and mini longline fishing gears, and by providing fishers access to these gears.
- ◆ Investing in the development of a local market for deepwater squid (Figure 3, see also boxed text on 'Fishery diversification').



Figure 3. Unloading diamondback squid at Tui'matamoana Wharf, Tongatapu. ©Ministry of Fisheries.

Fishery diversification

Diversification into different target species was a key focus under Phase 2 of the Project. Tongan deepwater fishers were trained in fishing for deepwater squid (including diamondback squid *Thysanoteuthis rhombus* and neon flying squid *Ommastrephes bartramii*) using deepwater dropline techniques (see Figure 4), loligo squid using jigging machines, small pelagics using scoop nets and nearshore pelagic fish such as tunas using mini longlines (deployed either horizontally or vertically). Sets of these fishing gears were provided to the NFC to support the long-term viability of the diversification activities. These diversification options have multiple advantages, including reducing operating costs (particularly in the case of squid and small pelagics, which can be used as bait – prior to the Project fishers were importing frozen arrow squid from New Zealand for use as bait), reducing fishing pressure on deepwater fish populations and creating new economic opportunities for local fishers to increase domestic food security. They give fishers the alternative to engage in other fishing activities when a particular species is in season or in demand, or when conditions do not allow access to deepwater grounds. In particular, the deepwater squid and vertical longline approaches showed great promise – over 4 t of deepwater squid were caught during trials in 2022, while yellowfin tuna and even blue marlin were caught on the vertical longlines!

Significant investment was made in developing a local market for deepwater squid. Notably, the two deepwater squid species targeted did not have a local name, indicating that they were seldom if ever fished for in Tonga previously. To increase public awareness, a naming competition was held and advertised via local radio and Facebook – a popular medium in Tonga. Several food stalls were also established where the public could taste squid cooked in several different ways. To further raise awareness and interest, squid were sold to the public at reduced cost. The result is a fresh, healthy and delicious new seafood product available to consumers. The squid are excellent grilled, as sashimi, boiled in coconut milk or cooked in taro leaves in an umu.



Figure 4. Diversification into deepwater squid was a key focus of the Project. ① Tongan fishers fishing for diamondback squid with SPC's Fisheries Development Officer William Sokimi. ② Dr Tu'ikolonga'ahu Halafihi (MoF) shows off diamondback squid to King Tupou VI. ③ Diamondback squid after a successful fishing trip. ④ Diamondback squid packaged and ready for sale. ⑤ A happy customer at the Tui'matamoana Wharf, Tongatapu. Images ©Ministry of Fisheries.



Figure 5. Some of the capacity building activities undertaken during the project. ① Skippers and crew following their Master/Engineer Class 6 course. ② Members of the Fafine Tonga 'o Ngatai Women in Fisheries Group following training in fish handling and processing hygiene, and with new processing equipment. ③ MoF and NIWA staff at NIWA's Wellington campus for training in data analysis and fish age estimation. ④ MoF and NIWA staff undertaking training in the *tongafish* R package. Images ©Ministry of Fisheries and Brad Moore.

Capacity building

In addition to the fisheries diversification training described above, several activities were undertaken to improve capacity along the supply chain (Figure 5):

- Training was provided to fishers in the form of Master/Engineer Class 6 courses and three at-sea safety training modules, giving them valuable technical skills, increasing their employability and enhancing at-sea safety. Safety grab bags, including a personal locator beacon, lifejacket, compass, flashlight, mirror and whistle, along with training in their contents, were also provided to fishers to promote safety at sea.
- Members of the Fafine Tonga 'o Ngatai Women in Fisheries Group were provided training in fish handling and processing hygiene to improve marketability of catch, reduce wastage and maximise economic returns, and in accounting and business practices to increase revenue and business confidence. In addition, a range of equipment was provided to further support business development and improve working conditions, such as insulated bins to hold fish, better knives, cutting boards, gloves, boots, aprons and cleaning supplies.

A number of capacity building activities were provided to MoF staff to strengthen their ability to monitor and manage the fishery, including:

- Regular in-country and online training for staff in the R statistical environment and the *tongafish* R package.
- Attachments to SPC for training in economic analyses.
- Supporting MoF staff attendance at an international deepwater fish-ageing workshop in Hawaii.
- Supporting MoF staff attendance at regional R training courses.
- Secondment of a MoF staff member to NIWA Wellington for a ten-week internship to learn R programming, fisheries analysis and stock assessment principles.
- A combined data analysis and fish age estimation workshop with MoF staff held in NIWA Wellington.

Gender and social inclusion

To inform activities in this area, a social inclusion and gender equality analysis of Tonga's deepwater fishery was commissioned in 2015 and completed in 2016 (Dwyer 2016). This report led to the Fafine Tonga 'o Ngatai Women in Fisheries Group being integrated into the PMG early in the Project to ensure their needs and aspirations were incorporated in decision-making processes. In addition, regular meetings outside of the PMG structure were held with the group to increase engagement and ensure their needs were understood.



Figure 6. Damaged fishing vessels following the Hunga Tonga-Hunga Ha'apai eruption and resulting tsunami, Sopu, Tongatapu, Tonga. Images © Ministry of Fisheries.

The group was instrumental to the developing squid fishery and the associated marketing plan. They organised squid processing infrastructure, including labelling, processing, packaging and distribution. They also led the public tastings of squid, organising food stalls and cooking squid in different ways to help increase public awareness.

COVID-19 and the Hunga-Tonga Hunga-Ha'apai eruption

Over its life, the Project encountered two significant challenges to delivery. The first was COVID-19, which resulted in closure of the export market, reduced food imports and local lockdowns. This highlighted the fragility of the fishery and of the food system in Tonga as a whole. To adapt, fishers stopped targeting flametail snapper and increased targeting of other species for the domestic market such as kingfish (*Seriola* spp.), saddleback snapper (*Paracaesio kusakarii*; Palu mutumutu) and rusty jobfish (*Aphareus rutilans*; Palu polosi). At the time of writing, the export market had not yet resumed, although discussions are ongoing with both the existing market in Hawaii and with new markets in Australia.

On 15 January 2022 HTHH erupted, resulting in a debris field and a plume of ash rising over 50 kilometres into the atmosphere, and a devastating tsunami that severely impacted Ha'apai, Tongatapu and surrounding islands (Figure 6). A damage assessment conducted by MoF in the weeks after HTHH indicated that only four of the 30 licensed deepwater demersal line fishery vessels were seaworthy, with most sustaining damage from the tsunami. To maintain food security after the eruption, MoF supported those deepwater demersal fishers that could go fishing to increase fish production by subsidising ice and bait, purchasing and on-selling demersal fish to the public at reduced costs, and subsidising deepwater squid fishing from the Tongan Government's HTHH response fund. With support from the Tongan government and some good old-fashioned Tongan ingenuity, most deepwater vessels are now repaired and back fishing.

Next steps and concluding remarks

Although Project activities officially ended in June 2023, there is still much to be done. MoF staff are currently working with New Zealand's MPI and Project staff to develop an updated management plan for the fishery incorporating key project findings. Changes in the deepwater demersal fishery towards alternative target species (e.g. saddleback snapper, rusty jobfish) will require additional biological studies to determine their life history characteristics and assess their vulnerability to fishing. Investment will be required to increase the efficiency of fishing and improve the fishery's resilience to climate change. Both the deepwater squid and mini longline diversification activities show great promise and would benefit from further support. With sustained collaboration between science and industry, strong co-management, and continued diversification of catches and markets, the fishery could ultimately be a model for demersal line fisheries throughout the Pacific Island region.

Acknowledgements

We thank the many people who have contributed to the Project, including Mele 'Atuekaho, Vilimo Fakalolo, Elaine Havealeta, Moana Mahe, Samuela Pohiva, Michael Po'uliva'ati, Salome Taufa and the late Hon. Minister for Fisheries Semisi Fakahau (MoF), Owen Pau'u and Kathrine Biggs (MFAT), Lindsay Chapman, Andrew Smith, Phil James, Jean-Baptiste Marre and Julie-Anne Kerandel (SPC), Toni Ferdinands, James Tafatu and Paul Cresswell (MPI), the deepwater fishery licence holders and fishers, members of NFC, members of the Fafine Tonga 'o Ngatai Women in Fisheries Group, Maire Dwyer (consultant – Gender and Social Inclusion), Bruce Bird (consultant – Marketing), Peter Philipson (consultant – Economics), Simon Mardle (consultant – Bioeconomics) and Joanna Bourke (consultant – Marketing). The Project was funded by the New Zealand Ministry of Foreign Affairs and Trade.

References

- Dwyer M. 2016. Social inclusion and gender equality analysis of Tonga's deep water fishery. Final Report to the National Institute of Water and Atmospheric Research Ltd (NIWA), April 2016. 23 p.
- Halafihi T. 2015. Ecology and biology of *Etelis coruscans* and *Pristipomoides filamentosus*: Case study of the Tonga deep-water bottomfish fishery. PhD thesis, University of Canterbury, Christchurch, New Zealand. 247 p.
- James P. 2016. Tonga Deep Water Management Plan 2017 to 2019: Results from bio-economic modelling. Noumea, New Caledonia: SPC. 37 p.
- Mardle S. 2021. Bioeconomic model of Tongan deepwater snapper fishery. Final Report to the National Institute of Water and Atmospheric Research Ltd (NIWA), May 2021.
- McKenzie A. 2016. Development of Tonga demersal line fisheries NZAid Activity report: descriptive analysis of the Tonga deepwater bottom fishery to inform a spatial simulation model. 67 p.
- McKenzie A. 2020. Development of Tonga demersal line fisheries NZAid Activity report: descriptive analysis of the Tonga deepwater bottom fishery to inform a spatial simulation model (using data to the end of 2019). 71 p.
- McKenzie A. 2023. *Etelis coruscans* (flametail) stock assessment for Tonga to 2022 fishing year. Wellington, New Zealand: NIWA.
- McKenzie A., Vaipuna L. and Malimali M. 2023. Descriptive analysis of the Tonga deepwater snapper fishery using data to the end of 2022. Wellington, New Zealand: NIWA.
- NFC 2021. National Fisheries Council Strategic Plan 2021–2025. Nuku'alofa, Tonga: NFC. 15 p.
- Wakefield C.B., Williams A.J., Newman S.J., Bunel M., Boddington D.K., Vourey E. and Fairclough D.V. 2015. Variations in growth, longevity and natural mortality for the protogynous hermaphroditic eight-bar grouper *Hyorthodus octofasciatus* between the Indian and Pacific Oceans. Fisheries Research 172, 26–33.
- Wakefield C.B., Williams A.J., Fisher E.A., Hall N.G., Hesp S.A., Halafihi T., Kaltavara J., Vourey E., Taylor B.M., O'Malley J.M., Nicol S.J., Wise B.S. and Newman S.J. 2020. Variations in life history characteristics of the deep-water giant ruby snapper (*Etelis* sp.) between the Indian and Pacific Oceans and application of a data-poor assessment. Fisheries Research 230, 105651.

© Copyright Pacific Community (SPC), 2023

All rights for commercial / for profit reproduction or translation, in any form, reserved. SPC authorises the partial reproduction or translation of this newsletter for scientific, educational or research purposes, provided that SPC and the source document are properly acknowledged. Permission to reproduce the document and/or translate in whole, in any form, whether for commercial / for profit or non-profit purposes, must be requested in writing.

Original SPC artwork may not be altered or separately published without permission.

The views expressed in this newsletter are those of the authors and are not necessarily shared by the Pacific Community.

Original text: English

Pacific Community, Fisheries Information Section, BP D5, 98848 Noumea Cedex, New Caledonia
Telephone: +687 262000; Fax: +687 263818; spc@spc.int; <http://www.spc.int>