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Editorial

Stocks of the four main tuna species fished in Oceania are in relatively good health. This is one of the conclusions of the studies conducted by SPC's Ocean Fisheries Programme and presented at the 15th meeting of the Scientific Committee of the Western and Central Pacific Fisheries Commission (see Graham Pilling's article on p. 2). But things aren't completely rosy: overall catches keep increasing; the side effects of certain techniques, including drifting FADs, need to be better controlled and limited; and the impact of fishing on non-target species, particularly on sharks and rays, remains too great and it is urgent to impose stricter rules to reverse the trend. This concern for sharks and rays is shared by many, including the World Wildlife Fund for Nature (see Andy Cornish's article on p. 34).

Unlike tuna fisheries, whose major importance for the region's economies is undisputed, coastal fisheries often suffer from a lack of recognition. The creation of an annual Regional Fisheries Ministers Meeting, endorsed during the 50th Pacific Islands Forum in Tuvalu, will certainly assist in making the voice of coastal fisheries better heard at the ministerial level (see Andrew Smith's article on p. 32).

The 18th CITES Conference of Parties has decided to 'list' three species of tropical sea cucumbers. This will mean that in order to be allowed to export these species, countries that are parties to CITES will need to prove that their stocks are healthy, and will remain so at the current level of fishing effort. Two of these species, white teatfish and black teatfish, are high-value species present in the Pacific Islands region. George Shedrawi and colleagues believe that this binding decision provides opportunities for the better management of the beche-de-mer trade in general (see their article on page 6).

Aymeric Desurmont, *Fisheries Information Specialist, SPC*

A short break during tuna transshipment work, Majuro, Marshall Islands. (Image: Francisco Blaha)



Ground-breaking science at the 15th meeting of the WCPFC Scientific Committee

Representatives from countries across and beyond the Pacific met this August in Pohnpei, Federated States of Micronesia for the 15th Regular Session of the Scientific Committee (SC) of the Western and Central Pacific Fisheries Commission (WCPFC). At this meeting, delegates review the latest science relevant to the management of migratory species in the western and central Pacific Ocean (WCPO), and make formal recommendations to the WCPFC meeting held in December each year. This is the big meeting for the scientific team of the Oceanic Fisheries Programme (OFP) of the Pacific Community (SPC). OFP is the WCPFC's scientific and data management services provider. The OFP papers and presentations to this meeting provide the backbone for important discussions on scientific aspects of the largest tuna fishery in the world.¹ It is also the key pathway through which OFP's work translates into concrete outputs for Pacific Island communities. The OFP team was heavily involved in presentations and working groups for all four themes reviewed by the SC: data and statistics; stock status; management issues; and ecosystems and bycatch mitigation.

SPC – in collaboration with the Pacific Islands Forum Fisheries Agency – provided the latest tuna catch information for the WCPO. The provisional tuna catch for 2018 was estimated at over 2.7 million tonnes, with a delivered value of just over USD 6 billion. This catch level was the second highest on record, and represented just over 80% of the total Pacific Ocean catch and 55% of the global tuna catch.² Given the impact of our new knowledge on bigeye growth on the estimated status of this stock,³ there has been great interest in improving our understanding of the biology of all tuna stocks in the WCPO. The latest ageing results developed in collaboration with the Commonwealth Scientific and Industrial Research Organisation in Australia for both bigeye and yellowfin tuna were presented to this meeting of the SC. While there is still more work to be done, this new information will feed into new assessments of both of these stocks that are scheduled for next year.

This year, new stock assessments were presented by SPC for WCPO skipjack, southwest Pacific striped marlin, and WCPO oceanic whitetip shark.

The skipjack assessment benefited from a new understanding of the stock's biology that was provided by Japanese colleagues. Similar to bigeye tuna last year, this changed our perception of the status of the stock slightly, but it continues to be in the 'green zone' of our 'Majuro plot'⁴ (i.e. not overfished, and not subject to overfishing) (Fig. 1). This assessment will form the basis for further work in 2019 to inform the WCPFC as to whether the interim target reference point for the stock (the level the stock should be at to achieve what managers want from the fishery) should be adjusted.

The southwest Pacific striped marlin assessment presented this year was the first performed since 2012. Across the range of models examined within this year's assessment, over two-thirds indicated that the stock was overfished, although more than half of the models indicated that overfishing has not been occurring recently. The potential management actions required for this stock, including the enhancement of the current management measure, will form part of discussions at the 16th meeting of the WCPFC in December.

The oceanic whitetip shark assessment, led by the New Zealand consultancy Dragonfly, indicated that the stock was below most management benchmarks. Management measures are currently in place for this stock aimed at reducing fishing impacts. While the assessment suggests these are having a beneficial impact, further work has been identified to examine whether the measure is sufficient to allow stock recovery.

In the discussions on management issues, SPC scientists presented work to support the 'harvest strategy' approach to tuna stocks. This approach focuses on longer-term objectives for fisheries and stocks, and aims to move away from annual short-term decision-making. This work is ongoing, and the latest developments in the framework for skipjack and South Pacific albacore were presented. A key future development is a consideration of the consequences of managing the fisheries of one stock on other stocks caught in the WCPO. This 'multispecies' issue was the focus of two different SPC papers, which highlighted the interactions that need to be taken into account when developing both target reference points for bigeye and yellowfin tuna stocks, and when developing harvest strategies for these stocks and key fisheries.

¹ Over 45 papers were written and presented by OFP authors this year. See <<https://www.wcpfc.int/meetings/sc15>> for full details

² More information on the catch and fishing patterns are available at: <https://www.wcpfc.int/node/42905>.

³ See: www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/FishNews/153/FishNews153_23_Hampton.pdf

⁴ Named 'Majuro plot' because it was first presented at the SC10 meeting in 2014 – held in Majuro.

Two SPC-led analyses related to fish aggregation devices (FADs) in the WCPO were presented. The first, in collaboration with the Parties to the Nauru Agreement (PNA), evaluated the latest information from the PNA FAD tracking programme. It presented the spatial pattern of FADs, whether areas of higher FAD densities had different tuna catch rates, and the fate of FADs, particularly those that drifted outside the main fishing grounds of the companies that owned them and eventually beached on shorelines or coral reefs. The second, in collaboration with industry partners Tri Marine and South Pacific Tuna Corporation, presented preliminary analyses of the patterns of tuna aggregation below FADs, as estimated by echosounders fitted to drifting FADs. Echosounder use on FADs is now widespread throughout the fishery, and has the potential to provide novel and valuable information for scientific analyses. Insights into the pattern and rate at which tunas may aggregate around newly deployed FADs, trends just prior to fishing set events, and the spatial pattern of biomass estimates were presented for the first time.

Ongoing tagging of tuna around FADs, to examine how long individuals remain around FADs and their behaviour while they remained there, has begun to identify some of

these patterns in relation to factors that influence tuna aggregations such as local FAD density, moon phase and time of day at the FAD. This exciting work has already provided some interesting results that may help identify new mitigation measures for the catches of small bigeye and yellowfin in sets around FADs.

Finally, reflecting the fact that target tuna are not the only marine species caught during fishing operations, we developed estimates of annual seabird mortality using the latest information collected by regional observers. Bycatch estimates in the purse-seine fishery were very low (approximately one mortality per year). In longline fisheries, for which mortality estimates were higher, the spatial pattern of incidences was examined for the most recent years, where enough observer information was available. Increasing the coverage of observers on longline vessels would help improve these calculations and highlight approaches to further reduce impacts.

In addition to SPC's work, contributions were also presented by our scientific colleagues who work across the Pacific, including an assessment for North Pacific striped marlin by the International Scientific Committee for Tuna and Tuna-like

Species in the North Pacific Ocean, alternative assessment approaches for sharks by Dragonfly Consulting, estimates of shark release mortality by the United States, and a report from a workshop on the issue by the Areas Beyond National Jurisdiction project, work on biodegradable FAD designs and ecosystem indicators by the European Union, and safe release guidelines for birds developed by New Zealand scientists.

Next year's proposed assessments for SPC include bigeye and yellowfin tuna. Further work for OFP in 2019 includes the WCPFC's Technical and Compliance Committee (TCC) meeting, and the WCPFC meeting to be held in Port Moresby in December, where the SC's and TCC's recommendations are reviewed and translated into actual management measures and regulations.

For more information

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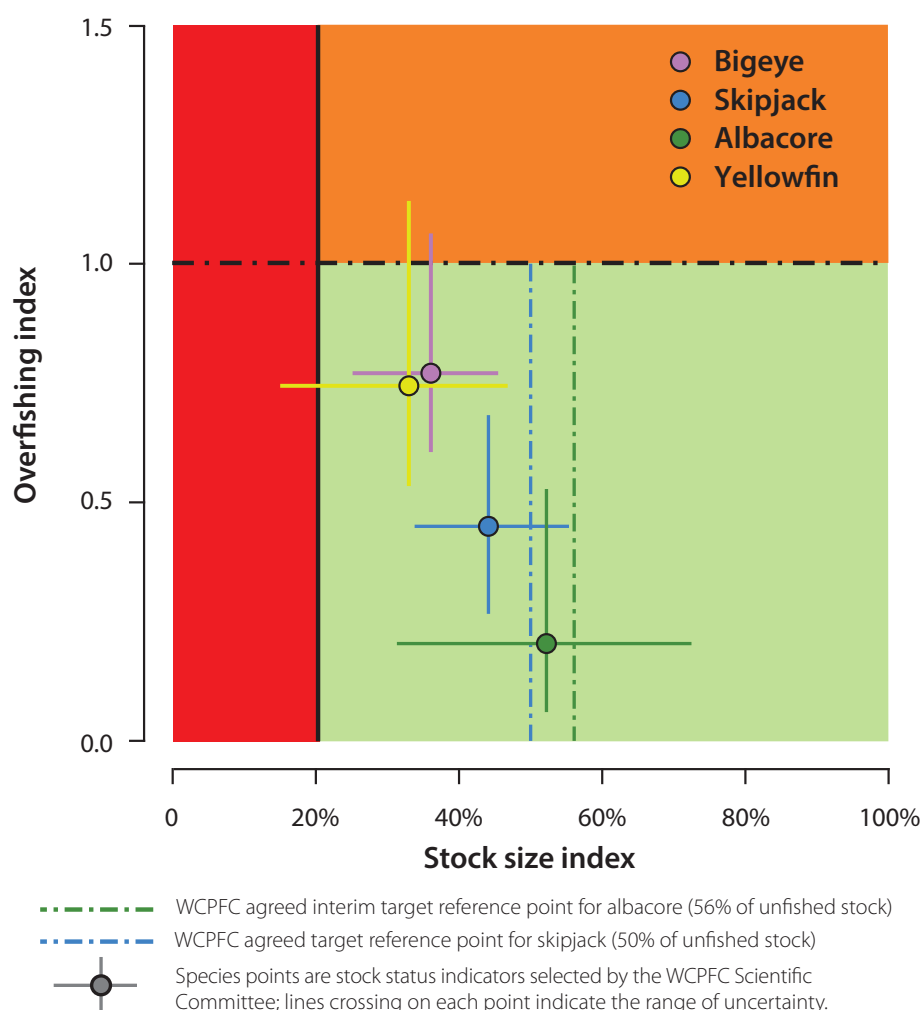


Figure 1. 2019 Majuro plot

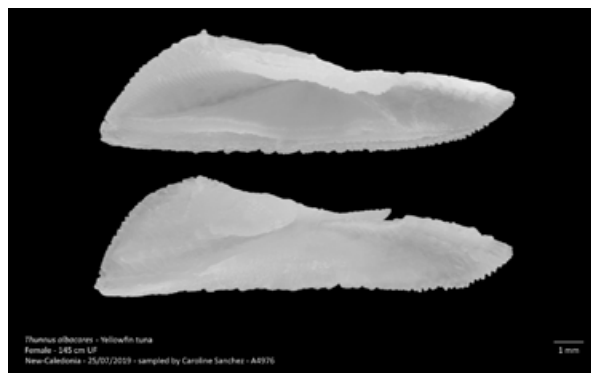
Help us find out how tuna age and how fast they grow and win USD 100!

Since 2006, the Pacific Tuna Tagging Programme, endorsed by the Western and Central Pacific Fisheries Commission and implemented by the Pacific Community (SPC), has been organising fish tagging events annually. On this year's pole-and-line tagging cruise through Solomon Islands, Papua New Guinea and Federated States of Micronesia, tunas labelled with conventional white tags also received an injection of strontium chloride to validate the deposition rate of the increment formations (often called growth rings) that are observed and counted in fish otoliths as a way to estimate fish age and growth.

Otoliths are small 'ear stones', calcium carbonate structures located on either side of the head. They allow fish to find their balance and perceive linear acceleration, both horizontally and vertically. As otoliths grow, they incorporate chemical 'markers' from the water (such as calcium, strontium, and other elements and stable isotopes). The concentrations of these markers reflect both the environment the fish swims through, and intrinsic processes such as physiology and metabolism. Once a marker is incorporated into a growth ring, it remains there permanently, providing a time-stamped chemical record of the fish's experience. By counting the growth rings on otoliths, scientists can estimate the age of a fish; however, the periodicity of ring formation needs to be validated. The external application of chemical markers during tagging events has proved to be a useful method in this regard.

Strontium chloride (SrCl_2) and oxytetracycline (OCT) markers have been widely used to validate increment formation in tunas (Wild and Foreman 1980; Wexler 1993; Wild et al. 1995; Clear et al. 2000). SrCl_2 is often preferred over OCT because of public health concerns; the United States Federal Drug Administration prohibits the use of OCT in wild fisheries, whereas SrCl_2 is a mineral that occurs naturally in seawater, and is regarded as safe for human consumption (Sax and Lewis 1987). SrCl_2 is even used in toothpaste to reduce dental hypersensitivity! Importantly, both strontium and chlorine are present naturally within otoliths, and previous studies using SrCl_2 for mark-recapture experiments on tuna have shown that SrCl_2 did not induce mortality (e.g. Clear et al. 2000).

Prior to the tagging cruise, a SrCl_2 solution was prepared at SPC's laboratory. Onboard the tagging vessel, the injection procedure is quite rapid. Following capture, the fish is placed on a tagging cradle and the scientists use a self-filling dosing syringe designed for continuous injection. To identify fish that have been injected with SrCl_2 , a white tag is placed behind the second dorsal fin. After injection in the muscle, the SrCl_2 is then metabolised and incorporated into the otolith structure. The strontium readily substitutes for the calcium in the otolith matrix, and the SrCl_2 injection leaves a distinct mark on the otoliths that is clearly visible under a scanning electron microscope. When a marked fish is recaptured, and knowing its time at liberty, the number of increments counted on the otolith after the mark can then be compared with the number of days since the fish



Yellowfin tuna otoliths. (Image: Elodie Vourey, SPC)

was tagged, providing a validated increment deposition rate. This information can then be used to age other fish of the same species, thus providing crucial data on age structure of tuna populations, which is necessary to accurately estimate stock status through the assessment models.

At the end of August 2019, 215 skipjack and yellowfin tunas had been injected with SrCl_2 , and SPC is aiming to tag 1000 fish. To be able to extract and analyse otoliths from tagged and re-captured fish, SPC scientists will need the entire fish. This also provides scientists the opportunity to collect other biological samples: the stomach, muscle, liver, gonads and the dorsal spine. A full set of analyses can be undertaken on the same fish; for example, measuring mercury and/or isotope concentrations, and analysing stomach content and conducting genetic analyses. To preserve the quality of the samples, following capture onboard purse-seine and freezer longline vessels, SrCl_2 -injected fish must be kept frozen at all times, whereas fish from 'fresh' longliners can be sampled upon arrival at port. Since 2009, biological sampling training, including otolith extraction, has been provided by SPC, and in each major port, samples can be collected by observers, port samplers or fisheries officers.

If, by chance, you encounter a white tag on a tuna, please contact SPC directly. We need to maximise our chances of extracting as many sets of otoliths as possible. New posters, which have been translated into several languages, are now available at www.spc.int/tagging. The finder of a fish carrying a white tag will be rewarded USD 100. In addition, the fish will be bought from the fishing vessel or the cannery where it was found at a price of USD 10/kg (weight of the



The 5th Western Pacific Tuna Tagging Cruise is on its way

Keep an eye out and report tag findings!



The vessel left Noro on July 22 and will be back on September 20

It is planned to deploy a minimum of **15,000 conventional tags**, **100 archival tags**, and **do 1000 injections** to mark the otoliths of yellowfin and skipjack tunas for growth studies



★ ★ Found a fish with a tag ? ★ ★
If the tag is orange or white, we will need the whole fish!

- Leave the tags in the fish.
- Place the fish in a freezer and never let it defrost.
- Contact SPC using the link below.
- Bring the fish to the closest fisheries office for collection of samples.

www.spc.int/tagging



August 2019

whole fish, not gilled and gutted). And, finally, observers will be rewarded USD 50/fish to help in the coordination and collection of samples.

Further information will be provided at the end of the tagging cruise. Stay tuned!

References

- Clear N.P., Gunn J.S. and Rees T. 2000. Direct validation of annual increments in the otoliths of juvenile southern bluefin tuna, *Thunnus maccoyii*, by means of a large-scale mark-recapture experiment with strontium chloride. *Fishery Bulletin* 98(1):25–40.
- Sax N.I. and Lewis R.J. Sr. 1987. Hazardous chemicals desk reference. Van Nostrand Reinhold, New York, NY. 1084 p.
- Wild A. and Foreman T.J. 1980. The relationship between otolith increments and time for yellowfin and skipjack tuna marked with tetracycline. *Inter-American Tropical Tuna Commission Bulletin* 17(7):507–560.

Wild A., Wexler J.B. and Foreman T.J. 1995. Extended studies of increment deposition rates in otoliths of yellowfin and skipjack tunas. *Bulletin of Marine Science* 57(2):555–562.

Wexler J.B. 1993. Validation of daily growth increments and estimation of growth rates of larval and early-juvenile black skipjack, *Euthynnus lineatus*, using otoliths. *Inter-American Tropical Tuna Commission Bulletin* 20(7):399–440.

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CITES listing of sea cucumber species provides opportunities to improve management of the beche-de-mer trade

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Introduction

While dried and processed sea cucumbers (commonly known as beche-de-mer) have been traded on international markets for a millennia (Conand and Byrne 1993), over the last 40 years trade has increased exponentially due to buoyant prices driven by the growing demand from Asia (Anderson et al. 2011). Easy access to sea cucumber habitats combined with their biological characteristics of slow growth, late age-at-maturity, and broadcast spawning reproductive strategy has made sea cucumbers especially vulnerable to overexploitation by fishers. These animals play a key role in maintaining ecosystem services through bioturbation and nutrient cycling, hence recent documented declines in populations have led to increasing concerns of the potential flow-on effects on ecosystem health (Purcell et al. 2013, 2016). If overexploitation continues, there is the possibility of densities decreasing to a level at which successful reproduction and replenishment of the population cannot be sustained; this is known as the 'Allee' effect (Allee 1938; Friedman et al. 2011; Kinch et al. 2008a; Purcell et al. 2013). Such an outcome benefits neither fishers nor sea cucumbers; therefore, international, regional and local management frameworks must be structured to significantly reduce the probability of this occurring.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international legal mechanism for regulating trade in overexploited species so that they can continue to perform their roles within the ecosystems they inhabit. Recognising that sea cucumbers were being heavily exploited, the United States of America submitted a discussion paper in 2002, at the 12th meeting of the Conference of the Parties (CoP) (Bruckner 2006; Bruckner et al. 2003). In 2015, prior to CoP17, the Fish and Wildlife Service of the United States was considering whether to submit a proposal to list sea cucumbers on Appendix II of CITES. However after completing consultations with relevant range countries and discussions nationally, concerns were raised about insufficient information on trade, taxonomy, biology, and population status globally and a formal proposal was not submitted. In 2018, France, as part of the European Union, and a number of other proponents (Kenya, Senegal, Seychelles and the United States of America) proposed listing black teatfish (*Holothuria whitmaei* – Pacific Ocean species, and *H. nobilis* – Indian Ocean species), and white teatfish (*H. fuscogilva*). At the 18th CITES CoP held in Geneva, the proposal to list the three teatfish species was accepted, with a 12-month deferral, by countries Party to CITES on 25 August 2019 by a majority vote of 108 of the 145.

Teatfish population status and CITES

As part of a memorandum of agreement between CITES and the Food and Agriculture Organization of the United Nations (FAO), FAO is responsible for assessing all marine

and aquatic organisms that have been proposed for listing. As a result, FAO was tasked with determining the status of sea cucumber fisheries and trade in beche-de-mer products globally. The 6th FAO Expert Panel Meeting was convened at FAO headquarters in Rome from 21–25 January 2019. The panel concluded that given the low reproductive rates, slow growth, and essential density thresholds for successful reproduction of *H. whitmaei*, the estimated decline in population size to 30% of baseline met the CITES criteria for



White teatfish. (Image: Viliami Fatongiatau, Tonga Ministry of Fisheries)

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White teatfish live (image: PROCFish)
and processed (image: Eric Aubry)



Black teatfish live (image: Pauline Bosserelle, SPC)
and processed (image: Eric Aubry)

listing in Appendix II³ (FAO 2019). It was also reported that *H. fuscogilva* did not meet the criteria, while there were not enough data to make an assessment on *H. nobilis*. However, because of the high likelihood of confusion in identification between dried *H. fuscogilva*, *H. nobilis* and *H. whitmaei* in trade, a 'look-alike' provision was included³ and, under the convention, all three species then met the criteria.

Exporting under CITES (Appendix II)

Within the Pacific Islands region, Papua New Guinea, Solomon Islands, Vanuatu, Fiji, New Caledonia, Tonga, Samoa, Palau, New Zealand and Australia are members of CITES. The requirements for exporting a species listed in CITES Appendix II applies to CITES Party countries regardless of the destination. Importing countries that are also signatory to CITES also need to be part of the chain-of-custody, which allows tracking of exported species. The four major beche-de-mer exporting countries in the Pacific Islands region are Papua New Guinea, Solomon Islands, Vanuatu and Fiji. While most other countries in the region have exported beche-de-mer product, it has been less frequently and in much lower quantities.

With the listing of teatfish species on CITES Appendix II, there is now a requirement for Party countries to build on their existing fishery management strategies in order to be consistent with the provisions of CITES Articles IV and X⁴ for an Appendix II-listed species. These strategies include determining population status via stock assessment, setting and policing of catch quotas, and use of spatial and temporal closures. For those species listed, a 'non-detriment-finding' (NDF) is required, which clearly establishes what level of export quotas are sustainable, allowing the species to persist and continue their roles within the ecosystems they inhabit (Rosser and Heywood 2002). An NDF is a determination by the scientific authority of the exporting country on whether international trade is likely to be detrimental to the survival of the species in that country⁵ (Rosser and Heywood 2002). The information needed to make the determination is not trivial, and in some cases may be greater than the capacity of individual country management authorities (i.e. national conservation agencies) and scientific authorities (national fisheries agencies). Difficulties in implementing successful and sustainable management are already prevalent in the Pacific Islands region (Kinch et al. 2008a, b), due principally to economic and technical constraints. Nevertheless, Pacific Island countries and territories (PICTs) can build on existing fisheries

³ Annex 5 of Resolution Conf. 9.24 (Rev. CoP17). <https://www.cites.org/eng/res/09/09-24R16.php>

⁴ <https://www.cites.org/eng/disc/text.php#IV> and <https://www.cites.org/eng/disc/text.php#X>

⁵ https://www.cites.org/eng/prog/ndf/Guidance_NDF

management structures and use rigorous stock assessments to set quotas to facilitate exports under CITES. The increase in oversight of an Appendix II listing will provide a better understanding of the trade in teatfish sea cucumber populations within each PICT and this should enable much better control of export pathways. Furthermore, it is important to use the CITES NDF determination as a positive mechanism for conservation agencies to collaborate with national fisheries agencies and develop achievable sustainable-use thresholds and quotas for these species.

How to proceed?

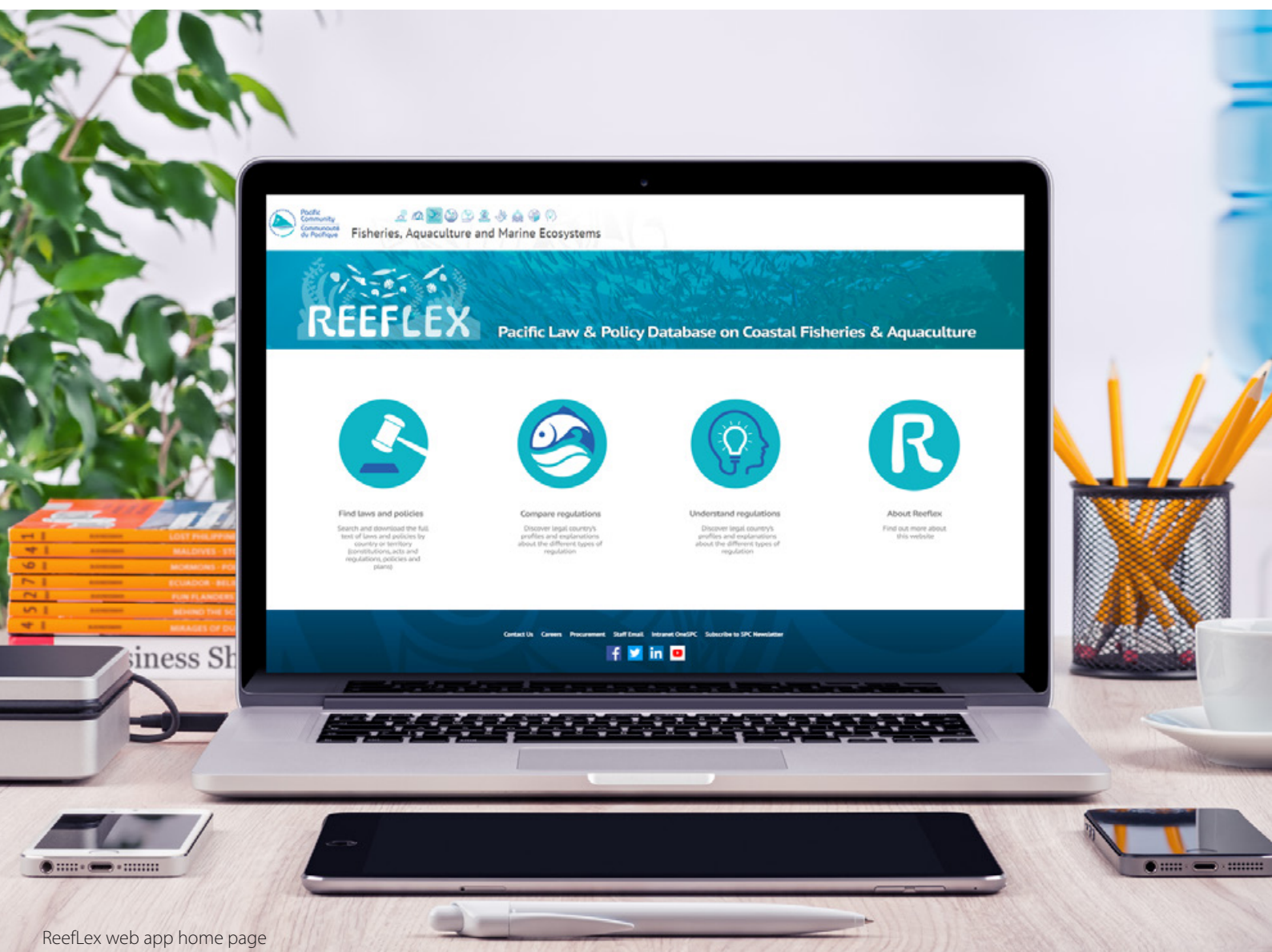
PICTs that are intending to sustain or develop an export trade in beche-de-mer will have to ensure that their ability to collect appropriate data to demonstrate their compliance with CITES requirements is maximised. Artisanal fishers who are the primary collectors of sea cucumbers are central to all PICT communities, hence this is a regional issue. Communities and countries need to mobilise resources and share successes and failures to ensure there is a collective improvement in the management of sea cucumber stocks across the region. This includes multilateral engagement with organisations such as the Pacific Community, the Secretariat of the Pacific Regional Environment Programme, FAO and numerous non-governmental organisations that can provide technical expertise and advice where needed and will work with the CITES secretariat to address capacity shortfalls across PICTs. A CITES listing can be a catalyst for improving the management of sea cucumber fisheries, which will ensure that the livelihoods and revenue that is generated for communities and governments can be sustained into the future (Purcell et al. 2017).

References

- Allee W.C. 1938. The social life of animals. New York: W W Norton and Co. <https://doi.org/10.5962/bhl.title.7226>
- Anderson S.C., Flemming J.M., Watson R. and Lotze H.K. 2011. Serial exploitation of global sea cucumber fisheries: Serial exploitation of sea cucumbers. *Fish and Fisheries* 12:317–339. <https://doi.org/10.1111/j.1467-2979.2010.00397.x>
- Bruckner A.W. 2006. Proceedings of the CITES workshop on the conservation of sea cucumbers in the families Holothuriidae and Stichopodidae, 1–3 March 2004, Kuala Lumpur, Malaysia.
- Bruckner A.W., Johnson K.A. and Field J.D. 2003. Conservation strategies for sea cucumbers: Can a CITES Appendix II listing promote sustainable international trade? *SPC Beche-de-mer Information Bulletin* 18:24–33.
- Conand C. and Byrne M. 1993. A review of recent developments in the world sea cucumber fisheries. *Marine Fisheries Review* 55:1.
- FAO (Food and Agriculture Organization of the United Nations). 2019. Report of the Sixth FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially Exploited Aquatic Species, (No. 1255), FAO Fisheries and Aquaculture Report. Food and Agricultural Organization of the United Nations, Rome.
- Friedman K., Eriksson H., Tardy E. and Pakoa K. 2011. Management of sea cucumber stocks: Patterns of vulnerability and recovery of sea cucumber stocks impacted by fishing. *Fish and Fisheries* 12:75–93. Available at: <https://doi.org/10.1111/j.1467-2979.2010.00384.x>
- Kinch J., Purcell S., Uthicke S. and Friedman K. 2008a. Population status, fisheries and trade of sea cucumbers in the Western Central Pacific. p. 7–55. In: Toral-Granda V., Lovatelli A., Vasconcellos M. (eds). *Sea cucumbers: A Global review of fisheries and trade*. FAO Fisheries and Aquaculture Technical Paper 516.
- Kinch J., Purcell S., Uthicke S. and Friedman K. 2008b. Papua New Guinea: A hotspot of sea cucumber fisheries in the Western Central Pacific. p. 57–77. In: Toral-Granda V., Lovatelli A., Vasconcellos M. (eds). *Sea cucumbers: A global review of fisheries and trade*. FAO Fisheries and Aquaculture Technical Paper 516.
- Purcell S., Conand C., Uthicke S. and Byrne M. 2016. Ecological roles of exploited sea cucumbers. *Oceanography and Marine Biology* 54:367–386.
- Purcell S.W., Mercier A., Conand C., Hamel J.-F., Toral-Granda M.V., Lovatelli A. and Uthicke S. 2013. Sea cucumber fisheries: Global analysis of stocks, management measures and drivers of overfishing [WWW Document]. *Fish and Fisheries*. Available at: <https://doi.org/10.1111/j.1467-2979.2011.00443.x>
- Purcell S.W., Crona B.I., Lalavanua W. and Eriksson H. 2017. Distribution of economic returns in small-scale fisheries for international markets: A value-chain analysis. *Marine Policy* 86:9–16. Available at: <https://doi.org/10.1016/j.marpol.2017.09.001>
- Rosser A. and Heywood M. 2002. Guidance for CITES Scientific Authorities: Checklist to assist in making non-detriment findings for Appendix II exports. IUCN, Gland, Switzerland and Cambridge, UK. xi + 146 p.

ReefLex: An app on coastal fisheries and aquaculture legislation

A test version of the ReefLex (Pacific Law and Policy Database on Coastal Fisheries and Aquaculture) web app¹ went live early 2019 as part of the Pacific Community (SPC)-implemented Coastal Fisheries Governance Project funded by the New Zealand Ministry of Foreign Affairs and Trade.



ReefLex web app home page

This app is designed to allow users access to and compare laws and policies on coastal fisheries and aquaculture management in 23 Pacific Island countries and territories (22 SPC member countries and Timor Leste). It targets decision-makers, fisheries managers, specialists and researchers as well as civil society. Graphic redesign work is currently underway to improve its usability and better guide visitors.

ReefLex is more than a simple compendium of documents. To facilitate understanding of the legal framework of coastal fisheries and aquaculture in each country or territory, the database offers three tools: a document search tool, a regulations analysis tool and an overview tool currently under development.

¹ <http://purl.org/spc/fame/cfp/reeflex>



Search tool: accessing laws and policies by country or territory

About 1000 documents have been arranged by country and type (e.g. constitutions, laws, regulations, policies and management plans) from many different areas such as fisheries, aquaculture, navigation and the environment. These documents have been selected from more than 30 online sources of information (government sites and international legal databases) or are digitised versions of documents SPC has collected during fieldwork (particularly in terms of legislation by local bodies).

Once the user has selected the country, the tool displays a list of both key and related documents (e.g. fisheries legislation and the regulations implemented to apply that legislation) along with any amendments or modifications. The tool provides an overview of each document in the form of a datasheet containing, in particular, a link to the PACLII file (i.e. the University of the South Pacific's legal database) and a summary from FAOLEX (i.e. the legal database of the Food and Agriculture Organization¹ of the United Nations). The user can also download the document directly if it is available in PDF format.



Analysis tool: comparing management measures between several countries or territories

This comparative tool allows users to quickly access provisions in a country or territory's legislation without having to consult the legal documents themselves. It began with the information contained in an SPC publication (2005) entitled *Size limits and other coastal fisheries regulations used in the Pacific Islands region*². That information was then verified in detail and supplemented via a thorough analysis of coastal fisheries-related legislation and regulations.

Users will be able to compare extracts of regulations from each country, categorised by species or group of species (e.g. bivalves, crustaceans, sea cucumbers, gastropods, fish) as well as by type of management measure (e.g. fishing bans, protected areas, fishing seasons, minimum catch sizes, fishing or aquaculture licenses, trade regulations on fisheries and aquaculture products). Each provision is displayed along with references to relevant legislation and any possible penalties in the event of non-compliance.



Overview tool: understanding the legal framework of each country or territory

This overview tool, currently being developed, contains country factsheets that provide the legal, political and institutional profiles for each country, along with communication materials developed by SPC (e.g. posters, leaflets). This part of the database is designed to provide background information that is vital for analysing and understanding regulations and to facilitate access to available awareness-raising materials.

ReefLex is constantly being improved and updated to make it easier for the general public to use the database. Interested fisheries departments can request direct access to ReefLex to put new legislation that has been approved in their countries online themselves. In that way, users will have access to the most recent documents and up-to-date information.

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¹ https://www.spc.int/DigitalLibrary/Doc/FAME/Manuals/Anon_05_Size_limits.pdf

A series of posters to help understand regulations

Why are there areas where we can't go fishing? Why do we have size limits for certain fish or invertebrate species? Why do we ban certain types of fishing? Some of the questions raised in this series of simple educational posters available on SPC's website² and which will also be available from the ReefLex app along with other fisheries-regulation information tools.



² http://www.spc.int/coastfish/index.php?option=com_content&Itemid=30&id=502

Fiji's Muanaira Women's Group sees promise in pilot mangrove oyster farm

It's hard work walking over sharp shells in the mud, reaching in among dense mangrove roots and chipping off oysters. But members of the Muanaira Women's Group have been doing this work for years, harvesting the oysters that cling to the roots of mangroves in the Rewa delta and carrying them back in buckets to be sorted and prepared. Oysters here are a key part of life, used for consumption, for traditional purposes, and as a source of income when sold at the Suva Market as shelled oyster meat.



Three-month-old oysters are placed in wide mesh bags attached to poles fixed in shallow and protected areas where tides and sea chop will gently rock them. (Image: Tim Pickering)

Scientists of Fisheries Research at Fiji's Ministry of Fisheries have teamed up with the aquaculture staff of the Pacific Community and the Vutia community members to find out if there is an easier way to ensure a steady supply of edible oysters.

A study tour of aquaculture techniques used overseas, and at Mago Island in Fiji, guided a spat-catching trial that started within the Vutia fishing grounds late last year when plastic sticks were set on wooden racks in shallow water. Juvenile oysters that settled onto the sticks were collected in February this year as roughly 5–10-mm shells, then counted and transferred to plastic mesh baskets hanging on stakes. After three months of culture, these oysters were checked and found to have grown rapidly.

Members of the Muanaira Women's Group are impressed by the size of oysters after only three months. Already many are about 7.5 cm long and 5 cm wide. The fine-mesh nursery bags were starting to look very full, and the oysters needed thinning out. New bags of wider mesh-size were made, and the oysters were size-graded and placed into the new bas-

kets. These were then re-attached to the poles that make up the pilot project farm, where hung baskets are gently rocked by sea motion, which produces nicely shaped oysters with a deep cup.

It normally takes one and a half years to produce a good-sized edible oyster, but it looks like these could be ready for harvest in about one year.

With such promising results, members of the Muanaira Women's Group are hopeful that their oysters will be more plentiful, easier to harvest, and provide more income to their community for generations to come.

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Tilapia farmers in Fiji learn to make floating feed

For aquaculture farmers, feed is a major operating cost. In Fiji, it has been estimated that feed represents 50–60% of production costs for fish farmers. To improve feeding efficiency, the Pacific Community (SPC) and Fiji's Ministry of Fisheries (MoF) have collaborated to invite world-renowned fish feed expert Dr Albert Tacon to share his knowledge and experience during a feed training workshop. From 6–10 May 2019, 13 fish farmers and 12 MoF staff attended the workshop at MoF's Nadurulou Freshwater Research Station (NRS). The training was organised as part of the New Zealand Ministry of Foreign Affairs and Trade 'Sustainable Pacific Aquaculture Development Project' (PacAqua).

Workshop participants were particularly interested in the production of trial batches of floating feed, a first for Fiji. In 2018, the NRS feed room was renovated and a new floating feed machine, built in China and with the capacity of producing 150 kg of feed per hour, was installed with assistance from the Food and Agriculture Organization of the United Nations and SPC. Globally, most commercial farmers utilise floating feed as it allows them to see fish feeding on the surface and observe how much they consume. Done correctly, this can have major impact on feed cost reduction. However, this technology and operational know-how has not been available in the Pacific Islands region until now.

Currently, farmers use on-farm mixed feeds made of loose ingredients or locally manufactured, commercial sinking tilapia pellets. Although sinking feed is available and has good formulations, current feeding practices result in feed being lost at the bottom of the pond. There is, therefore, a need to develop new feeding strategies to improve feeding efficiency. During the training, five improved feed formulations, using locally available ingredients, were developed. Ingredients included milled byproducts such as rice meal, mill mix, pea meal, copra meal and broken rice, as well as tuna-based fish meal available from local manufacturers, and imported wheat flour and soya bean meal. This will allow farmers to have a choice of ingredients to use, based on cost and availability.

Farmer and MoF staff can now use the new machinery to manufacture small batches of 400–800 kg of feed per day for research and on-farm use. MoF can produce the five trial diets and undertake growth and survival trials in their ponds. Specialised broodstock diets can be formulated to improve hatchery conditioning and production from existing breeders. Improvement in feed practices and feed storage was another key highlight of the workshop. The use of low-cost feed dispersal mechanisms, such as bag feeders and auto-feeders, can improve the utilisation of commercial and on-farm mixed feed. Mr Seru Batibasaga, MoF Fisheries Officer, is currently developing a protocol that will enable farmers, under his guidance, to book and use

the machinery. Based on an average of nine days per month allocated for feed manufacture, around 40–80 t of feed can be produced monthly. This theoretically can result in 20–40 t of fish being produced by farmers. In fact, as farms grow to produce more, farmers will probably need to work with larger commercial feed producers, rather than struggle to obtain small quantities of feed from NRS, and organise their transportation, storage and processing.

The training also included a visit to Pacific Feed Ltd, which provided insights into commercial feed manufacturing processes, along with costs and constraints faced by suppliers to obtain high-quality ingredients at reasonable prices. It is important to note that in many Pacific Island countries, there are no commercial fish feed manufacturers and, hence, it is difficult for fish farmers to access a regular supply of commercial (sinking or floating) feed. Where ingredients are available at reasonable costs, strengthening the capacity of local feed manufacturers will help develop the fish aquaculture industry.

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Dr Albert Tacon, world-renowned tilapia feed expert (first row, second from left) and workshop participants. (Image: SPC)

Promoting the exchange of knowledge on aquatic biosecurity in the Pacific

With the aim of improving capacities and procedures in the field of aquatic biosecurity and aquatic animal health management in French Polynesia, the Aquaculture Section of the Pacific Community, in collaboration with veterinary and fisheries authorities in New Caledonia, organised an exchange between veterinary services in French Polynesia and the biosecurity authority in New Caledonia in July 2019.

The exchange between the two territories focused on visiting the different biosecurity control points in New Caledonia that control the introduction and dissemination of exotic pathogens and exotic animal species.

Visits were organised to biosecurity control points at the airport, commercial port, post offices, cargo area, and the biosecurity and quarantine facility.

Possible collaborative approaches between the two French territories in matters of diagnosis, control, prevention and treatment of diseases of aquatic animals were discussed by veterinary and biosecurity officials, with a special emphasis on the diagnosis, control and reporting of notifiable diseases affecting shrimp farming.

One of the main aspects of future collaboration between French Polynesia and New Caledonia is the use of the services offered by the New Caledonian national veterinary laboratory in the implementation of the French Polynesian epidemiological surveillance programme for aquatic animals. It should be noted that the New Caledonian national veterinary laboratory is currently accredited to analyse most of the regional notifiable diseases for aquatic animals.

In addition, the competent authorities from both territories agreed to collaborate in the development of specific guidelines for aquatic animal welfare in aquaculture. These guidelines will address issues related to animal welfare during production (e.g. stocking densities, farming systems, manipulation), transportation (e.g. transportation type and duration, manipulation) and slaughtering.

To conclude, although regional capacities and skills in the field of aquatic biosecurity are still limited, countries and territories are trying to learn from each others' experiences. Exchange visits and training sessions are key to protecting aquatic environments and production systems in the Pacific Islands region, and keeping them safe from the introduction and spread of exotic pathogens and exotic aquatic animal species.

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New Caledonia's national veterinary services could assist French Polynesia in the development and implementation of a national epidemiological surveillance for the shrimp sector. (Image: Michel Bermudes, SPC)

Annual Regional Fisheries Ministers Meeting established to consider coastal fisheries, aquaculture and broader ocean issues affecting fisheries

While regional fisheries ministers in the region meet annually at the Pacific Islands Forum Fisheries Committee Ministerial Meeting (FFCMIN) to consider tuna and oceanic fisheries issues, there has not been an opportunity for ministers to meet and discuss coastal fisheries and aquaculture issues of regional significance, nor broader oceans management and governance issues related to regional fisheries.



CROP agencies reporting to the Special Regional Fisheries Ministerial Meeting (Pohnpei, FSM, 20 June 2019).

L-r: Roger Cornforth (DDG, SPREP), Dame Meg Taylor (SG, PIFS), Chair, Hon. Marion Henry (Secretary for Resources and Development, FSM); Dr Manu Tupou-Roosen (DG FFA); Dr Andrew Smith (FAME CFP (DD) SPC).

In June 2019, immediately after FFCMIN, a Special Regional Fisheries Ministerial Meeting was held to review and adopt terms of reference establishing an annual Regional

Fisheries Ministers Meeting (RFMM). The establishment of the RFMM was welcomed and endorsed by Pacific Leaders at the 50th Pacific Islands Forum in Tuvalu.¹

¹ www.forumsec.org/wp-content/uploads/2019/08/50th-Pacific-Islands-Forum-Communique.pdf

The purpose and role of RFMM is to consider, discuss and take decisions on:

- Coastal fisheries and aquaculture issues of regional significance and/or high importance, including reports from the SPC Heads of Fisheries meeting, coastal fisheries working groups, and the Coastal Fisheries Report Card² on the progress of the Regional Roadmap for Sustainable Fisheries³.
- Broader oceans management and governance issues as they pertain to both coastal and oceanic fisheries, such as the impacts of climate change, ocean acidification and marine pollution on fisheries resources, food security and livelihoods.
- Any fisheries implications arising from wider regional policy processes.
- Fisheries issues to be reported to Pacific Leaders for consideration under the Standing Item on Fisheries, in addition to the outcomes of FFCMIN pertaining to offshore fisheries issues under the mandate of the Pacific Islands Forum Fisheries Agency, and consolidated reporting on the Regional Roadmap for Sustainable Fisheries.

Current members of RFMM are the fisheries ministers of the Pacific Islands Forum and Tokelau. The agenda for RFMM will be developed in advance by the Pacific Islands Forum Fisheries Agency, the Pacific Community, and the Pacific Islands Forum Secretariat, and involve early consultation with other relevant regional and/or subregional bodies and the Secretariat of the Pacific Regional Environment Programme. RFMM will identify opportunities for engagement with relevant external stakeholders, including civil society organisations and the private sector, development partners, agencies of the Council of Regional Organisations in the Pacific, and working groups.

The Heads of Fisheries (HoF) meeting is the only regional forum for discussing and setting priorities for coastal fisheries and aquaculture, for the joint consideration of oceanic fisheries, coastal fisheries and aquaculture, and where all SPC members participate.

The HoF meeting takes place every two years to discuss the strategic direction and work programme of SPC's Division of Fisheries, Aquaculture and Marine Ecosystems (FAME), and issues of regional importance to fisheries and aquaculture. Because these issues are only reviewed and discussed every two years, it limits HoF's capacity to be proactive rather than reactive. The 11th HoF meeting (HoF11) in March reviewed HoF's purpose, priorities and direction, and endorsed a two-year trial of annual HoF meetings. HoF will continue to focus on guiding FAME's strategic direction and work plan priorities, and consider strategic regional fisheries policy and governance issues, and emerging issues of concern. HoF11 also agreed that coastal fisheries and aquaculture technical issues should be dealt with by the Regional Technical Meeting on Coastal Fisheries (RTMCF), with its outcomes forwarded to HoF meetings for consideration.

With HoF to be held annually, and the establishment of RFMM, there is, for the first time, an agreed on flow of information, advice and decisions on coastal fisheries and aquaculture issues at the regional level.

- The Regional Technical Meeting on Coastal Fisheries (RTMCF) considers the main technical issues affecting coastal fisheries and aquaculture in support of better science-based resource management, equitable access to resources and the safety of fishers. RTMCF will report to:
- HoF, which will continue to focus on guiding FAME's strategic direction and work plan priorities, and consider strategic regional fisheries policy and governance issues, and emerging issues of concern. HoF will report to:
- RFMM, which will consider coastal fisheries and aquaculture issues of regional significance, and broader oceans management and governance issues related to regional fisheries. RFMM will report on fisheries issues to Pacific Leaders for consideration under the Pacific Islands Forum Leaders Standing Item on Fisheries.

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² www.spc.int/DigitalLibrary/Doc/FAME/Brochures/SPC_2019_Coastal_Fishery_Report_Card.pdf

³ www.spc.int/DigitalLibrary/Doc/FAME/Brochures/FFA_SPC_2015_Roadmap.pdf

Solomon Islands firmly supports aquaculture through policy framework

Robson Hevalao¹

The potential and importance of the aquaculture sector for improving economic growth and food security in Solomon Islands is highlighted in various key government policies. For instance, the ‘Solomon Islands National Development Strategy 2016–2035’ states that ‘fisheries and aquaculture will be developed to improve the social and economic livelihoods of all Solomon Islanders.’ And, aligning with the National Development Strategy, the ‘Democratic Coalition for Change Government Policy’ specifies that ‘development of the aquaculture sector aims to create a robust environment targeting good governance, food security, socio-economic, and strengthen public, private partnerships.’

The Solomon Islands Ministry of Fisheries and Marine Resources (MFMR) is mandated to oversee the development of aquaculture in the country. In 2019, MFMR adopted its first national fisheries sector strategic policy: the ‘Solomon Islands National Fisheries Policy 2019–2029’. Aquaculture is one of the three key strategic policy focus areas highlighted under that policy. Prior to that, an important operational-level policy document specifically on aquaculture was adopted in 2018: the ‘National Aquaculture Development and Management Plan 2018–2023’. The aquaculture development and management plan is a roadmap for operationalising objectives related to aquaculture contained in higher policy documents such as the National Development Strategy, Democratic Coalition for Change Government policy, and national fisheries policy.

A three-day stakeholder consultation workshop was held from 10–13 July 2019 by MFMR, with key stakeholders from the tilapia and seaweed farming sector to review and develop a Tilapia Action Plan and a Seaweed Action Plan. These two action plans, when approved, will further streamline, clarify and operationalise the higher policy objectives contained in the MFMR policy map (Fig. 1).

The action plans will help ensure that farmers benefit from government services related to aquaculture. In his introductory remarks, the MFMR Undersecretary of General Services emphasised the importance of developing action plans, and noted that tilapia and seaweed farming make a significant contribution to income, food security, livelihoods and living standard of Solomon Islanders, especially those living in rural communities.

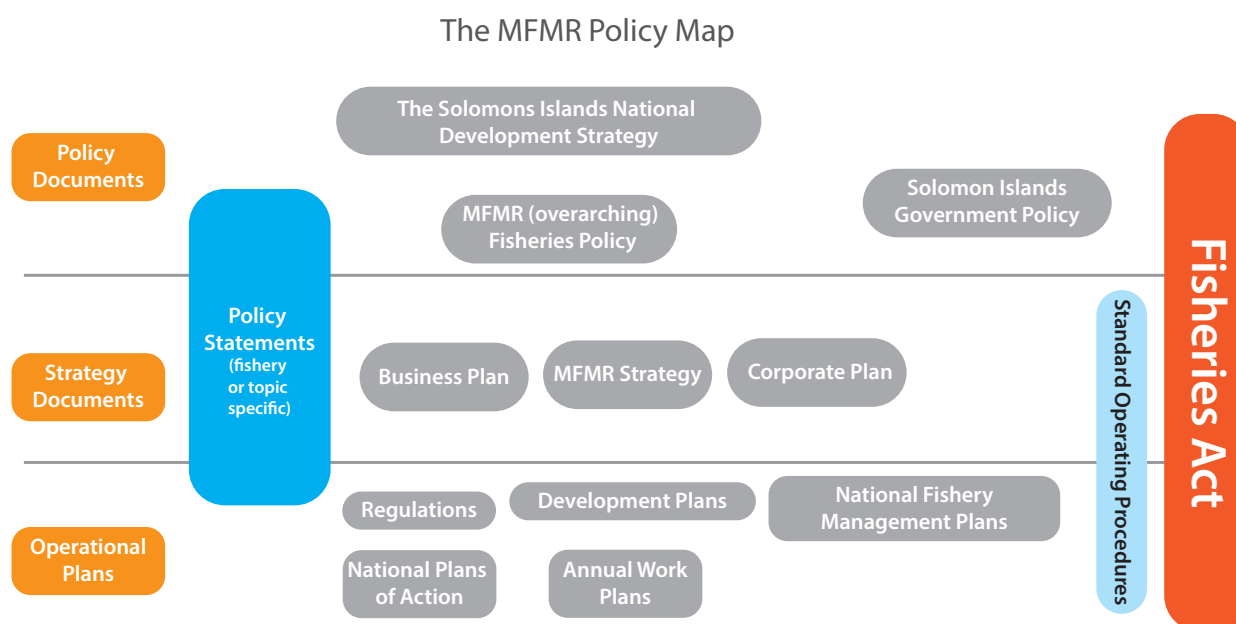


Figure 1: MFMR policy map (Solomon Islands National Fisheries Policy 2019–2029).

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Being involved as a Pacific Islands Fisheries Professional

As a policy officer with MFMR, I was part of a team assisting with the development of MFMR aquaculture policies and their linkage to higher overarching government policies. In February 2019, I joined the Pacific Community (SPC) as a Pacific Islands Fisheries Professional (PIFP), and was part of the SPC team that went to Honiara in July for the three-day stakeholder consultation workshop. It allowed me to improve my understanding of the difference between a strategic policy document and an operational-level document.

On reflection, since I have been at SPC as a PIFP within the Coastal Fisheries Management, Science and Livelihoods Section, I have clearly improved my skills in preparing for and conducting stakeholder consultations; and in formulating, updating and reviewing coastal fisheries and aquaculture management policies and plans.

I would like to point out that as an MFMR Policy Officer and PIFP, I am very proud of the efforts made by the Solomon Islands Government and MFMR to highlight the importance of aquaculture in national key policy documents. I am also very proud to be part of a team at SPC that works hand-in-hand with MFMR towards the vision of a healthy aquaculture sector that improves the social and economic livelihoods of all Solomon Islanders.



Tilapia farm ponds in Solomon Islands. (Image: Tim Pickering, SPC)



Seaweed farming in Solomon Islands (Image: Gideon Tiroba)

Acknowledgements

I would like to thank the Solomon Islands Government and MFMR for giving me this once-in-a-lifetime opportunity to work with SPC as a PIFP. I would also like to thank the New Zealand Government for providing the funding for my one-year attachment to SPC. It has given me a rare opportunity to work and engage with professionals, not only in coastal fisheries and aquaculture, but also in fisheries generally. It has also given me a chance to view things through a regional perspective and appreciate regional issues in fisheries, as well as the innovative ways to address those issues.

The development of a semi-quantitative guideline for monitoring nearshore fish aggregating devices

Jeff Kinch,¹ Joelle Albert² and Anne-Maree Schwarz³

Nearshore fish aggregating devices (FADs) are just that, a device for aggregating fish in nearshore areas. Nearshore FADs have been deployed in many Pacific Island countries and territories (PICTs) as a tool to enhance food security and income for fishers and communities (Albert et al. 2014; Masu and Albert 2014; Bell et al. 2015; Cambell et al. 2016; Tilley et al. 2019), and to reduce pressure on coastal fisheries (Sokimi and Beverly 2010; Amos et al. 2014).



Fish around a fish aggregating device (Image: William Sokimi, SPC)

In support of FAD programmes in PICTs, several manuals have been produced in the past by the Pacific Community (SPC) to provide technical details on site surveys, construction, deployment and maintenance of nearshore FADs (Anderson et al. 1996; Gates et al. 1996, 1998; Chapman et al. 2005a), as well as for fishing at them (Preston et al. 1998).

In acknowledgement of technological progress and the uptake of FAD programmes across the Pacific Islands region, an ‘Expert Consultation on Nearshore FADs’ was held by SPC in Vanuatu in June 2016 (Albert 2016), and in October 2018, a joint Food and Agriculture Organization

of the United Nations (FAO) and SPC ‘Consultation on Small-Scale Tuna Fishery Development and Associated Value-Chains in the Pacific’ was convened at SPC headquarters in New Caledonia (Gillett et al. 2018). The results of these two consultations highlight the fact that there are still issues with the deployment of nearshore FADs, and that there is limited information concerning the costs and benefits associated with FAD use, as well as suitable monitoring advice to inform national nearshore FAD programmes. Overall, there has been limited monitoring associated with nearshore FADs (Sims 1988; Chapman et al. 2005b; Albert et al. 2013, 2018; Sharp 2014). The lack of both suitable

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information and the effectiveness of nearshore FAD monitoring programmes can be attributed to geographical remoteness, the costs involved in extensive monitoring programmes in often remote areas, and the lack of appropriate data collection methodologies.

To address these issues, in May 2019, 11 participants from the Pacific Islands region came together at SPC's headquarters to participate in a joint FAO/SPC 'FAD Monitoring Think Tank'. Representatives that attended this Think Tank included Candice Guavis (Marshall Islands Marine Resources Authority), Wilson Kaesi (Fishers Association – Vanuatu), Semisi Meo (Conservation International – Fiji), Rachael Rabi (Papua New Guinea National Fisheries Authority), Meshach Sukulu (WorldFish – Solomon Islands), Mele Tauati (FAO), Peter Tiamua (Vanuatu Fisheries Department), and Sapetu Tiitii (Samoa Ministry of Fisheries and Marine Resources). The Think Tank was facilitated by Joelle Albert (WorldFish), Anne-Maree Schwarz (Consultant) and Jeff Kinch (SPC).

To prepare for discussions during the Think Tank and the development of a simple nearshore FAD monitoring guideline, a questionnaire was provided to PICT representatives at the 11th Heads of Fisheries in March 2019. This questionnaire was also provided to targeted staff at national fisheries agencies using an online survey. In total, 16 responses were received and highlighted that the top three reasons why FADs are important for PICTs were that they:

- support coastal fisheries management activities by providing alternative fishing grounds that shift fishing effort away from coral reef systems;
- enhance food security and improve nutrition; and
- increase economic returns for fishers.

During the Think Tank, the pros and cons of different methods of collecting data were discussed. Methods discussed included fish landings (catch-per-unit-effort, creel survey), household surveys, focus group discussions, key informant interviews and market surveys. Key indicators and considerations were also discussed, including the number of fishers fishing at FADs and on reefs, FAD fishing frequency and catches (number, weight, length).

As a result of the Think Tank, a semi-quantitative guideline is now being developed that covers simple and low-cost sampling protocols based around focus group discussions and key informant interviews to monitor the key elements associated with FAD programme objectives.

The semi-quantitative monitoring guideline is intended to be accessible to all national fisheries agencies even where resources for monitoring programmes are limited, and as such, is purposely focused on simple sampling and low-cost methods. It does not preclude national fisheries agencies up-scaling monitoring efforts if financial, technical and human resources are available.

It is expected that a new nearshore FAD deployment manual, which is currently being finalised, and the semi-quantitative nearshore FAD monitoring guideline will be available in the coming months. The semi-quantitative nearshore FAD monitoring guideline will then be trialled with PICTs that are participating in the FAO/Japanese International Cooperation Agency's project for enhancing livelihoods and food security through nearshore FADs in the Pacific Islands region. Other national fisheries agencies are also welcome to test the semi-quantitative nearshore FAD monitoring guideline once it is available.



A coastal fish aggregating device. (Image: William Sokimi, SPC)

Acknowledgements

The FAD Monitoring Think Tank was a joint initiative between FAO and SPC. The facilitators would like to thank the regional participants that were able to come and share their expertise and experiences. Acknowledgements are also extended to Michel Blanc, William Sokimi and Ian Bertram for their various inputs in the leadup to the Think Tank, as well as Seya Brighton for coordinating all of the logistical requirements.

References

- Albert J. 2016. Sharing Pacific nearshore FAD expertise. SPC Fisheries Newsletter 150:37–41.
- Albert J., Beare D. and Andrew 2013. Nearshore FADs in Solomon Islands: Monitoring their effectiveness and the costs and benefits of their deployment. Honiara, Solomon Islands: Ministry of Fisheries and Marine Resources.
- Albert J., Beare D., Schwarz A.-M., Albert S., Warren R., Teri J., Siota F. and Andrew N. 2014. The contribution of nearshore fish aggregating devices (FADs) to food security and livelihoods in Solomon Islands. PLoS ONE. 9 (12): e115386. doi:10.1371/journal.pone.0115386.
- Albert J., James P., Joy L., Tiamua P. and Warren R. 2018. An analysis of data collected by community monitors from 20th February 2017 to 31st July 2018 and through key informant interviews with study communities. Port Vila, Vanuatu: Vanuatu Fisheries Department.
- Amos G., Nimoho G., Fujii M., Seko A., Inuma M., Nishiyama N., Takayama T. and Pakoa K. 2014. New FAD development approach strengthens community-based fisheries management in Vanuatu. SPC Fisheries Newsletter 144:40–47.
- Anderson J. and Gates P. 1996. Fish aggregating device (FAD) manual: Volume 1 – Planning FAD programmes. Noumea, New Caledonia: South Pacific Commission.
- Bell B., Albert J., Andrefouet S., Andrew N., Blanc M., Bright P., Brogan D., Campbell B., Govan H., Hampton J., Hanich Q., Harley S., Jorari A., Lincoln-Smith M., Pontifex S., Sharp M., Sokimi W. and Webb A. 2015. Optimising the use of nearshore fish aggregating devices for food security in the Pacific Islands. Marine Policy 56:98–105.
- Campbell B., Hanich Q. and Delisle A. 2016. Not just a passing FAD: Insights from the use of artisanal fish aggregating devices for food security in Kiribati. Ocean and Coastal Management 119:38e44.
- Chapman L., Pasisi B., Bertram I., Beverly S. and Sokimi W. 2005a. Manual on fish aggregating devices (FADs): Lower-cost moorings and programme management. Noumea, New Caledonia: Secretariat of the Pacific Community.
- Chapman L., Bertram I. and Pasisi B. 2005b. FAD research project: Final results from community surveys, gender assessment, and catch and effort data analysis. SPC Fisheries Newsletter 113:27–47.
- Gates P., Cusack P. and Watt P. 1996. Fish aggregating device (FAD) manual: Volume II – Rigging deep-water FAD moorings. Noumea, New Caledonia: South Pacific Commission. 43 p.
- Gates P., Preston G. and Chapman L. 1998. Fish aggregating device (FAD) manual: Volume III – Deploying and maintaining FAD systems. Noumea, New Caledonia: Secretariat of the Pacific Community. 43 p.
- Gillett R., Blanc M., Cartwright I., Batty M., Savins M., Albert J., Idechong N., Tanetoea M., Emberson T. and Sokimi W. 2018. Forty years of small-scale tuna fishery development in the Pacific Islands: Lessons learned. SPC Fisheries Newsletter 157:60–68.
- Masu R. and Albert J. 2014. Nearshore fish aggregating devices food security in Solomon Islands. SPC Fisheries Newsletter 146:25–31.
- Preston G., Chapman L. and Watt P. 1998. Vertical longlining and other methods of fishing around fish aggregating devices (FADs): A manual for fishermen. Noumea, New Caledonia: Secretariat of the Pacific Community.
- Sharp M. 2014. Positive results of a FAD monitoring programme in Yap. SPC Fisheries Newsletter 143:34–38.
- Sims N. 1988. A cost-benefit analysis of FADs in the artisanal tuna fishery in Rarotonga. Noumea, New Caledonia: South Pacific Commission.
- Sokimi W. and Beverly S. 2010. Are moored fish aggregation devices the solution to sustaining small-scale fishing? SPC Fisheries Newsletter 132:10–12.
- Tilley A., Wilkinson S., Kolding J., López-Angarita J., Pereira M. and Mills D. 2019. Nearshore fish aggregating devices show positive outcomes for sustainable fisheries development in Timor-Leste. Frontiers in Marine Science 6:487. doi: 10.3389/fmars.2019.00487

Enhancing coastal fisheries monitoring, control, surveillance and enforcement

The Pacific Community (SPC) and the New Zealand Ministry of Primary Industries (NZMPI) have been working together since 2017 to deliver training in coastal fisheries monitoring control surveillance and enforcement (MCS&E) for SPC Pacific Island members. The workshops focus on the basic skills that a coastal fisheries officer needs in order to fulfil his or her day-to-day roles in the field, such as interviewing techniques, taking statements, gathering evidence, operational planning, and undertaking market inspections. The training also emphasises community education and awareness of the need to sustainably manage their marine resources. Workshop participants are provided with fishery officer notebooks, high-visibility vests, and caps they can use in future inspections.

Regular members of the training team are Ian Freeman from SPC, and Jeff Dunlop and Mark Nicholson from NZMPI's *Te Pātui* programme, with additional trainers available as required. The workshops have been successfully conducted in Port Vila and Santo in Vanuatu; Kiritimati in Kiribati; and Majuro in the Marshall Islands.

The workshops include classroom sessions along with practical exercises, including a market and fish vendor inspection at the end of each workshop to give participants some real life experience. The inspections have been a huge success, with several offences being detected and illegal product confiscated in Kiribati and Vanuatu. On Santo, one retailer was issued an infringement notice in the

amount of VUV 100,000 (~USD 1000) for possession of a considerable amount of green snail shells and meat and undersized lobsters.

A recent workshop took place in Port Vila and Luganville on Santo in Vanuatu in July 2019. Ian Freeman and Jeff Dunlop were accompanied by Mark Nicholson, whose experience as a fisheries officer and fisheries prosecutor for the New Zealand government strengthened the delivery of more advanced training to participants, particularly in Port Vila. The usual market inspections were conducted after both training workshops, with illegal product including green snail and trumpet shells confiscated in Port Vila and Luganville. A significant quantity of frozen beche-de-mer



Fisheries officers in Kiritimati, Kiribati, inspecting a lobster-holding raft. (Image: Ian Freeman, SPC)

was also confiscated from one of the retailers, and should result in the issuance of a heavy penalty paid to the Vanuatu Fisheries Department.

An interesting discovery during the inspections in Luganville was three whale teeth. While these were most likely removed from a dead stranded whale, their possession in Vanuatu is illegal so they were confiscated. Management of these species often falls to environmental agencies, so the MCS&E training can be tailored to include CITES¹-listed species and endangered/protected species if a country requires this.

With the limited number of trained enforcement people in many of our member countries, the training team encourages the involvement of officers from the various regulatory and enforcement agencies such as Police, Customs, Environment, Wildlife along with fisheries officers so each agency can assist each other when needed or as requested, which helps to improve consistency in enforcement approaches. The benefits of this interagency approach were highlighted recently in Kiritimati in Kiribati where three conservation officers from the Environment Department attended the MC&S workshop, and in Majuro, Marshall Islands where officers from Customs, Immigration, and Biosecurity attended alongside coastal fisheries staff.

The team will adapt the coastal fisheries MCS&E training to suit each country's or territory's needs and will place



Fisheries officers inspecting the Marshall Islands Marine Resource Authority market on Majuro Atoll. (Image: Ian Freeman, SPC)



Jeff Dunlop presenting to students in Majuro, Marshall Islands. (Image: Ian Freeman, SPC)

¹ CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora

special emphasis on specific MCS&E areas as required. The training team is also able to assist individual fisheries officers with specific MCS&E advice and mentoring upon request.

Most recent and future work

In August 2019, one week of coastal fisheries MCS&E training took place in Tarawa, Kiribati, which included authorised officers from the outer islands along with fisheries officers appointed by the Ministry of Fisheries Marine Resources Development. With Kiribati's reliance on subsistence fishing as its main source of animal protein and 29 participants attending, the training provided important knowledge to those involved with managing the fisheries.



Illegal frozen beche-de-mer taken from a retailer in Luganville on Santo in Vanuatu, July 2019. (Image: Jeff Dunlop, NZMPI)

Several new training activities are planned for the coming months. Mark Nicholson has developed learning modules that cover the processes needed to develop a prosecution case file to the standards required to support prosecutors in court. How well a case file is put together, including having enough evidence to prove each element of the offence, is critical to the successful outcome of a court case. Included in these modules are important lessons on courtroom etiquette and processes so that new fisheries officers will be less apprehensive when they give evidence in court for the first time.

The team anticipates this training will only be offered to those countries and territories that have experienced coastal fisheries officers, or countries where coastal MCS officers have completed the first workshops.

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Background to capacity building in MCS&E

The Pacific Community's (SPC) involvement in MCS&E commenced with the project 'Improving fisheries food security and sustainable livelihoods for Pacific Island communities'.

The project is funded by New Zealand's Ministry of Foreign Affairs and Trade (MFAT) and focuses on strengthening governance structures and processes, specifically legislation, policy and monitoring, control, surveillance and enforcement (MCS&E), which are very weak for coastal fisheries and aquaculture.

Te Pātuitanga Ahumoana a Kiwa² (or Te Pātui for short) is New Zealand Ministry for Primary Industries' (MPI's) Pacific fisheries capacity development programme. Seven Te Pātui staff work in partnership with Pacific island fisheries administrations to develop their capacity to manage their offshore and coastal fisheries.

Under Te Pātui, MPI fisheries management and compliance subject matter experts develop and deliver support to Pacific fisheries agencies including:

- Needs assessment
- Project advice and support
- Technical fisheries management and compliance training
- Skills development in writing, project management, and data analysis
- Attachments or secondments into MPI
- Career mentoring.

Te Pātui's three MCS advisors offer training and support on a variety of offshore and coastal fisheries matters, including coastal fisheries MCS, high seas boarding, information management, and prosecutions

² Te Pātuitanga Ahumoana a Kiwa, means 'partnerships in Pacific fisheries' in Te Reo Māori.

Fiji's development of effective coastal fisheries compliance

Damian Johnson¹

Through its 5-year and 20-year national development plans, and the 2017 United Nations Ocean Conference, Fiji has made a strong commitment to improve the management of its inshore fisheries resources. In 2017, Fiji's Ministry of Fisheries (MoF) established the Inshore Fisheries Management Division (IFMD) to directly respond to this commitment. IFMD was established to formulate, review, administer and enforce national fisheries legislation and regulations, and to align, review, implement, monitor and evaluate policies, strategies, plans, programmes and projects to better manage and protect Fiji's inshore fisheries resources. IFMD is supported in its development through support from the New Zealand Government. The division builds on the previous work of officers from the four geographic divisions across Fiji, and seeks to ensure consistent and clear direction for inshore fisheries management and compliance activities.

Under the leadership of IFMD's Principal Fisheries Officer (PFO), Richard Veeran, the division has developed three key functional areas:

- 1) Establish a robust inshore fisheries data collection programme to develop an understanding of the health of Fiji's inshore fisheries stocks and to ensure that informed decisions can be made to support robust management.
- 2) Build strong capacity to develop the fisheries management plans, regulations and policies necessary to ensure Fiji's inshore fisheries are effectively managed and conserved.

- 3) Establish a compliance unit that will effectively and efficiently lead the enforcement of Fiji's inshore fisheries laws.

To ensure the effective targeting of MoF's compliance capability, IFMD has developed an operational compliance strategy (OCS). The OCS provides overarching guidance and coordination for fisheries compliance activities undertaken by MoF and its partner agencies, and recognises the range of activities and different mechanisms that can be used to achieve compliance – from awareness raising and extension activities through to enforcement activities and prosecutions.



Staff of the Inshore Fisheries Management Division, Offshore Fisheries Division and Divisional Compliance pictured with the Hon Minister for Fisheries Semi Koroilavesau, following completion of the first four-week compliance induction training. (Image: Fiji Ministry of Fisheries)

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Officers completing an audit of a large seafood wholesaler in Suva. (Image: Liliana Rabuku)

The OCS acknowledges that improved compliance is founded on extension and outreach activities undertaken by MoF officers. The roles of these activities are not generally viewed as traditional compliance roles but their contribution to increasing compliance has been of significant importance. These outreach activities are fundamental to increasing compliance by improving the awareness of fisheries rules and the reason for their implementation.

While extension and outreach are important, the OCS also recognises that there is a need to have real consequences for serious and repeat non-compliers. To target enforcement activities, the OCS focuses on developing a risk-based system that ensures that the response is informed by the seriousness of the non-compliance and other pertinent information, such as prior offences. Effective enforcement action requires consistent and complete records of interventions and some recorded or formal action being taken for all identified non-compliance. This requires capable officers to consistently deliver these important services.

To this end, the IFMD compliance team was established in 2019 with the recruitment of seven full-time inshore compliance officers. These officers are based throughout Fiji and work closely with the existing divisional staff to deliver effective compliance services consistent with the OCS.

The new staff completed a four-week intensive compliance induction training in Suva between 6 May 2019 and 31 May 2019. The IFMD officers were joined on this training by eight additional officers from each of the four geographic divisions and the Offshore Fisheries Division.

The training assessment was based on and included 10 modules that covered core compliance learning areas, from an introduction to the concept of compliance, legislation, compliance approaches and communication and species identification to note taking, statements, caution interviews, planning and conducting interventions, case file preparation and prosecutions.

The prosecution module included mock court processes where officers were required to present evidence from case files the officers had prepared during the training following live interventions. This prosecution module was well supported by the Fiji Environmental Law Society – which provided experienced lawyers, who collectively had more than 40 years of court room experience in Fiji – to fill the roles of prosecutor, defence and magistrate. The lawyers prepared and presented cases just as they had during their professional careers, and the experience the officers gained from this exercise was invaluable.



Officers confiscating illegal shells from a premise in the greater Suva area. (Image: Viniana Rasuaki)



Inshore Fisheries Management Division and Offshore Fisheries Division officers wearing the new compliance and data collector uniforms funded by New Zealand. Pictured with the Minister for Fisheries, Hon Semi Koroilavesau, and New Zealand's High Commissioner to Fiji, Jonathan Curr. (Image: Damian Johnson)

The new compliance officers have been active for almost three months and have achieved a substantial amount in the short time since the training. IFMD compliance officers, working with MoF divisional staff have:

- undertaken more than 325 inspections;
- issued 65 formal warnings;
- confiscated, seized or sealed more than 3500 individual fish that were caught or held illegally; and
- commenced prosecution action on several cases.

This represents a prominent increase in compliance activity by MoF, and prosecution action has included the issuance of a fixed penalty notice for FJD 20,000¹ for the possession of endangered or prohibited species.

These excellent results are due to the dedication of the officers, their commitment to ensuring effective processes are followed, and their understanding of good compliance and enforcement practice. They have also been well supported by MoF management who continue to encourage the work of these officers in delivering more effective and consistent compliance processes.

Operational compliance uniforms, supplied via the New Zealand government, were recently provided to all compliance officers in IFMD and OFD, and the trained authorised officers in each MoF division. The uniforms increase the officers' visibility and represent the excellent work they carry out.

Uniforms may seem a small matter, but their use supports improved team cohesiveness, increased perceptions of competence and professionalism, and increased pride from the officers themselves.

Under the new Permanent Secretary, Craig Strong, MoF is currently undergoing a service delivery realignment, which has included a redesign of its brand and logo. The logo reflects the ministry's focus areas in 'sustaining, managing and protecting' Fiji's fisheries resources, and food security at the national and community level. The new compliance officers are delivering important services that contribute to the achievement of these priorities, as well as reflecting core ministry values of excellence, integrity, innovation, inclusiveness, professionalism and accountability. With their continued hard work, dedication and commitment, there is no doubt they will continue to deliver excellent results for Fiji's inshore fisheries in the years to come.

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² FJD 1.00 = USD 0.47 (September 2019)



Ecosystem-based management in Fiji to support healthy fisheries

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Introduction

Communities in Fiji rely heavily on marine and coastal ecosystems for subsistence fisheries and livelihoods. The increasing number of direct and indirect stressors on these ecosystems are impacting on their ability to provide provisioning services. To support communities in maintaining healthy, productive and resilient ecosystems, the Wildlife Conservation Society has been working with local communities to apply an ecosystem-based management approach to develop 'ridge-to-reef' plans. The planning process is informed by traditional ecological knowledge of natural systems, and complemented by biological and/or socioeconomic assessments. The resulting management plans have strengthened existing community protected areas under traditional management, created new protected areas and formalised management rules to regulate the use of coastal fisheries and terrestrial resources at a district-level. Addressing management at a district-scale ensures actions on land and catchment areas, have minimal impact on coastal resources.

Background

Ecosystem-based management (EBM) is an integrated approach that considers the entire ecosystem (e.g. land, rivers, lakes, coasts, coral reefs, ocean), including humans (McLeod et al. 2005; Clarke and Jupiter 2010). The overall aim of EBM is to maintain ecosystem health, services and resilience so that ecosystems can sustain human needs into the future (Agardy et al. 2011).

In particular, EBM has objectives and targets that:

- focus on maintaining the natural structure of ecosystems and their productivity;
- incorporate human use and values of ecosystems in the management of resources;
- recognise that ecosystems are dynamic and constantly changing;
- are based on a shared vision of stakeholders; and
- are based on scientific knowledge, adapted by continual learning and monitoring (Grieve and Short 2007).

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Participants to the Kubulau ecosystem-based management workshop. (Image: Akanisi Caginitoba, WCS)



Youth participation at Ovalau ecosystem-based management workshop. (Image: Eferemo Kubunavanua, WCS)

For Pacific Island coastal communities that rely heavily on marine and coastal ecosystems for subsistence fisheries and livelihoods, EBM offers a way to adapt to changing environmental conditions and increasing cumulative threats (WCS 2015). The EBM approach can be used for ridge-to-reef management, which considers the full range of uses and threats to marine and coastal ecosystems (Agardy et al. 2011), including to coastal fisheries. A key component of EBM is that it considers the indirect stressors that occur outside of, but impact on, a system; for instance, limiting the clearing of upstream vegetation, which can cause increases in sediment and nutrient run-off into the ocean that can be harmful to coral reefs (Fredston-Hermann et al. 2016; Brown et al. 2018; Hamilton et al. 2017). Managing these indirect threats alongside direct local pressures such as overfishing, can lead to healthier and more resilient ecosystems.

EBM is a broader concept than ecosystem-based fisheries management (EBFM), which specifically focuses on fisheries management and ecosystem components that interact with those fish stocks (e.g. predators, prey, habitats) (Jupiter et al. 2013). In the context of island ecosystems, where ecosystem services (including fisheries) and biodiversity rely strongly on connections between land and sea, EBM offers a more holistic and integrated land–sea management framework than EBFM (Clarke and Jupiter 2010; Agardy et al. 2011). As such, EBM plans are being formulated and promoted as an effective natural resource management tool across Pacific Islands, such as Fiji (Clarke and Jupiter 2010).

Origins of ecosystem-based management in Fiji

In 2005, the Wildlife Conservation Society (WCS), through the invitation of the provincial government and village chiefs, began providing assistance to the 10 villages of Kubulau District to develop Fiji's first district-level EBM management plan (WCS 2009). The overarching goal of EBM in Kubulau is the preservation of the functional integrity of Kubulau's ecosystems, from the ridge of mountains to the outer edge of coral reefs, through community-based management. The Kubulau EBM framework combines the most successful elements of the Locally Managed Marine Area (LMMA) network with broad protected area design principles for biodiversity conservation that take advantage of both traditional and Western approaches to marine coastal fisheries management. Through a participatory planning process, communities identified key ecosystem features for protection into the future, categorised the main threats effecting these features, and developed locally appropriate management actions to mitigate them.

Since then, WCS has refined the EBM planning process to align with lessons learned from the Kubulau management plan and community feedback. Some of the early lessons learned were:

- Management of coastal resources should always commence with an understanding of traditional practices and open communication with communities;

- Ecosystem management processes should respect the needs, interests, rights and aspirations of local communities and contribute to local and national goals;
- Protected areas need to be placed in a broader ecosystem management framework to reduce disturbance from outside the boundaries;
- EBM requires close collaboration between upland and lowland communities, as well as active, participatory engagement of stakeholders from all relevant sectors, which can include culture, fisheries, forestry, agriculture, and tourism;
- EBM should be adaptive as new information becomes available; and
- EBM provides a cost-effective approach for reducing vulnerability to climate change impacts.

All the learning and experiences gained have been incorporated into a practical hands-on facilitators guide to community EBM planning in Fiji (WCS 2015), which has been used to support the districts of Lekutu and Navakasiga, Vuya, Solevu, Nadi, Wainunu and Wailevu launch their own bottom-up, community-driven EBM plans. In addition, WCS is currently in the process of supporting communities in Bua and Dama districts, and Ovalau and Koro islands develop their own ridge-to-reef plans.



Sea cucumber monitoring. (Image: Sangeeta Mangubhai, WCS)



Kubulau ecosystem-based management planning workshop. (Image: Akanisi Caginitoba, WCS)

Ecosystem-based management planning process

The EBM planning process undertaken in all districts followed the WCS (2015) 'Facilitators guide to community ecosystem-based management planning in Fiji'. This process is based on traditional ecological knowledge and extensive scientific assessments (both ecological and socioeconomic), and complies with Fijian traditional protocols. It also empowers local ownership of the management plans. The five main stages of the process are as follows:

1. Scoping and pre-planning
2. Stakeholder engagement
3. Management planning
4. Implementation and monitoring
5. Review and adaptive management.

As part of the scoping and pre-planning stage of the EBM plans, WCS worked with communities and partners to first conduct an initial situational analysis to identify stakeholders and understand local issues and governance. The pre-planning process also involved reviewing existing information and data on fisheries, biodiversity and development

(i.e. current and future development plans). Any missing data were collected through socioeconomic surveys and rapid biological assessments. Once this information was collected, WCS started community engagement visits to villages to establish support from community leaders and nominate community representatives. During this stage, activities such as participatory community mapping were also undertaken to identify local resource use issues and priorities, existing management actions, and future management goals.

With community support, WCS, community members and other relevant stakeholders came together to undertake management planning. Workshops, community consultations and participative exercises were conducted to develop a shared understanding of the socioecological system. Targeted management strategies were then generated through participatory conceptual modelling. Using spatial planning, these management strategies were mapped into specific zones for particular uses, where the overall aim was to minimise environmental impacts, maximise fisheries opportunities and other ecosystem services, and reduce user conflict. Through these activities, communities identified causes of threats to local ridge-to-reef ecosystems, developed targeted management rules and established protected area locations as the basis of their EBM plan.

The resulting key components of the EBM management plans were:

- A description of the management area, including traditional fishing area (*qoliqoli*) boundaries, demographics, habitat descriptions, resource tenure, resource use and protected area boundaries.
- Discussion on habitat management issues for terrestrial, freshwater, estuarine, coastal and marine ecosystems, including habitat descriptions covering flora and fauna, endemic and endangered species and species of cultural and economic significance.
- A management implementation plan, including:
 - A discussion of key threats and underlying causes of those threats for each habitat;
 - Management rules for each habitat, including national laws and community rules;
 - Proposed management activities for each habitat; and
 - Best practice management recommendations for each habitat.
- A description of key management institutions and external stakeholders.
- An explanation of management roles and processes, including preparation; implementation, amendment and review of the management plan.
- An overview of compliance and enforcement issues.

As part of the planning process, WCS engages local authorities such as the provincial office and the provincial administrators office. These offices look after the development aspects occurring within the province, such as infrastructure and the traditional governance of *iTaukei* or traditional Fijian villages. The ongoing support of these offices, together with the Ministry of Fisheries, ensures management plans and strategies are incorporated into decision-making at the provincial level.

Implementation and monitoring of management plans

The management strategies set out in the EBM management plan are a synthesis of community rules and national laws. The community rules are endorsed by the Hierarchy Council (*Bose Vanua*) and the national laws are created by the national parliament and are legally binding on all people in Fiji. For each EBM plan, community Resource Management Committees (RMCs) were established. For island- and district-level plans, RMCs consist of at least one representative from each village. Each RMC is responsible for raising awareness and understanding of management rules, and promoting voluntary compliance in villages throughout

their district. An annual work plan has been developed to guide priority actions in each district. RMCs are also responsible for establishing a monitoring and enforcement programme, training fish wardens, obtaining resources and equipment for marine patrols, and recording rule breaches.

Review and adaptive management

As part of an adaptive management process, all of the launched EBM management plans will be reviewed and amended every five years (or as necessary) to reflect monitoring results and evolving management priorities of the communities. Kubulau District is the first to review and adapt its revised management plan in 2012, based on new monitoring data collected by WCS between 2007 and 2010 (WCS 2012). Bua District and Koro Island are currently in the process of reviewing and updating management plans that had previously been developed with support from researchers from the University of the South Pacific.

To assist in these monitoring and adaptive management efforts, WCS has developed a 'A Global Social-Ecological Systems Monitoring Framework for Coastal Fisheries Management' that builds on the organisation's experiences in Fiji (Gurney and Darling 2017). Monitoring efforts aim to track progress towards answering two important questions over the next 10 years: 1) What are the social and ecological impacts of conservation and management actions? 2) What social, ecological and governance contexts create successful outcomes?

Success of the plans

Ecosystem-based ridge-to-reef planning is not a new concept to Pacific Island communities, where traditionally, local communities have collectively governed land and sea resource access (WCS 2015). WCS and Fijian communities were able to build on these historic governing practices and develop EBM plans that promote more sustainable natural resource management, improved resilience and increased fisheries productivity in coastal and marine ecosystems.

The launching of EBM plans across Fiji has strengthened existing *tabus* (temporal fishing closure) and protected areas, and resulted in the creation of new ones across terrestrial, freshwater and marine habitats (e.g. WCS 2009). These EBM plans have also formalised a range of management rules that regulate the use of natural resources on community land and within customary fishing grounds (*qoliqolis*) (e.g. WCS 2016). By building on the practices outlined in the EBM facilitator's guide (WCS 2015) and example strategies from the established EBM plans, communities around the Pacific can foster their own community-driven and locally appropriate EBM plans to promote more sustainable fisheries in the region.

Acknowledgements

This article is dedicated to all the communities who have been working tirelessly to improve the management of their natural resources to ensure they remain healthy and productive for many generations to come. WCS is grateful to the Bua, Lomaiviti and Cakaudrove Provincial offices for supporting this work, as well as key government ministries – *iTaukei* Affairs, Fisheries, Agriculture, Waterways and Environment, Forestry, and Lands. This work could not have been done without the generous support of the John D. and Catherine T. MacArthur Foundation and the David and Lucile Packard Foundation.

References

- Agardy T., Davis J., Sherwood K. and Vestergaard O. 2011. Taking steps toward marine and coastal ecosystem-based management: An introductory guide. United Nations Environment Programme Regional Seas Reports and Studies 189:68.
- Brown C.J., Jupiter S.D., Albert S., Anthony K.R.N., Hamilton R.J., Fredston-Hermann A., Halpern B.S., Lin H.Y., Maina J. Mangubhai S., Mumby P.J., Possingham H.P., Saunders M.I., Tulloch V.J.D., Wenger A. and Klein C.J. 2018. A guide to modelling priorities for managing land-based impacts on coastal ecosystems. *Journal of Applied Ecology* 56(5):1106–1116.
- Clarke P. and Jupiter S. 2010. Principles and practice of ecosystem-based management: A guide for conservation practitioners in the tropical Western Pacific. Suva, Fiji: Wildlife Conservation Society. 43 p.
- Fredston-Hermann A., Brown C.J., Albert S., Klein C.J., Mangubhai S., Nelson J.L., Teneva L. Wenger A., Gaines S.D. and Halpern B.S. 2016. Where does river runoff matter for coastal marine conservation? *Frontiers in Marine Science* 3:273.
- Grieve C. and Short K. 2007. Ecosystem-based implementation of management in marine capture fisheries – Case studies from WWF's marine ecoregions. Gland, Switzerland: World Wide Fund for Nature International, Global Marine Programme. 76 p.
- Gurney G.G. and Darling E.S. 2017. A global social-ecological system monitoring framework for coastal fisheries management: A practical monitoring handbook. New York, NY: Wildlife Conservation Society. 63 p.
- Hamilton R.J., Almany G.R., Brown C.J., Pita J., Peterson N.A. and Choat J.H. 2017. Logging degrades nursery habitat for an iconic coral reef fish. *Biological Conservation* 210:273–280.
- Jupiter S.D., Jenkins A.P., Lee Long W.J., Maxwell S.L., Watson J.E.M., Hodge K.B., Govan H. Carruthers T.J.B. 2013. Pacific integrated island management – Principles, case studies and lessons learned. Secretariat of the Pacific Regional Environment Programme (SPREP), Apia, Samoa and United Nations Environment Programme (UNEP), Nairobi, Kenya. 72 p.
- McLeod K.L., Lubchenco J., Palumbi S.R. and Rosenberg A.A. 2005. Communication Partnership for Science and the Sea (COMPASS): Scientific consensus statement on marine ecosystem-based management. Available at: <http://compassonline.org/?q=EBM>.
- WCS (Wildlife Conservation Society). 2009. Ecosystem-based management plan: Kubulau District, Vanua Levu, Fiji. Suva, Fiji: Wildlife Conservation Society. 121 p.
- WCS. 2012. Ecosystem-based management plan: Kubulau District, Vanua Levu, Fiji. Suva, Fiji: Wildlife Conservation Society. 135 p.
- WCS. 2015. A facilitator's guide for ecosystem-based management planning in Fiji. Ecosystem-based management plan: Kubulau District, Vanua Levu, Fiji. Suva, Fiji: Wildlife Conservation Society. 124 p.
- WCS. 2016. Ecosystem-Based Management Plan: Nadi District, Bua Province, Fiji. Ecosystem-based management plan: Kubulau District, Vanua Levu, Fiji. Suva, Fiji: Wildlife Conservation Society. 83 p.



New data collection and management tools for sharks and rays

Andy Cornish¹

A lack of basic information on sharks and rays, and on practical approaches to limit their catches, remains an ongoing issue for fisheries managers in many Pacific Island fisheries and beyond. In response, James Cook University and the World Wide Fund for Nature have recently released a rapid assessment toolkit, and a guide to spatial protection, specifically designed for sharks and rays. These tools aim to support the development of sustainable fisheries management, and the conservation of threatened species.

Twenty years have passed since the launch of the International Plan of Action for Conservation and Management of Sharks.² While there has been considerable progress since then, many fisheries that take sharks – whether targeted or as bycatch – lack basic data and species-specific management. The situation is complicated by the great diversity of species and associated life-histories, with 507 species of sharks and 646 species of skates and rays now recognised.

Global catches of sharks and rays peaked in 2003,³ and have generally declined since then. A landmark 2014 study found that one out of four species were threatened with extinction,⁴ with many populations continuing to decline. The status of the shortfin mako shark has recently been downgraded to ‘endangered’ by the International Union for Conservation of Nature’s Red List, while giant guitarfishes and wedgefishes are now more threatened with extinction than

sawfishes.⁵ The latest Western and Central Pacific Fisheries Commission stock assessment for oceanic whitetip shark found that the spawning biomass had likely declined more than 95%.⁶

While the ecological roles of many elasmobranchs are not fully understood, it is clear that some are apex predators, and collectively they provide a diverse array of ecosystem functions. Conserving them is key to enhancing an ecosystem’s resilience to climate change. Losing these species deprives coastal communities in many countries of livelihood, food and tourism opportunities.

Effective spatial protection of critical habitats is one of the most practical and enforceable ways of reducing fishing mortality of elasmobranchs. It can also provide substantial benefits for sustainable fisheries management at national

¹ Leader of Sharks: Restoring the Balance, WWF

² See: <http://www.fao.org/ipoa-sharks/en/>

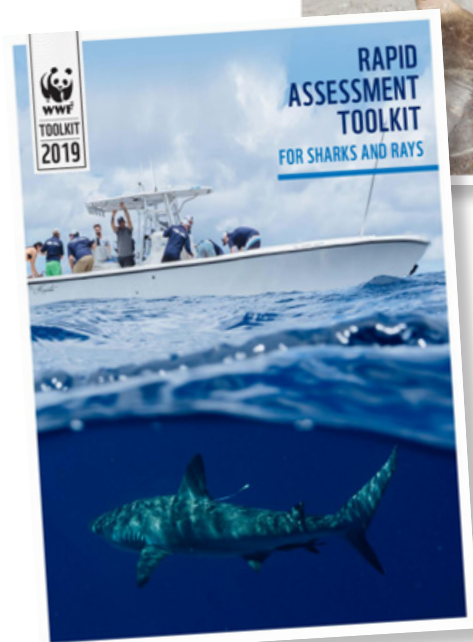
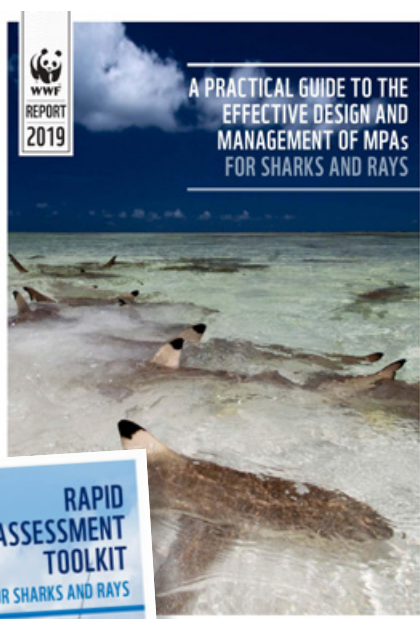
³ <https://elifesciences.org/articles/00590>

⁴ <https://elifesciences.org/articles/00590>

⁵ <https://www.iucnssg.org/press.html>

⁶ <https://www.wcpfc.int/node/42932>

and regional levels as well as for biodiversity conservation. With only 38 shark protection areas globally as of 2018, and thousands of fisheries taking sharks with little or no shark-specific management, there is great potential for spatial protection to be more routinely employed. One particular area ripe for growth is the use of spatial protection in conjunction with bycatch mitigation and other approaches to move fisheries that take sharks towards sustainability.



A practical guide to the effective design and management of MPAs for sharks and rays (image: naturepl.com, Cheryl-Samantha Owen / WWF), and the Rapid assessment toolkit for sharks and rays (image: Beneath the Waves / Diego Camejo).

To assist marine resource managers, the Centre for Sustainable Tropical Fisheries and Aquaculture (CSTFA) at Australia's James Cook University, and WWF have collaborated to produce 'A practical guide to the effective design and management of MPAs for sharks and rays' (MPA Guide)⁷ as well as a 'Rapid assessment toolkit for sharks and rays' (RAT Toolkit).⁸

A practical guide to the effective design and management of MPAs for sharks and rays (image: naturepl.com, Cheryl-Samantha Owen/WWF), and the Rapid assessment toolkit for sharks and rays (image: Beneath the Waves/Diego Camejo).

The MPA Guide builds on the most comprehensive global analysis to date of the effectiveness of shark-focused protected areas by the James Cook team. The guide also incorporates known information on the movement patterns of different shark species. Advice included in the guide can be retrofitted into already existing protected zones, or used when designing new spatial protection from scratch. The guide specifically advises on the best ways of:

- involving local stakeholders,
- monitoring and evaluation,
- accounting for shark and ray movement patterns,
- protecting critical habitats, and
- reducing fishing-related mortality.

As the research shows, the effectiveness of spatial protection for sharks and rays depends on the overlap between the protected area, the animals' movements, and critical habitats. As these vary widely by species, spatial protection proves to be more effective for some shark and ray species than others.

For highly mobile, pelagic species, dynamic spatial and temporal protection might be more appropriate, leaving room for greater management flexibility. Although spatial protection has rarely been applied to high-seas management, it could be a useful approach for pelagic fisheries where bans on capture and retention, combined with safe handling and release practices, are not sufficient to prevent ongoing population declines, such as with oceanic whitetip sharks.

Another key factor for the success of spatial protection is taking into account socioeconomic and cultural factors; that is, ensuring that all relevant stakeholders, particularly local communities, are included in the conservation and management plans from as early on as possible. It is essential to engage them to build trust, respect and support, and to ensure that local communities benefit from these fishery management and conservation measures – only then can spatial protection be successful for both people and sharks.

With nearly 50% of all described elasmobranchs lacking population and conservation status data, the RAT Toolkit aims to address the issue and help plug this gap by offering

⁷ MPA Guide (download pdf): <https://sharks.panda.org/tools-publications/marine-protected-areas>

⁸ RAT Toolkit (download pdf): <https://sharks.panda.org/tools-publications/rapid-assessment-toolkit>



Waisomo villagers prepare to drop anchor for a buoy marking Fiji's first shark-focused marine protected area. (Image: Meg Gawler / WWF)



A baited remote underwater video (BRUV) system being prepared, Pacific Harbour, Viti Levu, Fiji. BRUV is a method of monitoring the marine environment by using bait to attract fish into the field of view of a video camera. (Image: Marcel Keurntjes / WWF-Netherlands)

simple and practical tips for collecting scientific data. The absence of basic information continues to hinder better management, with many coastal fisheries lacking the necessary data to protect declining shark and ray populations and manage fisheries sustainably.

The RAT Toolkit allows for the selection of appropriate tools, depending on the knowledge gap of the particular waters where it may be used. Six tools developed for this publication consist of 'how-to' guidance written by respected experts in the fields of taxonomy, genetics, creel and market surveys, baited remote underwater video systems (BRUVS), tagging and tracking, and citizen science.

Data can be gathered quickly and easily thanks to these tools, which can help fishery managers and national authorities accurately determine the true state of their coastal environments and subsequently conserve and manage shark and ray populations sustainably.

Quality species-specific data collected by applying the tools can be used to produce Shark Assessment Reports and National Plans of Action (NPOA-Sharks) as well as Non-Detriment Findings (NDFs) for sharks and rays listed on CITES Appendix II. Many shark and ray populations face an uncertain future. With a growing urgency to develop NPOA-Sharks by shark fishing nations, and trade controls already in place for a number of species, our RAT Toolkit will help fishery managers and authorities to easily gather all the data needed to manage and conserve elasmobranchs sustainably.

Soft copies of both publications can be found on WWF Sharks website at:

<https://sharks.panda.org/tools-publications>.

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Working towards improving educational and training programmes for marine resource management

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The Pacific-European Union Marine Partnership (PEUMP) programme is a multi-partnership programme funded by the European Union (EU) and the Government of Sweden.² PEUMP is implemented by the University of the South Pacific (USP), Pacific Community, Pacific Islands Forum Fisheries Agency, and the Secretariat of the Pacific Regional Environment Program. In addition, these agencies work closely with several international and regional non-governmental organisations such as the Locally Marine Managed Areas network, World Wildlife Fund, International Union for Conservation of Nature, and Pacific Islands Tuna Industry Association. USP is implementing the capacity building component of the programme (Key Result Area 6 or KRA6) through education, training, research and development. This key result area is targeted at major stakeholder groups involved in fisheries and marine resource management in USP's 12 member countries as well as Palau, Federated States of Micronesia, Timor Leste and Papua New Guinea. Through PEUMP, USP aims to:

- build the capacity of Pacific Islanders in fisheries and marine management;
- increase employability opportunities for graduates;
- maximise linkages with existing regional bodies and institutions involved in fisheries and maritime education and professional development; and
- include gender and social inclusion, and human rights-based approaches into the fisheries sector.

To inform the implementation of KRA6, a training needs and gaps analysis was conducted, and included the collation of information on existing courses and programmes in all 15 (Pacific) African, Caribbean and Pacific (PACP) countries, interviews of key stakeholders to identify education and training needs, consideration of gender and social inclusion and human rights-based approaches for training and education needs, identification of amendments to existing and new courses and programmes, and identified delivery mechanisms and institutions.

The analysis was undertaken in three ways: a literature review, online survey and face-to-face interviews. The latter provided for the collection of additional views and checking for consistency with results obtained from the online survey. In total, 305 people were invited to participate in the online survey, with 89 of these providing responses. One hundred people participated in face-to-face interviews.

The key findings of the training needs and gaps analysis indicated that resource economics, marine biology and ecology, and the development of fisheries policies and management plans were also identified as priority needs. In addition to these more technical fields, a range of general cross-cutting skills were also identified. Among these, communication, writing skills and problem solving were ranked highly, while skills covering effective engagement with stakeholders, data interpretation and visualisation, gender and social inclusion and human rights-based approaches were also considered important. Several key recommendations for USP on the delivery of training and education to meet these identified needs including, making greater use of colleges and universities in other PACP countries.

To ensure the effective implementation of KRA6, it will be necessary to introduce specific topics in programmes and courses, and modifying the way in which the development and delivery of curriculums and courses is conducted in PACP countries. Continuing professional development through accredited technical and vocational education training institutions, and short courses for those already working in the fisheries sector, has also been identified as key requirement. It was also recommended that the main PEUMP implementing agencies and partners play a strong role in supporting the implementation of KRA 6. Overall, a high level of commitment, sustained by adequate funding and strong leadership, are critical for the achievement of KRA 6.

The challenge is for everyone to work together to enhance the employability and upskilling of Pacific Islanders for the sake of sustaining future economic and food security benefits from our marine resources.

The full training needs and gaps analysis report can be accessed at: <https://www.usp.ac.fj/index.php?id=22869>



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² See : https://www.spc.int/DigitalLibrary/Doc/FAME/Brochures/Anon_18_PEUMP_Leaflet.pdf

Future Pacific Ocean managers: Scoping skills and knowledge needs

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Summary

The importance of the Pacific Ocean for global geopolitics is being increasingly recognised, particularly with regards to resource extraction and the projected impacts of climate change. Pacific Islanders need a healthy ocean, and in response to increasing threats, several regionally appropriate and globally recognised approaches to the management of a sustainable ocean and coastal resources have been developed.

Formal education at the regional University of the South Pacific (USP) needs to continue to evolve in order to prepare students from Pacific Island countries (PICs) to meet future challenges as ocean managers. In this article we report on the findings of a scoping survey done with 30 USP students.

The survey found high levels of satisfaction among undergraduates admitted directly from high school, but among students who had prior work experience there was less satisfaction. Students highlighted their interest in the 'applicability' of learning, and called for a greater emphasis on group learning, face-to-face and practical approaches to learning as opposed to increasingly used online methods. The absence of any mention of using traditional knowledge for marine resource management suggests that further consideration in this area is needed. Analysis of the results suggest the following recommendations:

- Survey in-service professionals and employers in relevant fisheries and marine conservation sectors in individual PICs.
- Describe the different contexts and approaches to utilising and managing marine resources across the various PIC contexts.
- Develop and evaluate a more interdisciplinary skills list that may be appropriate to a variety of PIC contexts, including traditional knowledge, management and tenure.
- Explore and review potentially appropriate Pacific Island modes of learning based on experiences in the region, with particular attention to culturally appropriate ways of learning.
- Review prescribed and specialised classes in the context of Pacific Island fisheries and marine resource management strategies, culture and institutional capacities.

Introduction

Pacific Islanders depend heavily on marine resources, which provide many opportunities to contribute to not only their own livelihoods, but also to national economies. PICs face a unique set of challenges in the sustainable management of the vast ocean and coastal spaces populated by thousands of remote and diverse communities. The last few decades have seen what amounts to a revolution in the thinking and approaches to governing both offshore and coastal resources, a revolution that capitalises on traditional Pacific Island strengths, and adapts these to modern contexts (Govan 2017). Despite these promising advances, however, there is still significant concern that, faced with increasing local and global economic volatility and environmental

threats, PICs are far from achieving the vision of 'A secure future [...] based on sustainable development, management and conservation of our Ocean' (Govan 2017:16).

The need to address capacity constraints has been a constant call in regional ocean and fisheries-related policies for at least 20 years.³ The Framework for a Pacific Oceanscape calls for 'capacity building, including formal, tertiary and vocational training, and research [...] to be more carefully targeted at addressing our [Pacific Island] governance and management requirements' (Pratt and Govan 2010: Strategic Priority 4).

The question raised by new students and those who return from the work force (in-service students) is whether formal 'capacity building' has experienced anything like the

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³ See: Strategic Plan for Fisheries Management and Sustainable Coastal Fisheries in Pacific Islands (SPC 2003), Pacific Islands Regional Ocean Policy (SPC 2005)

‘revolution’ in fisheries and marine resource management and governance referred to above.

To help increase our understanding of this question, a scoping survey was conducted as a preliminary data-gathering exercise to canvas student opinion on current formal approaches at USP. The survey investigated informants’ motivations for coming to USP, what knowledge and skills these possible future Pacific Ocean managers are seeking, their assessment of the knowledge and skills they received at USP, and suggestions for additional topics or learning modalities. Informants comprised first year to third year students, post-graduate students, and students who were studying while currently or previously in-service.

Methods

At the outset, several meetings were held with Pacific Island fisheries officers, experienced regional diplomats, academics and consultants, all of whom concluded that training provided by the region’s academic institutions on ocean and coastal management should be reviewed. From these discussions, it was decided that a scoping survey should be carried out by students at USP, and that one of the objectives of the survey process should be to stimulate and encourage students to discuss training and education needs among their peers, with a view to participating in an ongoing process of consideration, reflection and development as to how to make any identified changes, and to move forward.

The survey involved a team of interested students with the third author on this paper serving as adviser. The team designed a survey (Annex 1) that was carried out in the second quarter of 2018, and administered to current and

former students of USP in the School of Marine Studies who studied in the Marine Management or Marine Science programmes. In total, 30 students were interviewed individually from four PICs: Solomon Islands (16), Fiji (6), Kiribati (4) and Vanuatu (4). Nearly one-third of respondents were women (9). The students surveyed included first year, second year, third year, post-graduate, and Master’s degree students, and included both pre-service students (those admitted to university straight from high school) and in-service students (those were or are currently working as fisheries officers). Three of the in-service respondents had recently graduated from USP.

Summary of findings

This section summarises the responses to the main survey questions.

What brought you to USP?

The 30 respondents gave 53 responses, with some giving multiple reasons (Table 1). One-quarter of respondents were motivated by learning about one or several topics in the marine field, mainly fisheries, resource management and conservation, and ocean environment and resources. Just over 20% expressed the desire to obtain a qualification. Other motivations expressed by less than 10% included the availability of scholarships, USP’s reputation, personal passion, and obtaining a job and helping their particular PIC.

The main feature was the variety of responses and the motivations given, with none strongly standing out. Knowledge seeking, passion and desire to help one’s country motivated

Table 1. Proportion of students at different stages of their education mentioning specific reasons for their choice to study marine management and fisheries at the University of the South Pacific. Number of students = 30, number of responses = 53 (some gave multiple responses).

	Year 1	Year 2	Year 3	Post-graduate	In-service	Total
Seeking knowledge in specific topics*	25%	26%	21%	20%	27%	25%
Obtain degree and/or qualification	50%	21%	14%		27%	21%
Scholarship availability		5%	14%	20%	9%	9%
USP’s reputation		11%	7%	20%	9%	9%
Passion and/or dream		11%	14%			8%
Getting a job		11%	7%	20%		8%
Help my country			7%	20%	9%	6%
USP School of Marine Studies and facilities			14%		9%	6%
Regional social interaction and experience	25%	5%				4%
Opportunity		5%			9%	4%
USP’s flexibility		5%				2%
Number of responses	4	19	14	5	11	53

* Topics were fisheries, resource management and conservation, ocean environment and resources, which comprised seven responses followed by single responses on ocean governance, marine science, aquaculture and climate.

just under 40%, while less altruistic motives such as the availability of scholarships and opportunities were mentioned by 13%. Getting a qualification or a job was mentioned as a motivation by 29% of respondents but it is impossible to say whether this was only for personal gain or as part of helping their family and country. Just over 20% mentioned opportunities and USP's reputation, particularly the School of Marine Studies.

What knowledge and skills were you looking for in particular, and for each of these, why?

All 30 informants responded to the survey question on the knowledge and skills originally sought at USP. In total, 73 different topics were broadly categorised (Table 2). Nearly one-third (33%) of the topics mentioned related to fisheries and marine resource management. Approximately 20%

related to specific skills, in particular research, while 15% related to sustainable development or marine resource use. A wide variety of interests comprised the remaining 32% of topics mentioned, and here it is notable that the topic of climate change only came up twice, and aquaculture and marine pollution were only mentioned once.

There are indications that post-graduate and in-service students are more focused on fewer topics. In contrast, first and second year students mentioned more skills-related topics.

Overall assessment of knowledge and skills received

Twenty-nine informants provided an overall assessment of knowledge and skills received from USP (Table 3). Just over a half rated the knowledge and skills they received as being 'very good', with a further 28% giving a rating of 'good', with

Table 2. Knowledge and skills sought by 30 students of the School of Marine Studies at the University of the South Pacific (Marine Management and Marine Science programmes). Students mentioned several topics each and the total number of topics raised was 73.

	Year 1	Year 2	Year 3	Post-grad.	In-service	Total
Resource and fisheries management	2	5	12	1	4	24
Resource management and conservation		2	6		2	10
Fisheries management	2	1	2	1	1	7
Fisheries policy and national law		1	2			3
Governance (government and communities)			2			2
Monitoring, control and surveillance		1				1
Career in fisheries management					1	1
Skills	2	8	1	2	2	15
Research skills		4	1	1	2	8
Computer skills	1	1				2
Report/writing skills		2				2
Communication skills	1					1
Public speaking and presentations		1				1
Time management				1		1
Fisheries development (sustainable)		3	5		3	11
Sustainable development and use of marine resources		3	5		2	10
Post-harvest					1	1
Others / various	2	7	8	1	5	23
General marine studies related		2	2	1		5
Applied and/or functional knowledge (in home country)		2			2	4
Law of the Sea, international law, ocean policy	1		2			3
Climate change		1	1			2
Other (unique topics)	1	2	3		3	9
Total topics	6	23	26	4	14	73
Students	2	10	8	3	7	30

* Single mentions were made of the following topics: Disaster management, shoreline erosion, aquaculture, regional institutions, ocean environment, marine pollution, ports services, marine ecology and assessments, restocking corals.

only 20% scoring it as fair or worse. The lowest scores were provided by in-service students.

Which courses and other experiences exceeded expectations?

When students were asked which USP courses or other experiences best delivered what the student had hoped for, informants frequently listed specific courses that delivered on their expectations and others that did not. At the USP Bachelor's degree level, students generally regarded all marine study courses as delivering on expectations. Nearly half (49%) of the students responded that all marine science and marine management courses were relevant and contributed towards their expectations. Conversely, the courses most frequently mentioned as less useful, irrelevant or 'making up the numbers' were introductory courses from other fields such as Statistics, Earth Sciences, Chemistry and Biology. The compulsory foundation courses taken in the first year of full-time study were particularly criticised. In-service students provided a rich variety of feedback that would benefit from further investigation.

Activities such as field trips, laboratory sessions, practical experience, and research projects were highlighted as being important, along with other social activities, and student and staff interactions. Two notable comments and suggestions from some students were that: 1) some of the courses offered were very brief and that there were too few courses

covering areas of interest in ocean affairs, such as in the maritime sector and the shipping sector; and 2) the mode in which courses were delivered could be improved on. Both of these are discussed below.

Knowledge and skills that would be useful

In response to the question 'What knowledge and skills do you think would have been more useful?', many respondents did not have specific suggestions, although topics that were suggested focused on more practical experience and field work. These included a stronger focus, in order of priority on knowledge application, research and data analysis, aquaculture, writing, and policy development. Other topics that were mentioned were: conservation and management actions; coral reef survey methods; ocean governance, including Law of the Sea; sea transport; and monitoring, control and surveillance. A survey of potential non-governmental organisations and government employers was also suggested by one respondent.

Suggestions on best ways of learning

The students were asked to suggest 'What are the best ways of learning?' In total, 53 suggestions were made, and these are tabulated by category in Table 4. Over one-third (38%) of suggestions related to practical experience, field trips and field work; essentially 'learning by doing' or 'seeing'. A quarter of the suggestions related to group work discussions and

Table 3. Students' overall assessment of knowledge and skills received during their experience with the School of Marine Studies at the University of the South Pacific. Number of students rating on a five-point scale from 'very good' to 'very bad'.

Assessment	Year 1	Year 2	Year 3	Post-graduate	In-service	Total	%
Very good	2	5	5	2	1	15	51.7%
Good		4	1	1	2	8	27.6%
Fair		1			3	4	13.8%
Poor			1			1	3.4%
Very bad					1	1	3.4%



Table 4. Suggestions from 30 students from the University of the South Pacific's School of Marine Studies (Marine Management Programme and Marine Science Programme) on how to improve ways of learning.

	Year 1	Year 2	Year 3	Post-grad.	In-service	Total	%
Practical experiences		5	4	1	3	13	24.5%
Field trips and field work	1	4	1		1	7	13.2%
Group discussions	1	2	1	1	1	6	11.3%
Work attachments and/or internships	1	1	1	1	2	6	11.3%
Small group work for practical experiences	2	1			2	5	9.4%
Face-to-face (increase)		3	1			4	7.5%
Group work across cultures		2				2	3.8%
Others	1	6		1	2	10	18.9%

activities, with two students highlighting the value of having people from various cultures involved in group work. A number of responses related to suggestions for internship opportunities and a preference for face-to-face teaching as opposed to online learning. Individual suggestions included topics such as the application of critical thinking, having targeted research projects, media production, opportunities to get involved in teaching, conducting a training needs analysis, and better selection of teachers.

Discussion and recommendations

The pursuit of knowledge and having a passion for the topics and a desire to help one's country were prime motivations for attending USP, and were suggested by just under half of all students surveyed. This is somewhat counterbalanced by the more practical motivations of getting a job or a qualification. Features relating to USP's perceived niche or reputation played some role but perhaps not as large of one as might be expected. The variety of motivations expressed by this small sample of students indicates that there is no particular student profile, and that USP's School of Marine Studies is not clearly marketing potential job possibilities in the region.

Despite the above, it appears that the skills and knowledge most commonly sought by students relate to fisheries and marine resource management, rather than (sustainable) resource exploitation. This reflects a shift over the last two decades in regional and national policies, and a move from natural resource development to natural resource management. It will be important, however, to assess whether a generation of sustainable livelihoods and national revenue is becoming increasingly neglected as this area will be an integral part of future Pacific 'blue economies'.

The generally high level of satisfaction of students with the knowledge and skills received at USP is very positive but is mitigated by the lower scores received from those students who already had experience in the job market. It is

possible that students graduating from high school in Solomon Islands and Kiribati at least may disproportionately be impressed by the contrast with the relatively well-endowed USP and the technically more impressive courses.

Concerns raised about the applicability of learning in students' own contexts and countries – along with calls for more practical experience – may relate to suggestions that many teachers do not have sufficient practical knowledge of their students' countries. For students nearing graduation, the realisation of the differences between what is taught at USP, with a special emphasis on Fiji, and their home situations may cause concern about the applicability of ideas and theoretical approaches that they have been taught while at USP compared with the practical realities of their home countries. Traditional ecological knowledge and traditional practices were conspicuous by their absence in student responses, yet these are vital to natural resource management in most PICs. This suggests that a training needs analysis needs to be conducted to better describe the differing actual and potential contexts of traditional knowledge in PICs, and how traditional knowledge can be constructively brought into teaching as a valid field of knowledge and practical application.

Criticism of some of the introductory or general undergraduate courses may relate to these being generic and tailored to the general first year student body and, therefore, not meeting the expectations of more focused marine studies students. These courses should, however, also deliver some of the skills that are considered vital by students as they progress their studies, particularly in the areas of general research skills, communication and computing. This needs further investigation.

The topics being sought or taught do not seem to reflect the revolutions in oceanic and coastal fisheries management noted earlier or the forthcoming challenges posed by increased market pressure and climate change. However, the suggestions for improvement do indicate some pathways for more Pacific-appropriate topics and learning modes that

need to be further explored and developed. Discussions with students failed to show a discernible impact of the burgeoning literature on preferred Pacific ways of learning and skills considered vital to supporting and sustaining Pacific ways of life (cf. Thaman 1992, 2009; Nabobo-Baba 2013)

Students demonstrated a strong desire for more interactive learning opportunities that linked their acquired knowledge with practical application in the Pacific Island context. Without surveying graduates currently in-service in their home countries it will be hard to ascertain whether this represents a normal disconnect between academic training and the realities of working on the ground, or is a true mismatch between theory and country needs and realities.

Strong preferences for group work and face-to-face opportunities are likewise understandable in many PIC contexts, and is well-known to increase the effectiveness of learning. The mismatch between Western systems of teaching and appropriate Pacific ways using cooperative and participatory styles that simultaneously recognise the diversity of Pacific Island cultures has been highlighted (Thaman 2009). Recent moves by USP towards online teaching seem to contradict this, and the question therefore needs to be answered as to whether in the particular context of the Pacific these forms of learning are more appropriate.

The context of marine resource exploitation and management in the Pacific is substantially different from that elsewhere due to the high dependence on marine resources for food security, livelihoods and income generation. In oceanic fisheries there is a strong element of international collaboration and negotiation with distant-water fishing nations, while in coastal areas, balancing diverse livelihoods with sustainable use, traditional tenure and other access arrangements, culture and communities are cornerstones. This suggests that skills in areas not explicit in either the curriculum or in students' expectations may need to be explored to include areas such as international diplomacy and negotiations, trade issues, donor management, anthropology, sociology, Pacific cultures, traditional tenure arrangements, and participatory and facilitation processes.

Tailoring a curriculum suitable to PIC specificities is further complicated by the great diversity of national contexts. The cultural diversity of the Pacific is well known but there are also large differences in institutional capacity across PICs, which have varying levels of human development indices and pressing governance issues (Govan 2015).

The specificities and variety detailed above has implications in terms of the selection of lecturers and trainers; those without in-depth PIC experience may struggle to deliver appropriate and applicable learning experiences to PIC students. In addition, it is not clear if USP has considered the requirements of different PICs with regards to fisheries and marine resource management so as to design and tailor better courses.

This scoping study makes the following recommendations:

- Survey in-service professionals in the relevant fisheries and marine sectors in PICs, including those working in non-governmental organisations and government to explore gaps and topics that might need emphasis as well as potential graduate profiles.
- Describe the different contexts and approaches in fisheries, and marine resource management and development in a variety of PIC contexts, with a view to highlighting different skills needed.
- Develop and evaluate a more interdisciplinary list of potential topics and skills that may be appropriate to the variety of PIC contexts and, in particular, the incorporation of traditional knowledge, management and tenure.
- Explore and describe potentially appropriate modes of learning based on experiences in the Pacific and student feedback. Particular attention should be placed on culturally appropriate ways of learning.
- Review the appropriateness of currently prescribed courses in the context of natural resource management strategies, culture and institutional capacities in the Pacific Islands region. Approaches to covering the diversity of situations across PICs and cultures needs greater consideration.

References

- Govan H. 2015. Preliminary review of public expenditure of the Fisheries Agencies of Pacific Island Countries and Territories: Policy, operational budget and staffing support for coastal fisheries. Report for the Secretariat of the Pacific Community, FAME Division. Noumea, New Caledonia. DOI: 10.13140/RG.2.1.4949.9363. Available at: <http://bit.ly/budgetstudy2015>
- Govan H. 2017. Ocean Governance – Our Sea of Islands. P. 163–234. In: Katafono R. (ed). A sustainable future for small states: Pacific 2050. London: Commonwealth Secretariat. Available at: <http://bit.ly/Govan2017-OG>
- Thaman H.K. 1992. Towards a culture-sensitive model of curriculum development for Pacific Island Countries. *Directions* 13(1):1–11.
- Thaman H.K. 2009. Towards cultural democracy in teaching and learning with specific references to Pacific Island nations (PINs). *International Journal for the Scholarship of Teaching and Learning*: Vol. 3: No. 2, Article 6. Available at: <http://digitalcommons.georgiasouthern.edu/ij-sotl/vol3/iss2/6>

Nabobo-Baba U. 2013. Transformations from within: Rethinking Pacific Education Initiative. The Development of a Movement for Social Justice and Equity. *International Education Journal: Comparative Perspectives* 12(1):82–97.

Pratt C. and Govan H. 2010. Our sea of islands, our livelihoods, our oceaia. framework for a pacific oceanscape: A catalyst for implementation of ocean policy. (Includes the policy). Secretariat of the Pacific Regional Environment Programme: Apia, Samoa. Available at: <http://bit.ly/FrPacOc>

SPC 2003 Strategic plan for fisheries management and sustainable coastal fisheries in Pacific islands. Secretariat of the Pacific Community, Noumea, New Caledonia.

SPC 2005. Pacific Islands Regional Ocean Policy and Framework for Integrated Strategic Action. Secretariat of the Pacific Community, Noumea, New Caledonia. Annex 1

Annex 1

Interview format: Skills and knowledge useful for Pacific Ocean managers

Introduce the interviewer and explain reasons for the study. It is anonymous unless they want otherwise.

- ◆ Identify the skills and knowledge that are most useful for Pacific Ocean managers
- ◆ Discuss and develop options on appropriate ways to provide skills and knowledge

Informant details

1. Approximate age:
2. Gender:
3. Home country:
4. Scholarship?:
5. Work or study history (jobs and schooling):
6. Current year of study (of how many):

Motivation and interests

7. What brought you to USP?
8. What knowledge and skills were you looking for in particular and for each one why?

Do you want to be part of this study and work?

- ◆ How (informed of result, participate in meetings, carry out interviews)?
- ◆ If so, please give your name and email contact.

Assessment of experiences

9. What is your overall assessment of skills and knowledge you have received so far? (1 = very good, 5 = very bad)
10. What is your overall assessment of skills and knowledge you have received so far? (1 = very good, 5 = very bad)
11. What courses or other experiences delivered what you hoped for and which ones did not. Why?
12. What knowledge and skills do you think would have been more useful?
13. What are the best ways of learning in your opinion (including non-formal)?
14. Other suggestions

Socioeconomic aspects of oyster harvesting in the Rewa River delta area, Fiji

Jeff Kinch,¹ Bulou Vitukawalu,² Unaisi Nalasi,² Pitila Waqainabete² and Michel Bermudes¹

Introduction

Small-scale fisheries provide many benefits to Pacific Island communities. However, increasing engagement with the global economy is exerting pressure on various marine resources that generate these benefits. This pressure may be offset if communities have other livelihood options.

In the Vutia District of Rewa Province in Fiji, the women of Muanaira Village harvest oysters as a supplementary income activity. This oyster harvesting is centred around the collection of an oyster species (*Crassostrea* sp.) that was introduced in the mid-1970s. Before this, the women harvested a native oyster, *Saccostrea mordax*.

The Pacific Community (SPC) and Fiji's Ministry of Fisheries (MoF) is investigating the possibility of transferring effort from harvesting oysters by Muanaira women to oyster farming.³ The efforts of SPC and Fiji's MoF are also in line with the United Nations 'Voluntary Guidelines on

Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication' (FAO 2015), as well as the Melanesian Spearhead Group's 'Roadmap for Inshore Fisheries Management and Sustainable Development' (MSG 2015), and the Pacific Community's 'Noumea Strategy' (Pacific Community 2015). These instruments call for various actions to be taken by member countries to ensure the sustainability of coastal fisheries and associated marine resources. Activities by SPC and Fiji's MoF are also in line with Sustainable Development Goal 14, which promotes the conservation and sustainable use of all marine resources for sustainable development purposes (United Nations 2015).

To help inform future work, a socioeconomic survey was conducted to understand the importance of oyster harvesting and to also explore oyster harvesters' attitudes towards oyster collection and their potential interest in oyster aquaculture.



Oyster collecting along the Rewa River, Fiji. (Image: Jeff Kinch, SPC)

¹ Pacific Community

² Fiji Ministry of Fisheries

³ See article on p.12 of this issue.

Background

The first introduction of non-native oyster species to the Rewa River delta area was in 1974, when the Pacific [Japanese] oyster (*Crassostrea gigas*) was introduced to Lau-cala Bay (Ritchie 1974). The first batch of these oysters died during a flood event that same year, while the 1976 introduction survived. This species did not endure due to heavy predation by the mangrove mud crab (*Scylla serrata*) (Eldredge 1994). In 1975 and 1976, the Philippines oyster (*Crassostrea* sp.⁴) was introduced, possibly as an alternative (Ritchie 1975; Eldridge 1994). Muanaira Villagers refer to the Philippine oyster as the New Zealand oyster because it was introduced from New Zealand under the coordination of Apisai Sesewa, a Fiji MoF staff member at the time. The first batch of these oysters, which were introduced in 1975, died during a flood event that same year, while the 1976 introduction survived. (See Annex A for details of oyster introductions to Fiji.)

During the 1970s, Lasaro (Les) Radrodro Lalanabacari, a Muanaira Villager who is now a resident of New Zealand, was involved with these introductions. During the period of the socioeconomic survey, Les was home at Muanaira Village and provided additional details on these introductions. When he was involved in the oyster introductions, he utilised a tower system that was made of tiered fibro cement sheet and timber that measured 600 mm x 600 mm and stood 1.5 m in height. These towers were then suspended in the water. At the peak of production during 1975–1976, Les stated that he was selling between 200 and 300 dozen oysters per week at FJD 0.90 per dozen, with the largest single sale during that period being 600 dozen oysters to a local hotel. Despite this high demand, oyster production slowed because of ongoing theft of oysters from the grow-out towers. Once Les departed for New Zealand for further studies in 1976, interest in continuing oyster production waned.

Today, residents of Muanaira Village distinguish two species of oysters found in the Rewa River delta area, based on their size and the colour of their muscle scars. The native oyster (*S. mordax*) is generally small and has a white muscle scar, while the introduced species (*Crassostrea* sp.) grows considerably larger and has a black muscle scar. Preliminary sampling by SPC in November 2018 suggests that *Crassostrea* sp. now makes up approximately 40% of the oyster population in the Rewa River delta area.

Community

Rewa Province is the smallest province in Fiji and is divided into three parts covering a land area of around 272 km² (Saumaki 2007). The first and largest part of Rewa Province,



Oyster midden in Muanaira Village showing predominance of introduced *Crassostrea* sp. (Image: Jeff Kinch, SPC)

encompasses the capital city of Suva and the surrounding hinterland to the west. Suva is a major commercial, shipping and industrial centre and has rapidly expanded in the last 50 years. Rewa Province is also the heart of the *burebasaga*, one of three traditional chiefly confederacies found in Fiji (Saumaki 2007).

All Fijian villages are linked to the national government structure through their districts (*tikina*) and provincial councils. The Rewa Provincial Council was established in 1874 and is headed by the *roko tui*, who is appointed by the Fijian Affairs Board and serves the same purpose as a mayor or administrator. Under the Fijian Affairs Act, each village also has a *turaga-ni-koro*, who is also a member of the district council, which reports to the provincial council and the Fijian Affairs Board. A *turaga-ni-koro* is responsible for calling village meetings to discuss village-related matters.

In Fiji, 89% of all lands are held under customary tenure and governed by traditional leadership structures (Scheyvens and Russell 2012; iTaukei Land Trust Board n.d.). Virtually all indigenous Fijians (*iTaukei*) belonging to a village have a right to share in the natural resources that are part of their family or *mataqali* (clan) areas.

The population of Rewa Province in 2017 was 108,016 people (Fiji Bureau of Statistics 2018). Increases in the rural population (i.e. those that reside outside of Suva city) rose by nearly 21% between 2007 and 2017 to 14,533 people (Fiji Bureau of Statistics 2018). Approximately one-third of

⁴ At the time of this introduction, this oyster species was named *Crassostrea iredalei*.

this rural population resides in the core Rewa River delta area, which encompasses the Vutia District Council area.

In 2004–2005, Muanaia Village was reported to have a population of 344 people residing in 80 households, with control over an area of 739 acres (Saumaki 2007). In 2018, a survey conducted by the national government health programme reported that there were 230 people (116 males and 114 females) residing in Muanaia Village (Table 1). This represents a marked decline from 2004 to 2005 due to rural–urban migration, particularly as work opportunities and superior education and health services have become available in nearby Suva. In total, there are 45 inhabited households in Muanaia Village, with a further eight houses being vacant. Houses in Muanaia Village are made of either corrugated iron, concrete block, or timber planking. There are also nine additional households that are considered to be part of Muanaia Village but located at the old village site on Laucala Island.

The majority of Muanaia Villagers moved from Laucala Island to the present location in the mid-1950s. This movement coincided with the construction of the Vutia District School in 1953, with buildings originally constructed from local bush materials. In 1957, permanent buildings were constructed with cement block and corrugated iron roofing sheets. Other structures at Muanaia Village include a community hall with a health station, and churches. There are also four tradestores operating in Muanaia Village that provide simple products in the way of rice, tinned products, soap and other items.

Government assistance provided through the Rewa Provincial Council to Muanaia Village includes water tanks, solar panels and batteries, river bed protective structures, as well as dredging some parts of the Rewa River delta to aid access and provide flood control. Muanaia Village has also received external assistance in the past from the South Pacific Regional Environment Program (SPREP) on pollution control, and Vodafone, a mobile phone company that provided funding for cyclone recovery. Muanaia Village is also a targeted project village by the International Tropical Timber Organisation, which has a focus on community-based

management and restoration of vulnerable forests of the Rewa River delta.

Muanaia Village received electricity and piped water in 2008. All of the currently inhabited households have piped water to their house, with 39 of these also having flush toilets. This correlates well with assessments by Cardno (2013) who found that 80% of Fijian citizens who had water piped into their dwellings, also had a flush toilet. Most households have an indoor kitchen, while some have an outside cooking area. Most people utilise kerosene stoves, with some using propane gas as well. Those cooking outside used fireplaces burning mangrove wood sourced from the surrounding mangrove forests.

As there is no road access to Muanaia Village, people are reliant on fibreglass dinghies with outboard motors, with some of these operating as water taxis. There are currently 10 dinghies with outboard engines (nine of these are made of fibreglass, with one being aluminium) and two wooden punts. The lack of road access for rubbish collection also means that Muanaia Villagers either burn, bury or dump their rubbish in the nearby mangroves and coastal foreshore, or in the adjacent river or streams.

Environment

Laucala Bay and Suva Harbour make up Suva Lagoon, which is encapsulated by a large fringing reef. The Rewa River and its associated delta is the largest fluvial system in Fiji. *Tomaniivi* mountain has a catchment area of some 2920 km² that feeds the Rewa River (Lata 2010). The Rewa River also obtains water from the Wainibuka, Wainimala, Waidina and Waimanu Rivers which drain into it.

Because the Rewa River delta is less than 2 m above the high tide level, it is particularly vulnerable to flooding and future sea level rise. The delta area receives an annual rainfall between 5000 and 7000 mm each year (Lata 2010). Due to the large discharge of freshwater and sediments, the barrier and back reef lagoons fronting the Rewa River have several reef openings that allow significant wave energy to reach

Table 1. Age groupings for Muanaia Village in 2018.

Age group (years)	Stage	No.
0–1	Infant	4
2–5	Toddler	10
6–12	Child	31
13–19	Teenager	36
20–59	Adult	95
60 +	Senior	24

the coast, especially during storm and cyclone surges, with subsequent river bank and shoreline erosion. Monthly mean temperature varies from 22°C to 27°C over the year.

Methods

Interviews using a questionnaire (Bernard 2017) were conducted on 30 April and 1 May 2019 with the residents of Muanaira Village. Following a small focus group discussion with senior women in the village, 44 women were identified as being predominately involved in oyster harvesting. Men are also involved, but usually accompany their wives and assist with collection and carrying.

People that agreed to be interviewed did not receive any incentives for participating, and people interviewed were allowed to speak freely with their answers. All interviews were conducted in the main village. Before each interview was conducted, participants received a short briefing on the purpose of the survey (in the Bauan dialect) from one of the three female investigators, Bulou Vitukawalu, Unaisi Nalasi and Pitila Waqainabete, all of whom are Fijian. Daily briefings were also provided in English by Jeff Kinch and Michel Bermudes at the end of each day.

Data confidentiality and anonymity of each participant was assured by omitting names and contact information of each respondent in the analysis. Following Fijian village protocol, permission to interview oyster harvesters was requested

from the village *turaga-ni-koro*. Participant observation and further free flow discussion was conducted with the women while they were at their harvesting site.

In total, 23 interviews were conducted representing 10% of the total population of Muanaira Village and around half of all people identified to be involved to varying degrees with oyster harvesting. Overall, the respondent group was homogenous, with 100% being native Fijians (*iTaukei*), 87% of which were female, and 13% were male. On average, female participants were 51 years of age ($n = 19$; range: 27–77) and the average age of male participants was 53 years old ($n = 4$; range: 40–62). Of the female respondents, only two were the head of the household because they were widows, one lived by herself, and the other being the matriach of a household of nine other family members. Household size was, on average, five people per household ($n = 23$; range: 1–10).

Oyster harvesting

As noted above, the oyster harvesting grounds used by Muanaira Villagers are open to everyone that resides there, including female respondents who had married into Muanaira Village. These respondents were allowed to harvest oysters as they were now considered part of the extended kin-network, being an affine to the members of a particular *mataqali*. Harvesting oysters is seen predominately as women's work, and women are often accompanied by their spouses, family, extended family and friends. Oyster harvesting is,



Sorting oyster spat from collectors and getting it ready for deployment in oyster grow-out baskets. (Image: Jeff Kinch, SPC)



Map 1. Oyster grounds of the lower Rewa River delta exploited by Muanaira Villagers.

thus, a communal affair. Men sometimes accompany their wives to assist with collecting, but also to carry and load the heavy bags of oysters.

Oysters are harvested from the mangroves systems of Lauca-la Island (Map 1). Within the harvesting areas, there are several named areas: Brisbane, Cedua, Drauniwalai, Malikoso, Niakisiaga, Nukuwakai, Qasibale, Solo, Ucuinaqi, Ucuna, Valenidri, and Waikabasu. Access to these harvesting areas is by fibreglass dinghy with an outboard motor, although wooden punts that are rowed using oars are also used on occasion. Fibreglass dinghies with outboard motors are generally operated by men, as they are the owner and manager of these important assets. On average, depending on weather conditions, which will determine the route either through the delta mouth or through channels to the oyster harvesting area is about 20–30 mins and requires 20–25 litres of fuel. Fuel costs are met by the group, which will contribute FJD 5.00 each to pay for the charter, with a cost of FJD 30–40/trip. Members of a group are usually dropped off by a dinghy when it is going to Bailey Bridge Market, or to Nasilai, and will be picked up on the return journey.

Elderly respondents from Muanaira Village stated that they had begun harvesting the native oyster (*S. mordax*) when they were still girls back in the 1960s, later switching to harvesting the introduced species (*Crassostrea* sp.) when these increased in abundance from the late-1970s onwards. Other respondents began harvesting oysters when they became able to, first accompanying their mothers and later when they became responsible for their own households. Many younger women could state the actual year they started harvesting oysters, and several women ($n = 8$) began oyster harvesting when they moved to the village after marrying men from Muanaira Village.

Due to the nature of the mangrove environment where oysters are found, the toolkit used for oyster harvesting is relatively simple, consisting of knives, choppers, and pieces of steel. Plastic buckets and biscuit tins are used to hold collect oysters, which are then tipped into 10-kg, 25-kg or 50-kg flour sacks for transportation back to Muanaira Village. Approximately 80 oysters with shells will fill a 5-L container plastic bucket or biscuit tin.

When asked why they selected the introduced oyster (*Crassostrea* sp.), respondents stated that they were easier to open than the native species ($n = 10$) (*S. mordax*), or because their size was bigger ($n = 12$). Other food items collected while oyster harvesting included *kaikosa* (*Anadara cornea*, $n = 12$), seaweed (*lumi*, $n = 4$) and fish ($n = 2$). Twelve respondents usually collected between one or two 25-kg bags of oysters on each harvesting trip (Table 2). Out of 21 respondents, 10 stated that they harvested oysters once a week, 5 stated they harvested on a fortnightly basis, while a further 4 said that they harvested once a month, with another 2 stating they harvested only occasionally. Oysters were collected for food, sale, and community events such as custom and church activities. The average size of the introduced oyster (*Crassostrea* sp.) was 79 mm ($n = 100$, range: 52–144 mm), while for *kaikosa* (*A. cornea*), the average size was 57 mm ($n = 50$, range: 39–71 mm).

Table 2. Average number of bags of oysters harvested by Muanaira Villagers.

Bag size	No.	No. of respondents
10 kg	1	1
25 kg	1	6
	2	6
	3	0
	4	2
50 kg	1	2
	2	4
	3	1
	4	1
Total:		23

In general, post-harvest processing of oysters includes soaking them over night and then cooking and removing them from the shell. After this has been done they are refrigerated. Only one female respondent added value to her oysters by adding flavours such as lemon, chili, onion and vinegar. Two female respondents stated that they sold oysters shelled and unshelled, but uncooked.

Oyster shells that are left over from processing are either dumped in middens near people's houses or in the mangroves. A recent use for discarded oyster shells has been to use them as fill material for making concrete walking paths through the village, and for making small wharves, essentially an extended midden from the foreshore.

Income and expenditure

Most villages in the Rewa River delta are located along the banks of the river, and rely on it as a daily source of food and income. With the fringing reef and open sea nearby, fishing and gleaning are important activities for villagers as well.

Agricultural and plantation production are all important for subsistence and income.

Due to the nature of village life, many households find it difficult to detail their household income or expenditure even for the previous week (Fisk et al. 2017). This observation was the same for Muanaira Villagers, given the short time to conduct the surveys. Households in Muanaira Village with electricity using the Cash Power system stated they utilised between FJD 10 and 20 per week for electricity. The purchase of store-bought food was around FJD 70–100 per week. With the rising cost of food, households are likely to spend a higher percentage of their income on this commodity in the future. There may be additional costs for school children, including fees for specific activities and events. Providing goods, food, labour and support to the church is also very important, especially for special fundraising drives and other activities, which can use up a significant amount of household income.

Saturday is the main market day for Muanaira Villagers, with many making the trip to Nausori, the Bailey Bridge Market, or the main market in Suva. The sale of oysters depends largely on orders from family and friends residing in Suva although one female respondent stated that she sends oysters to relatives in Lautoka on the west coast of Viti Levu.

The sale of oysters was only a primary economic activity for two female respondents (Table 3). The most common sources of income reported were the sale of coconuts, the sale of *sasa* brooms made from the rib of coconut fronds, followed by fruit and vegetables. Two households reported that their husbands' salaries were their main source of income.

Table 3. Type and importance of economic activities for residents of Muanaira Village

Item	Total	Ranking				
		1st	2nd	3rd	4th	5th
Coconuts	16	12	3	1		
Brooms	11	1	7	3		
Fruit and Vegetables	8	3	2	2	1	
Fish	6	2	3	1		
Oysters	5	2	1	1		1
Salaries	2	2				
Baked goods	2		2			
Mud crabs	1	1				
Boat hire	1	1				
Mats	1				1	

The main market area is the Bailey Bridge Market in Suva with only three respondents making the effort to sell at the main market in Suva. All female respondents stated that oysters that had been processed for sale were sold in 2-L ice cream containers earning FJD 50 per container, with two women also selling oysters sealed in plastic bags earning FJD 15 per sale. No respondents used ice to keep the oysters cool while being transported or sold, or waiting to be given to relatives.

In addition, all female respondents who sold oysters stated that they were able to keep up with demand and could expand their sales if new markets were available ($n = 9$). Three respondents suggested targeting hotels, and another four suggested that export markets were possible if there was an opportunity. (Note that some respondents provided multiple responses.) This would require however, an increase in harvesting, or an increase in oyster farming to meet this demand, as well as addressing other issues such as transportation, food safety, and packaging issues.

Costs associated with getting to the various markets is detailed in Table 4. Prices vary for charter trips versus those involved with being a passenger (Table 4). Freight costs are charged in addition to charter fees or passenger fares. Once arriving at a specific place, additional trip costs may include bus or taxi fares (FJD 1.55–16), cost of a market table (FJD 3.60) and lunch (FJD 6).

Oyster-related health risks

Filter feeding shellfish, such as oysters, have the ability to accumulate toxic chemicals and pathogenic organisms in their tissues in concentrations greater than the levels found in the surrounding water, thus often becoming hosts for human pathogenic organisms. For the Laucala Bay area, Morrison et al. (2001, 2006, 2013) and Collen et al. (2011) have noted that contamination of trace metals, and persistent organic pollutants in sediments that were tested were relatively low, although higher concentrations were observed in Suva Harbour. Mercury levels for the native oyster (*S. mordax*) have

also been tested, with results ranging from 0.02 mg/kg to 0.061 mg/kg, and these results are regarded to be below the limits imposed by the World Health Organization (Kumar et al. n.d.; Morrison et al. 2006).

Effluent from pig pens, and the disposal of untreated human sewage into Suva Lagoon pose a constant threat to human health (see Naidu et al. 1991; Naidu and Morrison 1994; Morrison et al. 2006; Lal et al. 2007; Singh et al. 2009; Lata 2010; Collen et al. 2011; Roba 2014). Surveying levels of faecal coliform in the waters where oysters are harvested from, or may be grown out in the future, is important as the consumption of shellfish with high faecal coliform content can result in bacterial and viral diseases such as typhoid and paratyphoid infections caused by salmonella, as well as amoebic dysentery, cholera, shigella, type A hepatitis, and poliomyelitis.

In the late-1980s, faecal coliform was tested in the native oyster (*S. mordax*) taken from various points across the Suva Lagoon, with results ranging from 0.7 to 24,000 faecal coliform/g (Naidu et al. 1991; Morrison et al. 2006, 2013). Additional research from this period to 2005 shows that faecal coliform densities have ranged from 0 to 410,000 colony forming units/100 ml (Morrison et al. 2006, 2013). These results show high variation and further work is needed. Factors that can affect faecal coliform levels include rainfall and tidal conditions, as well as variations in population and size of the oysters collected for testing.

All female respondents that sold oysters stated that they received good consumer feedback from their relatives, friends and other purchasers and that their oysters were considered safe to eat.

Discussion

Exploring alternative pathways for oyster harvesters to reach greater economic independence through oyster farming could help reduce dependence on wild harvesting. At present, oyster harvesting is a supplementary economic activity for the

Table 4. Return costs for charter trips from Muaniara Village using motorised dinghies

From	To	Type	Amount (FJD)
Village	Bailey Bridge Market	Charter	40
Village	Bailey Bridge Market	Passenger	5
Village	Nausori	Charter	40
Village	Nausori	Passenger	5
Village	Nasali	Charter	20–25
Village	Nasali	Passenger	3
		Freight	5

women of Muaniara Village, with most sales being made to order by relatives and friends living in Suva. There is, however, interest by women at Muaniara Village to pursue oyster farming as evident by the attendance and participation with SPC and Fiji's MoF staff during the training on the making of oyster baskets for grow-out. For this to happen, however, there are several issues that need to be further investigated.

The first activity includes obtaining better biological data of oyster distribution and species composition, as well as determining what the actual costs would be to transfer effort from harvesting oysters to oyster farming. Conducting a detailed cost-benefit analysis as well as a market and value-chain analysis would, therefore, assist with determining overall feasibility and commercial viability. This is important as 11 female respondents stated that they would still harvest wild oysters even if oyster farming was successful, and nine female respondents noted that if they had their own vessels to access the oyster harvesting area, then harvesting oysters would be much easier.

Future climate change impacts also need to be considered, particularly with regards to water levels and quality across the Rewa River delta area due to sea level rise, as well as associated impacts from increased storm surges and cyclones. Eight female respondents have already noted that they perceived that mangroves where they harvest oysters were suffering from dieback, while another four thought that floods were affecting oyster populations.

Also, to make oyster farming successful, it would be necessary for someone to take on a strong coordination role to ensure that production was stable and that markets were accessed. Further investigation is required as to how best to achieve this through specific women's groups or a cooperative style approach.

If the production of oysters through farming was successful for Muaniara Villagers, there could also be the potential to trial oyster farming at similar sites throughout Fiji in areas such as Mago Island, Navua and Rakiraki where native oysters (*S. mordax*) are also found and consumed, but rarely taken to market. This could present opportunities for additional technical, economic and social research, and could lead to further development and diversification of the edible oyster industry for Fiji.

Increasing the marketability of oysters in Fiji, especially for supplying Fiji's tourism industry, would require ensuring confidence in consumers that the oysters are safe to eat. Taking into account the high and variable values of faecal coliform reference points noted by Morrison et al. (2006, 2013), the implementation of an epidemiological surveillance programme of both native and introduced oysters would be critical, both at the places they are harvested and at potential farm sites. Once further data are available, the classification of harvesting and potential farm sites according to one

of the three production areas (i.e. A, B or C) – as defined in the 'Codex Alimentarius' for bivalves – can be concluded (ISO 2016). If, after further testing, faecal coliforms values fall within groups B and C, a basic depuration process will be necessary, whereby oysters that are to be marketed are treated in filtered water for 24 to 48 hours before being sold at market.

Overall, there are opportunities to expand livelihood options through oyster farming, but further questions need to be answered. This will require continued collaboration between SPC and Fiji's MoF, and potentially other research partners, such as the University of the South Pacific's School of Marine Studies.

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References

- Bernard H.R. 2017. Research methods in anthropology: Qualitative and quantitative approaches. Sixth edition. Lanham, MD, USA: Rowman and Littlefield. 728 p.
- Cardno. 2013. Study on poverty, gender and ethnicity in key sectors of the Fijian economy. Suva: AusAID Market Development Facility. 89 p.
- Collen J., Atkinson J. and Patterson J. 2011. Trace metal partitioning in a nearshore tropical environment: Geochemistry of carbonate reef flats adjacent to Suva Harbor, Fiji Islands. *Pacific Science* 65(1):95–107.
- Eldredge L. 1994. Perspectives in aquatic exotic species management in the Pacific Islands. Noumea, New Caledonia: South Pacific Commission. 129 p.
- FAO (Food and Agriculture Organization). 2015. United Nations voluntary guidelines on securing sustainable small-scale fisheries in the context of food security and poverty eradication. Rome: Food and Agriculture Organization. 34 p.
- Fiji Bureau of Statistics. 2018. 2017 Population and Housing Census, Release 1: Age, Sex, Geography and Economic Activity. Suva: Fiji Bureau of Statistics.
- Fisk K., Crawford J., Slatter C., Mishra-Vakaoti V., Baledrokadroka S. and Rakenance A. 2017. Exploring multidimensional poverty in Fiji: Findings from a study using the individual deprivation measure. Canberra: Australian Aid.

- ISO (International Standards Organisation). 2016. ISO 16649-3:2015 – Microbiology of the food chain –Horizontal method for the enumeration of beta-glucuronidase-positive *Escherichia coli* -- Part 3: Detection and most probable number technique using 5-bromo-4-chloro-3-indolyl- β -D-glucuronide. Geneva: International Standards Organisation. Available at: <https://www.iso.org/standard/56824.html>
- iTaukei Land Trust Board. no date. Landownership in Fiji. Suva: iTaukei Land Trust Board.
- Kumar M., Aalbersberg B. and Mosley L. no date. Mercury levels in Fijian seafoods and potential health implications. Suva: World Health Organization.
- Lal P., Tabunakawai M. and Singh S. 2007. Economics of rural waste management in the Rewa Province and development of a rural solid waste management policy for Fiji. Apia, Samoa: Secretariat of the Pacific Regional Environment Programme.
- Lata S. 2010. Perceptions of future climate change in a vulnerable community and its implications for future adaptation: A case study of the Rewa Delta, Fiji. Unpublished MSc Thesis, University of the South Pacific, Suva, Fiji.
- Morrison R., Harrison N. and Gangaiya P. 1996. Organochlorines in the estuarine and coastal marine environment of the Fiji Islands. *Environmental Pollution* 93:159–167.
- Morrison R., Narayan S. and Gangaiya P. 2001. Trace element studies in Laucala Bay, Suva, Fiji. *Marine Pollution Bulletin* 42:397–404.
- Morrison R., Gangaiya P., Garimella S., Singh S., Maata M. and Chandra A. 2006. Contamination of Suva Lagoon. p. 146–155. In: Morrison R. and Aalbersberg W. (eds). *At the crossroads: Science and management of Suva Lagoon*. Suva: University of the South Pacific.
- Morrison R., Denton G., Tamata U. and Grignon J. 2013. Anthropogenic biogeochemical impacts on coral reefs in the Pacific Islands: An overview. *Deep Sea Research Part II: Topical Studies in Oceanography* 96:5–12.
- MSG (Melanesian Spearhead Group). 2015. Melanesian Spearhead Group's Roadmap for Inshore Fisheries Management and Sustainable Development: 2015–2024. Port Vila: Melanesian Spearhead Group.
- Naidu S., Aalbersberg W., Brodie G., Fuavao V., Maata M., Naqasima M., Whippy P. and Morrison R. 1991. Water quality studies on selected South Pacific Lagoons. United Nations Environment Programme Regional Seas Reports and Studies, No.: 136. Apia, Samoa: Secretariat of the Pacific Regional Environment Programme.
- Naidu S. and Morrison R. 1994. Contamination of Suva Harbour, Fiji. *Marine Pollution Bulletin* 29: 126–130.
- Pacific Community. 2015. A new song for coastal fisheries – pathways to change: The Noumea strategy. Noumea: Pacific Community. 14 p.
- Ritchie T. 1974. The 1974 status of experimental oyster culture in Fiji. *SPC Fisheries Newsletter* 12:38–42.
- Ritchie T. 1975. Experimental introduction of the Philippine oyster *Crassostrea iredalei* and Philippine green mussel *Mytilus smaraginus* in Fiji. Working Paper 19 presented at the 8th Annual South Pacific Commission Fisheries Meeting, 20–24 October 1975, Noumea, New Caledonia.
- Roba K. 2014. An investigation into trace metal contamination in the closed Lami landfill. Unpublished MSc Thesis, University of the South Pacific, Suva, Fiji.
- Saumaki B. 2007. Bose ni Vanua and democratic politics in Rewa. p. 213–242. In: Fraenkel J. and Firth S. (eds). *From election to coup in Fiji: The 2006 campaign and its aftermath*. Canberra: Australian National University Press. Available at: <http://doi.org/10.22459/FECF.06.2007>
- Scheyvens R. and Russell M. 2012. Tourism and poverty alleviation in Fiji: comparing the impacts of small- and large-scale tourism enterprises. *Journal of Sustainable Tourism* 20(3):417–436.
- Singh S., Aalbersberg W. and Morrison R. 2009. Nutrient pollution in Laucala Bay, Fiji. *Water Air Soil Pollution* 204(1):363–372.
- United Nations. 2015. The 2030 Agenda for Sustainable Development. New York, NY: United Nations.

Annex A

Oyster introductions to Fiji

Type	Year	Type/Quantity	From	To	Comments
<i>Crassostrea echinata</i> (Australian oyster)	1910	Individual oysters	Australia	Mago Island in the Lau Group	
	1981	2280 seed oysters	Tahiti	Laucala Bay near Suva; and Namarai Bay	Project terminated in the same year due to high mortality
<i>Crassostrea gigas</i> (Pacific/Japanese oyster)	1968	Individual oysters	Japan	Unknown	Project terminated in 1969 due to theft
	1969	Seed oysters	Japan	Bay of Islands near Lami	Good growth and survival
	1969	Seed oysters	Japan	Namarai Bay	Harvested
	1970	Seed oysters	Japan	Namarai Bay	High mortality
	1971	5000 seed oysters	USA (California)	Bay of Islands near Lami	Damaged in 1973 cyclone
	1972	200,000 cultchless seed oysters	USA (California)	Unknown	Poor survival
	1973	900,000 culched spat	Japan	Unknown	High mortality in transit
	1973	20,000 spat	Australia	Bay of Islands near Lami	
	1973	1 million cultchless spat	USA (California)	Unknown	
	1974	900,000 culched spat	Japan	Unknown	
	1974	1 million cultchless spat	USA	Rewa River Delta	Heavy predation by mudcrabs (<i>Scylla serrata</i>)
	1975	Unknown	Unknown	Unknown	
	1976	Unknown	Philippines	Unknown	Poor growth
	1977	100,000 cultchless spat	USA	Unknown	100% mortality
<i>Crassostrea iredalei</i> (Philippine oyster)	1975	300 oysters	Philippines	Rewa River Delta	100% mortality due to flood
	1976	Individual oysters	Philippines	Rewa River Delta	22% mortality
<i>Crassostrea virginica</i> (American oyster)	1970	Individual oysters	USA (Hawaii)	Bilo Bay near Suva	
<i>Ostrea edulis</i> (European oyster)	1977	Spat	Japan	Unknown	Introduced by private operation which closed after oysters reached marketable size
<i>Saccostrea commercialis</i> / <i>S. glomerata</i> / <i>Crassostrea commercialis</i> (Sydney/ Australian rock oyster)	1880s	Individual oysters	Australia	Savusavu on Vanua Levu	
	1968	Unknown	Australia	Unknown	
	1970	Unknown	Australia	Bilo Bay near Suva	
	1973	Unknown	USA (California)	Savusavu and Labasa on Vanua Levu; and Taveuni Island	
Unidentified	1973	200,000 cultchless spat	USA (California)	Unknown	

Rugby players, fish boards, Facebook and more as Fiji reimagines conservation campaigns to shift social norms and create durable change

Scott Radway¹ and Margaret Tabunakawai-Vakalalabure²

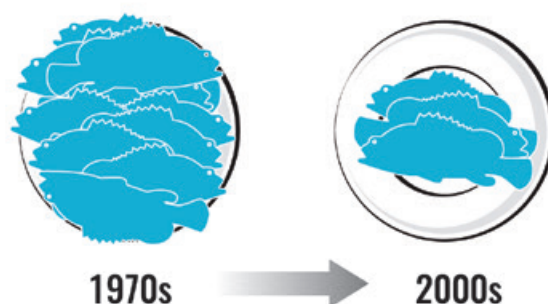
There is a story about a father in a rural Fijian village who is attending church on Sunday. At the end of the service, the church deacon reads the family names of those who have not yet given the church levy. The man, hearing his family name read out in church, immediately heads out to the village tabu area (marine protected area) and starts fishing to earn the money he needs to get his name off that list.

The point of the story, which we share at workshops to develop behavioural change approaches, is that until fishing in the tabu area is more shameful than hearing your name on the church list, we are going to have a hard time advancing sustainable fisheries management solutions.

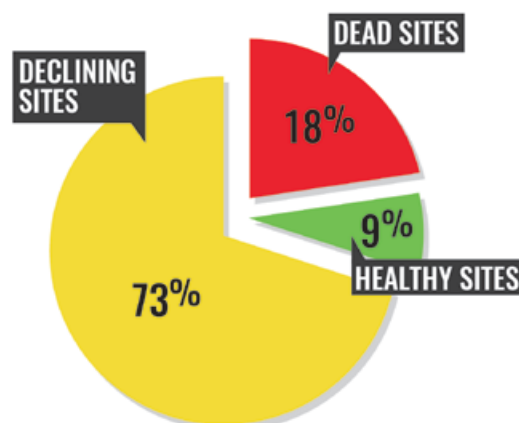
In Fiji, and across the Pacific Islands region, the loss of biodiversity and ecosystem health is increasingly threatening the well-being of rural communities that are heavily reliant on natural resources to meet their basic needs. Despite these vulnerabilities, short-term needs often drive decision-making at the community level as populations and incomes needs increase.

Because of this, cChange³ in collaboration with Fiji's Ministry of Fisheries (MoF) and Locally Managed Marine Area Network (FLMMA), launched an awareness campaign in 2014 with the underlying goal of shifting social norms around fishing. The campaign was specifically designed to reduce fishing pressure on rapidly declining grouper fisheries in Fiji. Commonly known as *kawakawa* and *donu* in Fijian, these A-grade fish support the livelihoods and food needs of communities nationwide and are culturally important to all Fijians.

Fiji saw a 70% decline in the landings of *kawakawa* and *donu* (grouper) over the past 30 years.



Of 22 breeding sites surveyed in 2003:



Two infographics used by the campaign to describe the grouper fishery decline in Fiji. (Images: ©cChange)

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² Coordinator, Fiji Locally Managed Marine Area Network. Email: margievt@gmail.com

³ cChange is an international non-governmental organisation dedicated to improving the lives of Pacific Islanders through strategic communications and behavioural change initiatives. <https://cChange.no/>

**“ I DON'T WANT TO BE REMEMBERED AS THE GENERATION THAT ATE IT ALL.
I WANT TO BE REMEMBERED AS SOMEONE WHO THOUGHT NOT JUST ABOUT
HIMSELF BUT ABOUT OUR FUTURE GENERATIONS. ”**

Waisale Serevi King of 7s

Say **NO** to harvesting, selling,
buying, possessing & exporting
Kawakawa and Donu, June
through September.

IT'S THE LAW.

Let them breed. Eat more later.

SEREVI
Ministry of Fisheries Fiji
SUSTAIN • MANAGE • PROTECT

4FJ
A MOVEMENT TO PROTECT
OUR WAY OF LIFE

www.4fj.org.fj

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Photo Courtesy of SEREVI ©

Inspirational poster with Fiji rugby legend, Waisale Serevi, a champion carrying out a simple message that goes beyond science. (Image: ©cChange)

In workshops and meetings in 2013, cChange worked with MoF and FLMMA partners to use a behavioural approach to address the underlying challenges and barriers to advancing fisheries management in Fiji. This approach targets activation points and incremental change. In simple terms: If you ask someone to do 10 things, they are likely to not do any of them. But if you can motivate someone to do just one thing to improve fishing grounds in Fiji, they will begin to self-identify as someone who takes action for healthier resources and will be more likely to take more actions.

As part of the campaign, we also wanted to create broad public support for improved fisheries management. In the

political realities of Pacific Islands, fisheries management is often less of a priority for communities than calls for roads, educational opportunities, and access to markets and health care. Government agendas typically reflect that reality. If the broad changes (and funding increases) needed for improved fisheries management were to take hold, there would need to be broad public demand for fisheries management in Fiji.

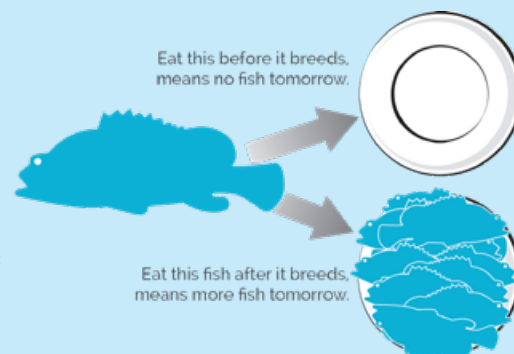
With declining grouper fisheries, we found our activation point. While it was not the most pressing issue in Fiji, it was an issue that was likely to change mindsets and build a foundation for long-term change.

Here were some of our key criteria:

Clear, simple message

To help groupers, we could ask the public to simply let the fish breed. Let them release their eggs, and we would have more fish later. In our market research in Fiji, and from market research from other regions, fish reproductivity often resonated better than other overfishing messages. For example, intuitively, people have a harder time believing that a few local fishers could cause so much damage to a big ocean. But stopping fish from having babies: that message was visceral. And it can be explained in minutes. No workshop needed.

IT'S SIMPLE
MATH



Science boiled down to simplicity. The campaign communicates the problem in simple terms and empowers people to make a difference. (Image: ©cChange)

Simple, relatively low-cost request

Working with MoF researchers and Yvonne Sadovy of the University of Hong Kong, we narrowed the amount of time to forego fishing for groupers to four months. These are the peak months for spawning (June through September) so it had the largest benefit for the least opportunity cost. The public request was for individuals from all walks of life to pledge not to eat, buy or sell these fish during their peak spawning months. In our messaging, we talked about the four months break being a little longer than a traditional fishing tabu (100 days) that is put in place after the death of a chief, a ban that has been practised for generations.

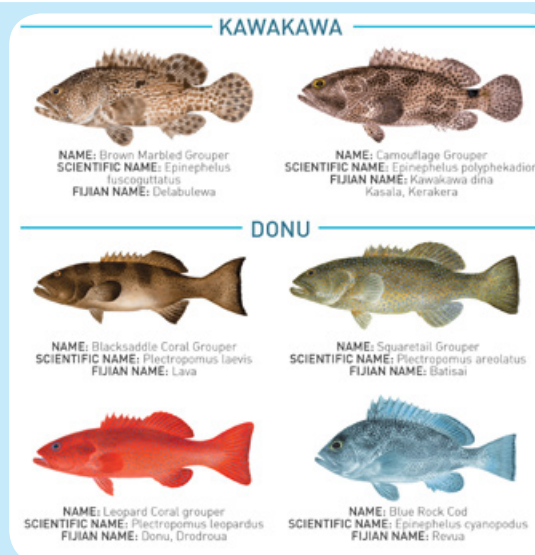


The campaign is asking people from all walks of life to take a simple pledge: 'I will not eat, buy or sell *kawakawa* and *donu* from June through September'. (Images: ©cChange)

Provides an activation point for creating a broad constituency for sustainable fisheries management

Groupers are culturally and economically important species, both to indigenous Fijians (*iTaukei*) and Fijians of Indian descent. A simple personal pledge makes it possible to help save something local people really care about. And, if people could come together to save their favourite fish, they would be more likely to help save other species from overharvesting. And if enough people backed the campaign, it would also elevate fisheries issues to a political level.

The campaign is designed to boost awareness about fish species known locally as *kawakawa* and *donu*, commonly called groupers in English. (Images: ©cChange and SPC)



Role modelling change

In March 2014, in partnership with MoF, we launched the '4FJ, A Movement to Protect Our Way of Life', at the De Vos on the Park, a hotel in downtown Suva. The 4FJ brand was designed as a hip mobile text abbreviation of its inspirational call to take action 'For Fiji'. People were asked specifically to take the 4FJ pledge to forego eating grouper during its peak spawning months.



The 4FJ brand, a short for 'For Fiji'.



As part of the 4FJ campaign strategy, champions were recruited to explain why action was needed. The campaign engaged with traditional chiefs, church leaders, fishers, political leaders, celebrity chefs, sports stars, beauty queens, and the list goes on. (Images: ©cChange)

The next critically important decision the campaign made was recruiting the right messengers to deliver the message. So, at the dais on 4FJ's launch day, there was a spectrum of local leaders, including a traditional chief, a pastor, a fisher, and a celebrity chef.

We recruited champions from all walks of life and all demographics, people who are well known or respected in Fiji. These were individuals who had far more influence over key demographics than any technical expert. And as the campaign rolled out, we shared just enough science to validate the problem and focused instead on why the champions were taking action, why they were going to the pledge for Fiji. We knew overfishing issues mattered, but they were too often lost in technical, abstract discussions. So, with 4FJ, we opened the door for Ratu Filimoni Ralogaivau, a traditional chief, to talk about the obligation each *iTaukei* had to maintain the things (groupers) that were part of their culture and identity.

Epeli Saukuru, a pastor at the Seventh-day Adventist Church in Suva, talked about the need to be a good steward of God's creation. Lisala Waqalala, a long-time fisher from Ra, talked about how groupers helped provide a good diet and pay for schooling.

One of the most prominent campaign champions, Fiji rugby legend, Waisale Serevi, connected the campaign to his village upbringings, where groupers were centrepieces at Sunday meals and community events. Serevi, who was not at the launch, in his press statement talked about two pillars that guided him as he travelled the world with rugby, *i tovo vakavanua* (traditions) and *lotu* (faith), and wanting the next generation to experience the same. These fish were inextricably linked to that upbringing, he said.

Repetition, repetition, repetition

The campaign was rolled out with national media. This meant promoting the champions to print and broadcast media, and appearances on talk back radio, which is more effective in reaching rural areas in Fiji. Repetition was key to our success. People rarely act after hearing a message once. There is typically no 'Aha!' moment in behavioural change. Change takes time as people are already inundated with messages and their own obligations and aspirations. People need to hear a message again and again.

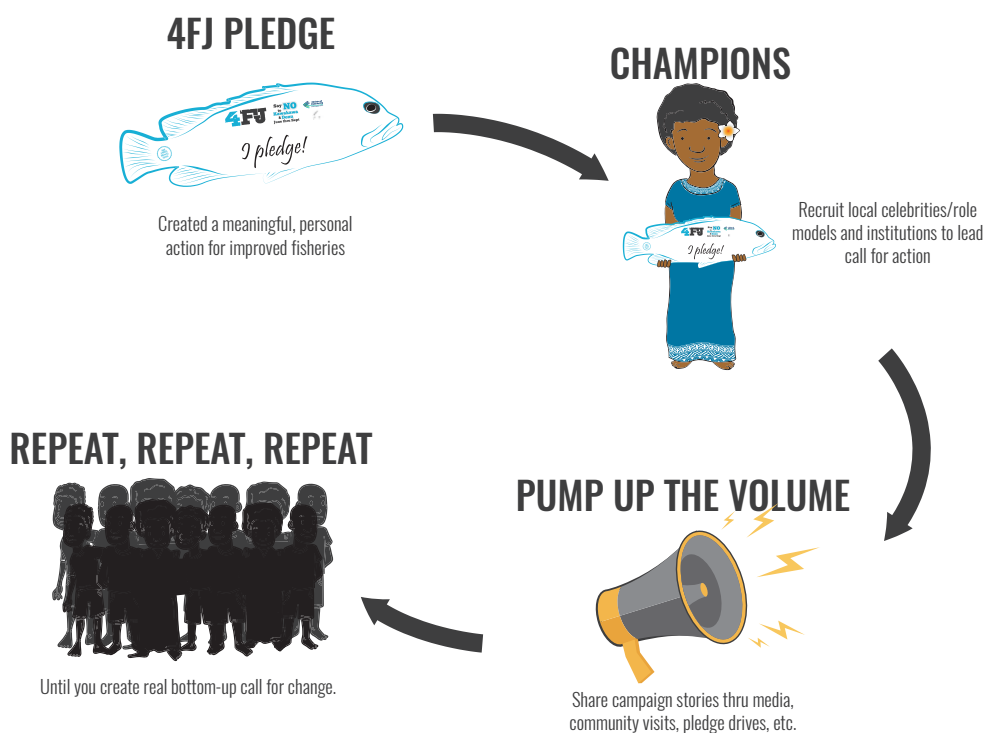
So, new champions were released nearly weekly during the spawning seasons. We also invested time in promoting the champions on social media, with a focus on Facebook, where usership is high and the campaign flourished with minimal resources. For example, on Facebook you can boost a post for as little as USD 5. We boosted a pledge photo for two days of Fiji 7s captain and Olympic gold medallist, Jerry Tuwai, taking the pledge with his family for USD 10. That post reached 70,000 people on Facebook in Fiji, receiving nearly 10,000 'likes'.

In addition, we conducted 4FJ pledge drives at public events, including the series of national festivals that occur during the peak spawning months, such as the Hibiscus Festival in Suva. Individuals visiting our booths, which were supported with volunteers, learned about the issues. People were then asked to write their name on a fish board shaped like a grouper and have their photo taken. Converts took photos individually but also with their friends, family, sports teams or work mates. Then, individuals signed a commitment sheet, which recorded their name, village/town and their pledge. We then posted the thousands and thousands of pledge photos on Facebook to help ensure individuals kept their pledges and spur others to follow. This was arguably the most successful campaign tactic because it allowed people to take meaningful action – right here, right now – to make a difference. Environmental outreach can often leave people overwhelmed and unsure how to make a difference. The 4FJ pledge was empowering.



The picture of Fiji rugby legend Waisale Serevi that was used to create the poster (Image: ©SEREVI)

Finally, we worked with an impressive group of community-based partners to conduct outreach directly to communities and key stakeholders. This was led by MoF, the Ministry of iTaukei Affairs, and FLMMMA partners. For that, we developed a simple outreach toolkit that supported partners to give short talks about the campaign during evening sessions or at lunch breaks. And we conducted presentations for businesses and institutions and worked with MoF in subsequent years to visit fish sellers and exporters in all of Fiji's major towns.



The 4FJ approach includes recruiting champions, engaging media, and seeking pledges. (Image: ©cChange)



Champion fisherman Lisala Waqalala convinced all the *mataqalis* (traditional clans) to get behind the campaign. (Image: ©cChange)

Fiji hears the call

The public and community response was immediate and positive. The simple message of letting the groupers breed, voiced by Fiji role models, resonated.

Here are a few snapshots.

4FJ fisher champion Lisala Waqalala spoke at the launch. Unbeknownst to the campaign, Lisala was so inspired by the event that he went back to his village and shared the 4FJ message. He convinced all the *mataqalis* (traditional clans) to get behind the campaign, and met several times with fishers to also gain their support. His village, Vitaw, became the first village in Fiji to make the 4FJ pledge and establish a traditional ban on fishing *kawakawa* and *donu* during the peak spawning months.

Another memorable story came from the remote island group of Lau, where traditional chiefs had banned the fishing of groupers during the peak spawning months after hearing about the issue on a national radio programme in 2014. Since that date, the chiefs have similarly banned the fishing of mullet fish and goatfish around locally identified key spawning months. The campaign did not learn about the chiefs' actions until 2018.

There were also institutional partners, which were critical to the campaign's growth. For example, the Methodist Church of Fiji and Rotuma was an early institutional champion. The largest religious institution in Fiji found the campaign a strong platform to meaningfully share its message of environmental stewardship.

Large businesses, such as Morris Hedstrom and Newworld IGA, both of which operate national supermarket chains, pledged to forego fish sales revenue to support the campaign. The tourism sector, led by the Fiji Hotel and Tourism Association, similarly got behind the campaign and passed a resolution to share it with members nationally. Inspired by the outpouring of support, Jacks of Fiji partnered with the campaign to print and sell 4FJ t-shirts in all its stores, at its cost, with a small portion of the proceeds coming back to the campaign.

The campaign also spread virally. In the first part of the campaign, for example, two Hibiscus Festival queen contests incorporated grouper images into their sarongs for a competition, without any coordination with the campaign. We found out with the rest of the viewers as they sauntered across the stage. It was also captured in part on Facebook where people shamed friends if they posted pictures of eating grouper during the peak spawning months.

By the third year of the campaign, pledge drives had garnered more than 15,000 in public pledges (today it is 25,000).

*25,000 have already pledged to not eat,
buy or sell kawakawa or donu (grouper) June through September.
Let them breed. Eat more later.*

cChange conducted a public opinion survey in the Suva-Nausori corridor in 2017 to gauge support for the ban and the impact of the campaign. The surveyors interviewed 252 adults at locations in Suva, Nausori, Nasinu and Lami. The sample size was based on population figures from the Fiji census.

The survey highlights included:



- 93% of those surveyed supported a proposed Fiji government four-month seasonal ban on *kawakawa* and *donu*.
- 71–76% of those surveyed believed *kawakawa/donu* species were overfished.
- Two-thirds thought *kawakawa* and *donu* were less available today in the markets, and were smaller and more expensive than they were a few years ago.
- 90% of the people who were aware of campaign, were more supportive of fishing rules and regulations; and
- 86% of the people who were aware of the campaign also wanted to know more about what they could do about overfishing.

Bottom-up change

From the onset of the campaign, supporters asked why the government could not simply ban fishing of groupers during the peak months, instead of asking for voluntary pledges. But top-down regulation rarely works because compliance is a key factor to success. The campaign target was to engage individuals and communities to understand the need for management measures and let a ban be driven by public support instead. Three seasons in the campaign, we were inundated with complaints when people saw egg-filled groupers on sale in markets.

In June 2017, buoyed by three years of the 4FJ campaign, the Government of Fiji submitted a voluntary commitment at the United Nations Ocean Conference 7, to ban the fishing, sale and export of all grouper species in Fiji from June to September, the following year. Then, in June 2018, a national four-month ban was implemented through a Public Notice from MoF.

As part of the implementation, MoF worked with cChange to develop new tools to raise awareness and compliance, namely a grouper ban factsheet, a ban poster listing all 27 types of groupers, a PowerPoint presentation and a 24-minute documentary that aired nationally. The factsheet was translated into iTaukei, Hindi and Chinese, and new champions, such as the Chinese Business Association of Fiji partnered with cChange to distribute materials through their networks. FLMMA partners also took the information materials out to communities.

Demonstrating the incremental change, new partnerships emerged through for compliance and enforcement. With public support high, we approached Fiji's town councils (who oversee and permit vendors at all formal markets), the Fiji Police Department and Customs, and the Fiji Revenue and Customs Service to collaborate on the ban's implementation. All were onboard. Led by MoF, three compliance and enforcement trainings were held, and these new partners actively conducted outreach activities to fish sellers and middlemen and communities, and assisted later with enforcement. This meant market masters visiting all vendors in their markets, and inspiring reports of community police officers taking pledge boards into villages. This was an unprecedented collaboration between these key government bodies and is expected to provide an important platform for MoF enforcement efforts in the future.



The grouper ban factsheet was one of the information tools used during the campaign (Images: ©cChange)

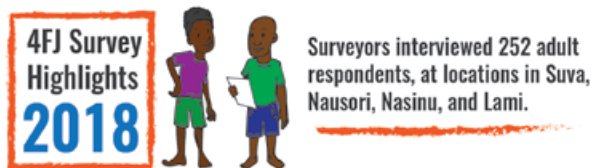


Poster listing the 27 banned grouper species. (Images: ©cChange and SPC)

Key informant interviews after the first year of the ban reported that the sale of groupers during the ban was limited, and was visibly absent from formal markets after June. The sale of groupers was mostly found in informal markets, such as roadside vendors, with a small number of vendors in formal markets selling it, typically hidden in coolers. In the second year, initial reports from MoF were that compliance was higher. In the first year of the legal ban, MoF confiscated fish and is now moving to levy fines in 2019, given the ample awareness that has been conducted. The only vocal opposition to the ban has come from mid- to large-scale commercial fishermen. These are individuals and entities that depend on volumes of fish, which aggregation sites reliably provide. Public support, however, has remained high.

In 2018, to further assess the ban's implementation and impacts, cChange conducted surveys at fish markets across Viti Levu. Surveyors interviewed 204 adults, 109 vendors, 90 consumers and 5 market masters at locations in Suva, Nasinu, Lautoka, Nadi and Ba. (Funding was not available for surveys on Vanua Levu.)

Some highlights were:



- 93–96% of consumers and vendors were aware of the seasonal ban and the majority supported it.
- Most consumers said the fish have not been in the market since June.
- Vendors reported few instances of being approached to buy or sell groupers after June, and 63% of vendors said there was no impact on total fish sales, with people buying as much fish but trying out new species.
- MoF received high marks for its outreach and enforcement actions, with over 75% of vendors and consumers saying the agency was doing a good job.

Foundation is set

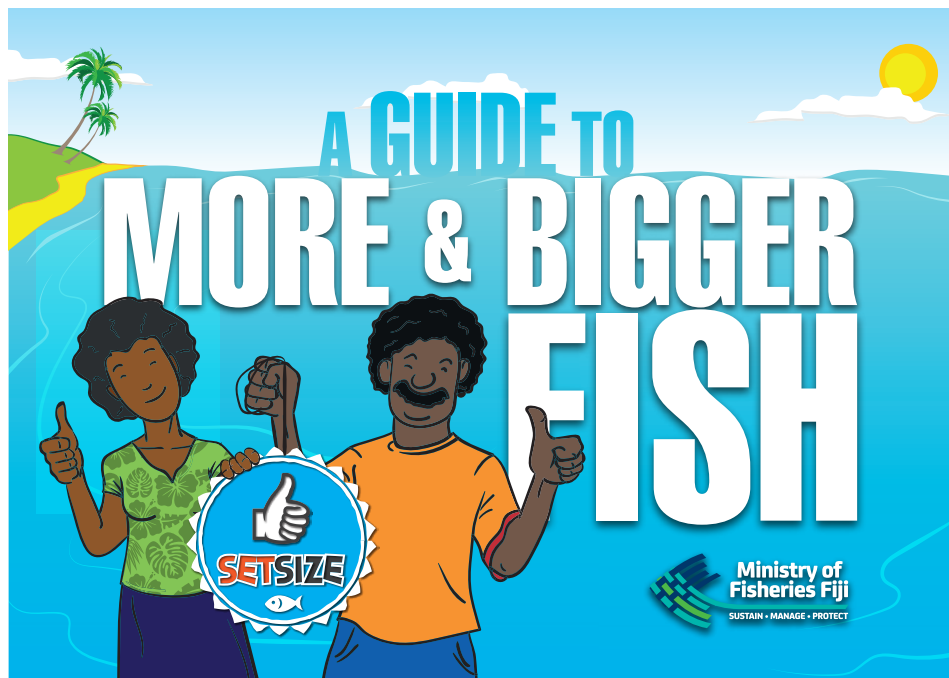
The 4FJ campaign was designed as an activation point for improved fisheries management in Fiji, and the campaign has successfully created both support for grouper fisheries management and a constituency that can support further actions. With MoF seeking to build its capacity to enforce fishing regulations, the ban's effectiveness is also growing.

Building on the 4FJ success, the next phase of the campaign is already underway, as new research into minimum sizes and spawning potential ratios has opened the door for the next incremental change in fisheries management for MoF.⁴

Called 'Set Size', the next phase of the campaign will work to discourage the capture of undersize fish. The core message remains simple and focused: 'We helped make sure groupers could breed, now let's help the rest of the fish.'

Funding permitting, the campaign will follow the 4FJ approach, including recruiting champions, engaging media, and seeking pledges to avoid capturing undersize fish at events nationwide. Site-based partners are also preparing to roll out Set Size in communities. The campaign is targeted to run for the next two years to ensure a wide public dialogue as Fiji moves to establish updated national minimum sizes, which will have more dramatic impacts on fishing than the four-month seasonal grouper ban. In addition, some fisheries might not provide fish large enough to meet the new minimum sizes set, given historic fishing levels. In addition, complying with the new sizes will again require considerable shifts in people's behaviours towards fishing as Fiji does not have a strong history in the catch-and-release

⁴ See the article 'Spawning potential surveys reveal an urgent need for effective management' in issue #158 of this newsletter: <http://purl.org/spc/digilib/doc/y6mf4>



The Set Size flipbook. (Image: ©cChange)

of undersize fish. Social norms will again be a critical component of success.

To address these issues, cChange has started creating video vignettes of fishers talking about sliding baseline and serial depletion, but in personal stories about the changes they have seen in their fishing grounds, with fish they use to catch but do not anymore, and the increased distance and time it takes them today to catch smaller and smaller fish. While research is critical, fisher testimonials are often more powerful in focusing local discussions. We are also piloting tools that portray fish at actual sizes to more effectively communicate the issue of undersize fish. For example, we have designed a banner that displays the most common food fish in Fiji at actual size, which can hang in a community and fish market. And we developed community-friendly tools, such as an illustrated A4 booklet on the drivers of overfishing, the impacts of overfishing, and the need for fish to reach Set Size, where enough fish are reproducing to ensure good stocks year after year.

Of note, the Set Size campaign also presents new opportunities for simple fisheries assessment tools for communities to check the health of their species of concern and take a host of local management actions beyond sizes, such as gear restrictions, protecting nursery grounds, limiting fishing effort, and establishing marine protected areas. With a simple traffic light system, communities can potentially assess their species of concern by measuring the sizes to determine the number of undersize in their catch and use that as a platform to discuss management options, if necessary. With science advisor support, including that of Dr Jeremy Prince of Biospherics, this is expected to be piloted in communities in upcoming months in collaboration with FLMMA.

Finally, the next phase of the campaign will be a key opportunity to engage with commercial fishers through forums, to ensure a broader dialogue with those most impacted by new regulations. MoF is also working to advance fisher forums that present the ministry's vision for supporting fishers to improve their livelihoods and to create safe space to discuss challenges with current and future regulations.

Beyond 4FJ

The question arises as to why there are not more campaigns like 4FJ. One of the biggest challenges to creating such campaigns is the scarcity of funding for outside-the-box initiatives to tackle changing mindsets. Most funding delegates communication as a support service for sharing science and project results, and does not allocate resources to support behavioural change approaches that meaningfully motivate action. In the case of 4FJ, with the David and Lucile Packard Foundation and the John D. and Catherine T. MacArthur Foundation, cChange was able to secure thoughtful and sustained support to use behavioural change approaches for improving food security and livelihoods of coastal communities.

Of note, another key challenge cChange has experienced in other countries and territories is forming the kind of broader partnerships that made 4FJ successful. It is often difficult to form such collaborations as there are many competing initiatives and objectives in most countries and territories and most often limited resources. Because, while this article is focused on pulling the curtain back on the 4FJ social marketing strategy, it is important to acknowledge that the campaign is a product of sound strategy but also its part-

nerships, starting with strong leadership at MoF, which is the public face of the campaign, and the Ministry of iTaukei Affairs and FLMMA partners. In countries with sprawling rural areas, networks matter.

That said, it is a worthy effort, whether it is a full-flown campaign or a small programme that simply takes a step back to rethink how it is engaging with stakeholders. Focusing on behavioural change forces programmes and projects to focus intensely on key stakeholders, what they care about, their aspirations and their challenges, and helps to create meaningful opportunities for them to create their bottom-up change.

In Fiji today, during peak grouper spawning, it is unlikely if someone hears their family name read at church on Sunday, they will be headed to a spawning aggregation site. And that is a very good start.

Acknowledgements

The 4FJ campaign, developed by cChange in support of Fiji's MoF, would not have been possible without the active and efficient collaboration of MoF, the Ministry of iTaukei Affairs through its Conservation Unit, and the partners of the Fiji Locally-Managed Marine Area Network, which includes large international non-governmental organisations, as well as national organisations and community-based organisations and advocates. The authors would also like to thank Dr Yvonne Sadovy of the University of Hong Kong and the Science for Conservation of Fish Aggregations organisation, who has served as a science advisor to the 4FJ campaign, and Dr Jeremy Prince, of Biospherics, who was the science advisor for the development of the Set Size outreach tools.



The Methodist Church of Fiji was an early institutional champion for the 4FJ campaign. (Image: ©cChange)

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