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In this issue

Editorial

The beaming smile of Jacob Sam Hioau, from Solomon Islands, preparing a grouper for lunch speaks volumes; having such a nice-sized reef fish to share is a rare privilege.

In the highlands of Monsavu, in the centre of Viti Levu, Fiji, the people of Rewasau have almost no access to reef fish because of the remoteness and inaccessibility of their village. However, an industrious group of women have set up small tilapia farms, and they use the fish not only to put food on village tables, but also to pay for services, because, as Tim Pickering explains, '... fish is a much sought-after source of protein for people in the highlands' (page 2).

The declining reef resources in the Pacific Island region are under threat from a number of sources, including from illegal fishers travelling all the way from Southeast Asia on so-called 'blue boats', which have been found operating in domestic waters of Palau, Federated States of Micronesia, Papua New Guinea and, recently, as far south as Australia and New Caledonia. Francisco Blaha describes the conundrum for countries in the region (p. 21): 'For countries where the poaching takes place, there is a huge drain on local finances when these boats are caught, and a huge drain on the locals' livelihoods when they are not.'

This issue describes a number of efforts across the Pacific Islands region to ensure that Pacific people maintain their access to healthy and plentiful marine resources, and to continue to bring smiles – like Jacob's – to the faces of many more Pacific people.

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Jacob Sam Hioau preparing a grouper for lunch in Rara, Solomon Islands (image: J. van der Ploeg, WorldFish).

Prepared by the Pacific Community, Division of Fisheries, Aquaculture and Marine Ecosystems, Information Section

Taking the fish to the mountains: Tilapia fish farming and the women of Rewasau Village, Monasavu, Fiji

Tilapia fish reared in Rewasau ponds are being posed here for the camera (image: Tim Pickering).

For women in Rewasau Village in the highlands of Monasavu, life is busy and it's tough. Their days are constantly filled with patient negotiation, learning and lots of hard work. Rewasau is in the interior of Viti Levu in the Fiji Islands. The village itself is quite inaccessible as the roads are steep and buses are unable to stop at the village itself. Like many other villages across Fiji, the people of Rewasau are resilient. They work hard and despite accessibility issues, are able to get their produce to Tavua market to sell.

In 2014, when the Fiji Ministry of Fisheries staff at Naduruloulou Research Station (NRS) started conducting fish farming workshops in Naitasiri to introduce villagers to farming of tilapia fish, a group of women in Rewasau saw this as an opportunity to earn a supplementary income for their families. When their first crop of tilapia was harvested, they realised this new found investment could also be used as a source of payment for services, because fish is a much sought after source of protein for people in the highlands. 'When I did my first harvest, the youth in the village helped to dig another pond and I gave them fish to eat as payment,' said Mere Sinu Kula, a farmer in Rewasau.

Many of the tilapia farmers engage in this activity together with their husbands. They admit that although decisions regarding the tilapia farm are jointly made, many of the big decisions have been made by the women as a group. 'When we did the first harvest, most of our fish was shared. We gave it as our tithe to the church and we shared it with other families. We said we would use the second harvest to sell, but when it was time to harvest again, Tropical Cyclone Winston hit our area, so we used most of our fish as payment for rebuilding our homes. All the women agreed that we would feed the youth as payment for building our church and our village hall. So we used our tilapia for that.' said Sylvia Nabola, one of several tilapia farmers in the village.

Even though Rewasau is at the foot of the largest dam in Fiji, water is still a problem for half of the village. Piped water is only available for one part of the village and many of the tilapia farms are on the other side of the village. The farmers have used traditional knowledge of water resources by building bamboo water pipes and identifying natural springs in the ground to fill their ponds. 'These women know where the natural springs are and how to

use their resources and where to place their ponds, but the problem is, they have a lot of livestock around the village. Many times the livestock damage the bamboo pipes so they always have to repair it,' highlighted Farm Development Officer at NRS, Ms Makalesi Rauto.

The women highlighted that accessing resources in the village was not a problem – whether it was water, land, livestock or the only four vehicles in the village. They acknowledged that control of these resources was not theirs, nor that of their spouses. Water and land is controlled by the *mataqali* so all decisions are made communally. However, for the livestock, the women said decisions on when to sell or eat their livestock was usually made with their spouses or other family members.

The four vehicles belong to other members of the village. The women say that every day a vehicle goes to Tavua town or makes a drop-off to the nearest bus stop. Accessing this transport often involves planning – who needs to go where, what time and who has money to contribute to the fuel. According to the women, they are good at coordinating this, as they often speak to each other and therefore know the needs of other families in the village – whether it is fish feed, or to sell yaqona or take someone to the health centre.

None of the women of Rewasau village know how to drive. When asked if they would like to learn, they smiled shyly and then excitedly. 'The men will just say, what's our business in learning to drive, how can we drive the trucks?' said one of the women. 'Maybe one day.' they all agreed.

These are experiences about tilapia farming related by women of Rewasau Village during one of several Gender in Aquaculture case study visits currently being conducted in Fiji. This is being done jointly by the gender team within SPC's Social Development Programme (SDP), the Aquaculture Section of the Fisheries Aquaculture and Marine Ecosystems (FAME) Division, the Fiji Ministry of Fisheries, and the Women in Fisheries Network – Fiji (WiFN-F). Rewasau was one of several tilapia farm sites visited in December 2016 in efforts to understand gender issues in aquaculture in Fiji.

Left: Fresh tilapia fish are a welcome addition to the mainly vegetable diet of people living in the mountainous interior of Fiji (image: Tim Pickering).

Right: Rewasau women carry sacks of tilapia feed up the hill. Fish harvested from their ponds were used to make payment for repairs to village homes and community hall (in background) damaged by Tropical Cyclone Winston (image: Tim Pickering).

Pacific island aquaculture is for the first time being formally assessed from a gender perspective, as part of work for the Community Aquaculture project administered by SPC with support from the Australian Centre for International Agricultural Research ACIAR. One of this project's goals is to ascertain the impacts that community aquaculture can have on household income, nutrition, and the status of women and children in Fiji, Samoa, Vanuatu and Kiribati. These results can be used to verify the ways that benefit flows of food to households and communities from small-scale fish farming, and identify possible entry points, policies or activities to further strengthen and improve this food production sector in the Pacific.

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Most of the fish ponds have been constructed close to village homes, which makes daily care easier (image: Tim Pickering).

The tuna pelagic ecosystem: The exciting inside story!
Setting up an ecosystem monitoring system

A great many things are hidden within the immensity of the Pacific Ocean and as scientists are, by their very nature, curious beings, we try to discover what lies under its surface. This is an enormous task, so one must choose their priorities well. Élodie Vourey and Valérie Allain from the Fisheries and Ecosystem Monitoring and Analysis Section of the Pacific Community (SPC) Oceanic Fisheries Programme have been focussing their energy on trying to understand one of the vital elements for explaining tuna abundance and movements; i.e. the micronekton that the fish eat.

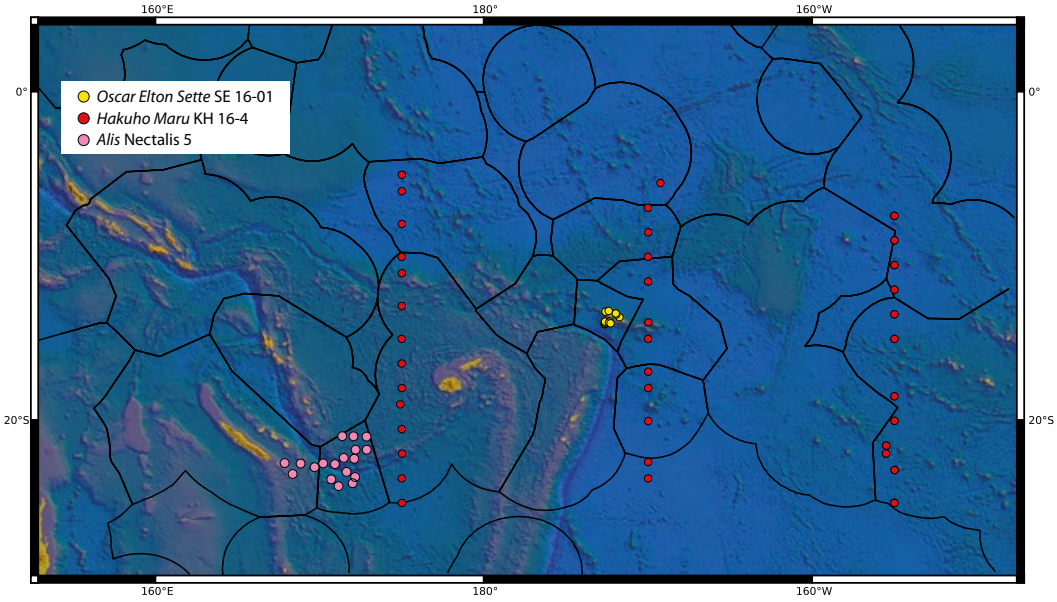

Figure 1.
Micronekton sampling zones in 2016 on board the research vessels *Oscar Elton Sette*, *Hakuho Maru* and *Alis*.

Part of Valérie and Élodie's work consists of examining the contents of tuna stomachs to find out what they eat. Another important part is determining where tuna food sources are concentrated, how abundant they are and which micronekton species are available. That involves nothing less than setting up a micronekton monitoring system in order to understand how the ecosystem operates, how it changes in response to climate conditions and what impact such changes may have on tuna stock abundance and movements: Find the food source and you'll find its predator!

A few scenarios may help better understand the important role that micronekton play in the pelagic ecosystem that tuna depend on.

- If the abundance of micronekton were to drop sharply due to climate change, this would mean less food for tuna. That could bring about a decrease in their growth and reproduction rates, or it could make them move to zones with more abundant food sources. In both cases, there would be a direct impact on yields or fishing strategies. So it is important to know the quantities of micronekton available, their spatial distribution and how they are changing.
- If the composition of micronekton species changes – for example, where certain small fish species are replaced with gelatinous organisms whose populations are exploding due to climate change – this will result in lower quality food for tuna, since gelatinous organisms are less nourishing. In this case, even if the quantity of micronekton remained the same, the change in its composition could have a negative impact on tuna growth and reproduction, and result in the tuna moving to more favourable zones. Therefore, it is not only important to monitor changes in micronekton quantities but also in its quality.

Monitoring micronekton species composition can be done in part by examining the contents of tuna stomachs. However, to determine micronekton's spatial distribution, the only current way is to go out into the field and check.

Phytoplankton can be partially monitored by satellite, but that is not yet the case with bigger organisms such as zooplankton and micronekton. For the latter two groups, models have been developed to estimate their abundance and distribution – such as the SEAPODYM model (Lehodey et al. 2015) – but field data to validate those models are very sparse.

Surveys at sea have to be carried out to observe the micronekton's vertical and spatial distribution, and to estimate its abundance and take samples to describe the micronekton species composition. A great deal of work was done in this area in 2016 since the Fisheries and Ecosystem Monitoring and Analysis Section team took part in three surveys at sea in New Caledonia, Samoa and in a large portion of the South Pacific (Fig. 1). This work was carried out in collaboration with other agencies that made their oceanographic research vessels available.

In March and April 2016, Valérie Allain took part in the first micronekton monitoring campaign of the year; i.e. 10 days in the waters of Samoa aboard the research vessel *Oscar Elton Sette*, an American ship that is approximately 70 m and belongs to the NOAA (National Oceanic and Atmospheric Administration). This was a multi-faceted mission and some teams worked during the day catching deep-water snapper and parrotfish, while a small team worked at night collecting micronekton using two different kinds of pelagic trawl; i.e. the Cobb and IKMT (Isaacs-Kidd Mid-water Trawl). A total of 12 hauls were carried out, collecting a large variety of fish, shrimp, squid and gelatinous organisms from the deep-sea (maximum depth: 587 m) to the surface. The Cobb trawl, with a cod-end mesh size of 1 mm and an opening of about 140 m^2, made it possible to catch bigger organisms than the IKMT, which has a cod-end mesh size of 0.5 mm and an opening of about 2.8 m^2. The catches were sorted into major taxonomic groups on board with the help of colleagues from the Samoa Fisheries Division.

Then in August and September 2016, there was a survey in the South Pacific on board the research vessel *Hakuho Maru*, a 100 m Japanese ship that belongs to JAMSTEC (Japan Agency for Marine-Earth Science and Technology). This mission was carried out in collaboration with the University of Tokyo, focussed on identifying the larvae of eel-like fish (e.g. common eel, conger eel, moray eel), leptocephalus, and their spatial distribution in the zone (Pickering 2016). In order to catch such larvae, which are part of the micronekton, an IKMT pelagic trawl (cod-end mesh size of 0.5 mm and an opening of about 8.7 m^2) was used, and while our French and Japanese colleagues were only interested in the leptocephalus, the SPC-IRD (French National Research Institute for Sustainable Development) team had access to all the other micronekton organisms. This was a very intense mission for the team, which included Patrick Houssard, an IRD PhD student, during the second part of the voyage; i.e. from Noumea to Pago Pago (4–17 August 2016), and Élodie Vourey from SPC for the third part of the campaign between Pago Pago and Tahiti (20 August–12 September 2016). In all, specimens were recovered from 48 IKMT hauls from a depth of 200 m to the surface.

In the R.V. *Oscar Elton Sette* lab, Valérie Allain (SPC) and Louise Giuseffi (NOAA) sort the micronekton organisms from a night haul off Samoa (image: NOAA).

Some specimens require careful handling, such as this 20-cm long *Chauliodus* sp., which can tilt its head to allow the ingestion of large prey (image: Valérie Allain).

Aboard R.V. *Alis*, Élodie Vourey (SPC) takes a sample from the liquid in which the micronekton bathes, in order to carry out DNA analyses (image: Valérie Allain).

In November and December 2016, Valérie and Élodie worked on board the oceanographic research vessel *Alis*, a 28 m French ship that belongs to IRD, for two weeks in the waters south-east of New Caledonia. This research trip, known as the Nectalis 5,[1] was the fifth in New

[1] http://www.spc.int/oceanfish/ofpsection/ema/biological-research/nectalis/447-nectalis-5-journal-a-logbook

Trawl nets used to collect micronekton (image: Élodie Vourey).

Gear used to collect and analyse seawater's physical and chemical characteristics, from 0–1000 m depths (image: Élodie Vourey).

Caledonia's series of voyages that began in 2011, designed to explore the open ocean. This very comprehensive campaign made it possible to collect data on the ocean's physical characteristics (currents, temperature), chemistry (nitrates, phosphates), and the phytoplankton, zooplankton and micronekton. Some 18 stations were sampled and a total of 32 hauls for micronekton (cod-end mesh size of 10 mm and an opening of about 100 m^2) were carried out between 564 m and the surface. The *Alis* is equipped with an echo sounder (SIMRAD EK60) that allowed the team to collect acoustic profiles of micronekton between the surface and a depth of 600 m throughout the voyage. This instrument provided a good overview of micronekton spatial distribution.

Therefore, a large number of samples were collected in 2016 and many months will now be needed to identify all the specimens currently stored in SPC's freezers. New campaigns are planned over the coming years, particularly in March 2017 in New Caledonia on board the *Alis*, once again in collaboration with IRD and possibly in March 2018 in Wallis and Futuna. SPC has also begun discussions with the KIOST (Korea Institute of Ocean Science and Technology) on carrying out a North Pacific campaign in the Palau and the Federated States of Micronesia area in late 2017 on board their new oceanographic research vessel, the *Isabu*.

[2] http://www.spc.int/oceanfish/ofpsection/ema/biopelagos

After laboratory analysis to identify the specimens collected and acoustic data processing, the goal of this work is to be able to provide countries with maps showing micronekton biomass distribution and micronekton biodiversity. Those data would then allow countries to identify areas that should be protected because, for example, they harbour a wide diversity of organisms or a high density of tuna prey and thereby are likely to be preferred feeding zones. By using this type of information, decision-makers can take fully informed management and conservation measures. That is the ultimate goal of the BIOPELAGOS[2] project (funded by the European Union's BEST 2.0 programme), which is designed to provide support to New Caledonia and Wallis and Futuna in managing the biodiversity of their oceanic pelagic ecosystems. Collecting such information in various zones of the Pacific, but also in the same zone repeatedly, will also make it possible to conduct in-depth analyses and gain a better understanding of the impact that environmental factors and climate change have on ecosystem organisation.

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Kiribati – Fish smarter, fish safer, fish better

In Kiribati, most urban fishers have evolved from using traditional canoes to using outboard powered open boats to pursue oceanic pelagic species. These fishers troll running schools, pursue flying fish or carry out midwater fishing using methods such as Kabara *(midwater chum fishing) and* Karaiti *(spreader rod fishing). In any case, their operations are confined to day trips or several hours of night fishing. An increase in operational costs over the last few years has made it difficult for many small-scale commercial fishers to return with a payload. Uncharacteristically bad weather, at times when good weather should be the norm, has created down-times that also reduced fishers' income.*

Fully equipped open boat ready for an overnight fishing trip.

To deal with their predicament, the fishers have had to fish smarter and plan their fishing trips better but their opportunities have still remained limited to the outcome of day trips and short night trips, mainly because of the type of fishing vessels they use. Previously, these fishers did roadside or 'house-to-house' sales to derive an income. Since the establishment of Kiribati Fish Limited (KFL) in Tarawa, fishers have the option of selling quality fish to KFL, which will then loin it and export it overseas. However, to produce quality fish they need ice and bait, which are additional expenses that put another strain on the returns from day trips. To address this issue and reduce their operational costs, fishers have realised that they have to be able to stay out in their fishing grounds for longer periods of times, until the catch makes the whole fishing trip financially worthwhile.

In August 2014, the Pacific Community (SPC) – with funding from New Zealand Ministry of Foreign Affairs and Trade (MFAT) and technical support from KFL – ran a training programme on fish aggregating devices (FADs)/midwater fishing methods to teach local fishers how to catch and provide quality tuna for export. Nine local fishers, two Fisheries Division staff members and two Maritime Training College (MTC) fisheries staff members were trained. Open boats were used for the practical fishing, which included vertical longline fishing, midwater handlining, trolling and drift-line fishing. At the end of the training programme, it was confirmed that these boats were not suitable for extended fishing trips. There just wasn't enough working space for a team of three, the fishing gear, ice, bait and a fish storage bin; fish couldn't be processed appropriately, and all aspects of small craft safety were greatly compromised. Furthermore, spending consecutive days at sea requires that the crew can find shelter for periods of rest, which was impossible on these open boats.

In light of this, these fishers had to make the most of any opportunities that came their way. Most of them resumed their day operations doing trolling, midwater handlining for tuna, and fishing for flying fish. The impasse here was

KFL's 11.9 m tuna longliner on dry land, undergoing repairs.

FAO-designed 10.5 m boat built in Fiji for KFL.

KIR 26 design fishing vessel, a 10.5 m trimaran.

the lack of suitable and affordable fishing vessels, available locally, that could be used for extended fishing trips. Their situation was to operate open boats or become part of the crew of the tuna longliners that supported KFL's operations; there was no 'in-between' solution for them.

Since 2013, the concept of producing a suitable fishing vessel to fill the gap was pursued. KFL first launched an 11.9 m tuna longline fishing catamaran – a KIR 24 design, built at Abatao boatyard, Tarawa. While this vessel sufficed as a small-scale tuna longliner to supplement KFL's operations, its price and the advanced boating skills it required made it out of range for open boat fishers.

KFL then brought in a smaller 10.5 m mono-hull boat from Fiji. This boat was an FAO design that had been introduced to the Pacific Islands region in the 1980s and early 1990s.

The KIR 26 trimaran

In April 2016, a new 10.5 m trimaran was launched at Abatao boatyard. The boat, a KIR 26, had been designed by Oyvind Gulbransen and the construction overseen by the boatyard owner, Michael Savins. The boat building was commissioned and funded by the New Zealand Aid Programme as part of their initiatives to improve the lives of the people of Kiribati. The plan was to run this vessel over a trial period to establish its economic viability and suitability as an offshore vessel for small-scale fishers. The Kiribati Ministry of Fisheries and Marine Resources Development (MFMRD) were designated owners of the vessel with provision that the vessel would be operated by KFL under commercial practices. There was also a provision that the Kiribati Maritime Training Centre's Fisheries Division would have access to the vessel to train their students provided their training schedule was produced in good time to allow KFL to align this with their programme for the vessel.

SPC's Nearshore Fisheries Development Section provided assistance to trial out the vessel on its maiden trip and made recommendations for its inception to commercial offshore fishing.

This vessel can comfortably accommodate four persons and has a spacious working deck. It is expected that with an expert crew it will only require three persons to operate. It was equipped with a radar, GPS, VHF radio, SSB radio, and a fixed steering compass. The vessel was also outfitted with the appropriate safety equipment standard for vessels engaged in offshore activities. These included an Emergency Position Indicating Radio Beacon (EPIRB), appropriate lifejackets for crew members (plus spares), a six-person liferaft, a standard flare required for small crafts, an SPC-recommended safety grab bag, and a standard first aid kit for small crafts.

The vessel was issued a Seagoing Certificate by the Kiribati Marine Department after passing their mandatory ship survey for coastal vessels.



Top left: Metal handreel to facilitate trolling and midwater fishing.Top right: A chum bait canister hanging beside the handreel ready for use. Bottom left: Kuralon rope as mainline. Bottom right: Spray system installed for dangler fishing.

Before the trials began the vessel was equipped to carry out the following fishing methods.

- Horizontal longline fishing using 4 mm Kuralon rope as mainline and a rope hauler to haul the line in. The mainline was stored in the outrigger hulls.
- Vertical longline fishing.
- Dangler fishing for tuna.
- Trolling for pelagic fish.
- Midwater scatter bait (chum/*kabwara*) fishing.
- Midwater spreader rod jigging (*karaiti*).
- Hang-net fishing for small pelagic species.
- Squid jigging.
- Deep bottom fishing (not recommended for the export market because of the fragility of fish stocks; but the three handreels installed on the vessel for midwater fishing and trolling can also be used for deep bottom fishing).

Outcome of the maiden trial

After the first sea trial, it was confirmed that the vessel could fish in reasonably rough seas and would excel in slight to moderate seas. If it was to be caught out in bad weather, it could abort the trip and return safely to base or head for a sheltered area without any cause for panic. Overall, the boat could adequately perform the tasks required of it and revealed itself as a good fishing vessel for its size. It has a 1.5 tonne hold capacity, but subsequent fishing trips should give an indication of the ideal hold capacity when targeting high quality fish.

Longline system

The hand-hauled rope longline system was installed to limit costs and free up deck space. The system worked

reasonably well but there was still room for improvement to speed up the operation and reduce the workload. The immediate adjustment would be to coil the mainline in bags then stow the bags in the storage hold. This would free up one crew member who could attend to handling and processing the catch.

A small hydraulic reel would greatly facilitate line hauling, but this would increase the overall cost of the boat and occupy desk space. However, a potential boat owner has the option to choose the system they prefer, as the KIR 26 design has sufficient space to install a small hydraulic longline reel.

Is there a chance to succeed with this type of vessel?

The debate over the optimum vessel size for commercial tuna longlining is not new in the Pacific region.[1] However, the financial means and operational context of the prospective vessel user should be a prime consideration before providing capital or technical support to domestic tuna longliner development. From SPC's perspective, large commercial fishing companies that normally have backing to support them financially would preferably require government and donor support in the form of trade initiatives and legal concessions. Individual small-scale fishers, on the other hand, lack the financial power to invest in large and expensive vessels – but should they be condemned to remain in the situation they are in with the inability to engage in safe, extended offshore fishing due to an inadequate although affordable vessel design?

The New Zealand-funded Kiribati Sustainable Coastal Fisheries Project (KSCFP) is providing a unique opportunity to test a new longline vessel design that allows operators to stay for two to three days at sea to chase tuna that is further offshore than those that they can currently access by using their trolling skiff. The KIR 26 trimaran mini-longliner that was commissioned by SPC under the KSCFP project is now being run commercially through a partnership between MFMRD, KFL and SPC. The catch and effort and financial data of the resulting fishing operation will be analysed later in 2017 together with similar data from KFL's other small (FAO mono-hull design) and medium-size (KIR 24 design) longliners. It is hoped that sufficient data will be available for an economic analysis that will aim at identifying the best vessel option for the I-Kiribati open-boat fishers who are willing to progress, engage in commercial longlining and make use of KFL's marketing opportunities.

Operating a small tuna longliner on extended fishing trips is hard work. Experienced fishers could be enticed to pursue the trade if they got good returns from their fishing effort, but first they need a proper boat to fish from and a good market to supply fish to. The concept is simple, yet it seems to be a difficult undertaking to implement and sustain development at this level.

Will the small-scale commercial fishers in Kiribati ever be given the opportunity to fish smarter, fish safer, and fish better from cabined boats? The Kiribati Sustainable Coastal Fisheries Project will hopefully provide an answer.

All images in this article by William Sokimi

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[1] See, for example: http://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/FishNews/79/FishNews79_22_Beverly.pdf

Marine conservation agreements as innovative financial mechanisms for biodiversity conservation and sustainable fisheries in the Pacific: The Vatu-i-Ra Conservation Park in Fiji

An innovative financial mechanism is being supported by the Pacific Community's RESCCUE (Restoration of ecosystem services and adaptation to climate change) project to promote marine conservation and coastal fisheries management in one of the Pacific's great wild places, the Vatu-i-Ra Seascape.

The Vatu-i-Ra Island

The Vatu-i-Ra Island lies at the heart of the Vatu-i-Ra seascape in Fiji (see map on next page), and encompasses an extraordinary 27,000 km^2 of forests, mangroves, seagrass meadows, reefs, deep channels and seamounts. The island is located in between Vanua Levu and Viti Levu, about 15 km off the coast of the Ra Province. The Vatu-i-Ra seascape is home to the largest population of nesting hawksbills in Fiji as well as green and loggerhead turtles. It is one of the few remaining sanctuaries for the highly prized but globally endangered humphead wrasse and bumphead parrotfish.

Local people marvel at frequent sightings of resident pilot whales and dolphins as well as humpback whales passing through on their annual migrations. Strong currents run through the deep Vatu-i-Ra channel, which nourishes a magnificent diversity of more than 300 coral and 1000 fish species. These, in turn, sustain breeding colonies of seabirds.

The seascape attracts approximately 36,000 tourists per year, and is a world class diving destination. In addition, subsistence and commercial inshore fish catches in the entire Vatu-i-Ra Seascape are estimated at approximately 5360 tonnes per year. The annual value of tourism and fisheries in the seascape is estimated at FJD 72 million (USD 35 million).

The Vatu-i-Ra Island is listed as a Site of National Significance in the Fiji National Biodiversity Strategy and Action Plan (NBSAP), and is one of the 28 internationally important areas for birds as recognised by BirdLife International for Fiji. The surrounding waters of the island support a diversity of marine life, and are a play-ground for a range of recreational uses including snorkelling, diving and game fishing.

The *qoliqoli*, or traditional fishing grounds surrounding Vatu-i-Ra Island, is shared by all 28 villages in the Nakorotubu District. Traditionally, fishers from all the villages along the coast have long stopped on Vatu-i-Ra Island and opportunistically harvested both seabird eggs and chicks, and fished on adjacent coral reefs.

Today the Vatu-i-Ra Island ecosystems are subject to various threats, the main ones being invasive species, a lack of control of visitors, and overfishing including poaching from outsiders. Protecting these ecosystems is critical in order to maintain the benefits they provide to local communities, fishers and tourists.

The RESCCUE project

The RESCCUE project is implemented by the Pacific Community and funded by the French Development Agency and the French Global Environment facility over a five-year period (2014–2018). The overall goal of RESCCUE is to contribute to increasing the resilience of Pacific Island countries and territories in the context of global changes, resorting especially to economic analysis and innovative funding mechanisms. RESCCUE operates on seven pilot sites in Fiji, French Polynesia, New Caledonia and Vanuatu. In Fiji, it operates in the Ra and Kadavu Provinces and is executed by a consortium led by the Institute of Applied Sciences from the University of the South Pacific, with Conservation International, the Fiji Environmental Law Association, Landcare Research and the Wildlife Conservation Society (WCS).

The Vatu-i-Ra Conservation Park

To preserve this unique natural heritage, and associated local communities' culture and way of life, WCS has been working with communities from the district of Nakorotubu, the Ra Provincial office, key tourism operators, customary owners of the Vatu-i-Ra Island, and local NGOs since 2015 to create a conservation park and develop an associated management plan. The proposed boundaries of the conservation park surround the Vatu-i-Ra Island (see map on next page). The main habitats within the proposed conservation park are fringing coral reefs, lagoons, pinnacles, and shallow and deep terraces. The Vatu-i-Ra Conservation Park aims to support long-term sustainable development in Nakorotubu by maintaining the health and productivity of the district's ecosystems. One of the park's conservation objectives is the creation of a permanent no-take area for fishing.

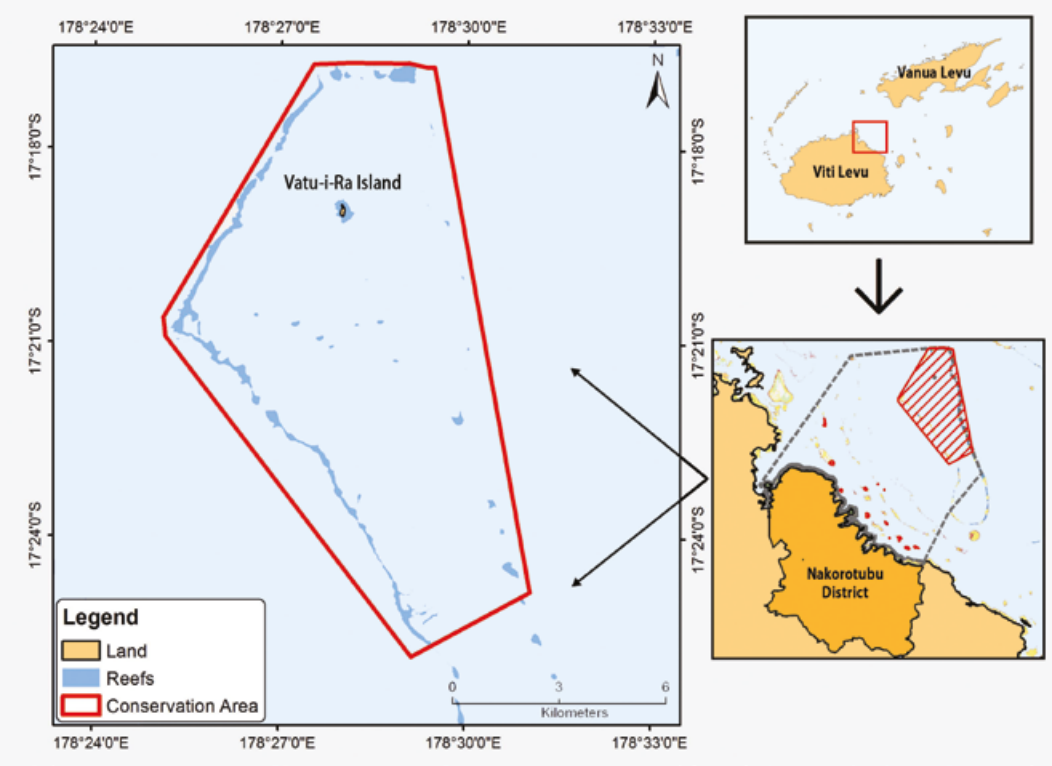
Stakeholders endorsed the management plan at one of the district meetings in October 2016. A key issue to deal with, however, is how to financially support the long-term management of the park and generate income for communities to compensate for potential losses of income due to the no-take area.

Setting up a Marine Conservation Agreement

One of the key RESCCUE project objectives in Fiji is to set up innovative economic and financial mechanisms such as Marine Conservation Agreements (MCAs) to ensure sustainability of integrated coastal management in the Ra and Kadavu Provinces. MCAs can be defined as *'any formal or informal contractual arrangement that aims to achieve ocean or coastal conservation goals in which one or more parties (usually right-holders) voluntarily commit to taking certain actions, refraining from certain actions, or transferring certain rights and responsibilities in exchange for one or more other parties (usually conservation-oriented entities) voluntarily committing to deliver explicit (direct or indirect) economic incentives'* (The Nature Conservancy, www.mcatools.org).

To support the implementation of the Vatu-i-Ra Conservation Park management plan, a partnership between local communities in the district of Nakorotubu, the Nagilogilo Resource Management Committee (NRMC) and local dive operators has been facilitated by WCS to establish a voluntary contribution to the conservation scheme. Dive operators visiting the conservation park will pay a voluntary contribution to an administrative body that is established to manage and disburse funds in return for agreed conservation objectives, including the permanent no-take area for fishing.

Once the conservation park and administrative body are established, further consultations with stakeholders will determine and finalise what the donations can be used for and how to allocate the donations between the communities that have access rights to the traditional fishing grounds. In return for this contribution, the villagers will not fish in the no-take area. This reduced fishing pressure is expected to preserve healthy fish stocks, thus maintaining the dive experience for tourists and providing recruitment fish stocks for adjacent areas for the benefit of local fishers. In addition, this will provide biodiversity outcomes (through improved fish numbers and potential species diversity), which will directly contribute to the Fijian Government's NBSAP implementation as well as international commitments fulfilment (e.g. Aichi Target 11)[1].



Proposed boundaries of the Vatu-i-Ra Conservation Park (source: the Wildlife Conservation Society).

[1] Adopted in 2010 under the framework of the Convention on Biological Diversity's Strategic Plan for 2011–2020, Target 11 provides that 'by 2020, at least 17 per cent of terrestrial and inland water areas and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascape'.

Community representatives, tourism operators and WCS – with guidance from the Fiji Environmental Law Association (FELA) – have now developed a governance structure and mechanism for the management of the conservation park and oversight of the voluntary contribution to conservation scheme. A Trust Deed is being drawn up, which will initially be overseen by a representative from the community, the tourism operators and WCS. A monitoring and evaluation framework has been developed for the conservation park, and baseline ecological and socioeconomic surveys have been completed.

It is expected that the fund, managed in an open and transparent way, will contribute to the conservation of this highly diverse area, protect the cultural and historical values that are important to local communities, while supporting education and community development that improves the quality of life and living standards of resource owners and communities in the Nakorotubu district. Given the level of engagement with communities around the use of this kind of mechanism, it is one of the most promising options for protecting marine areas while also providing a revenue stream for communities.

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From top to bottom:
Vatu-i-Ra Island;
Red-footed booby;
Reefs and dive operations surrounding the Vatu-i-Ra Island.
(Images: ©Stacy Jupiter/WCS, Lill Haugen).

The Marshall Island Marine Resource Authority (MIMRA) reaps the benefits of its equal employment opportunity practices

MIMRA is responsible for coastal and oceanic fisheries management in the Marshall Islands. It employs 85 staff members, 19 (22 per cent) of which are women. Women head both the Coastal and Community Affairs Division (Florence Edwards) and the Oceanic Fisheries Division (Berry Muller) and are therefore 40 per cent of the MIMRA executive team of five members.

Women predominate in the Coastal and Community Affairs Division. They undertake the full range of jobs. Lyla Lemari is a coastal fisheries research officer and enjoys diving as part of her work in monitoring coastal fish populations. The division also undertakes socio-economic surveys, and includes handcraft makers as they use marine resources. Florence Edwards noted that, in communities, women do not always recognise their own contribution. In their household surveys, women often refer to the man to answer the questions. Men do not always recognise the contribution of their wives. As an example, one husband who was interviewed said that he earned most of the household income through his fishing activities. The team then interviewed the wife who was earning more money than her husband from her handcraft activities.

The Oceanic Division first employed a woman as a licencing officer in the early 2000s. The first female MIMRA observer was employed in 2011 and now four of the 68 observers that are employed are women. Since June 2015, eight female observers achieved PIRFO[1] certification in the Pacific Islands region; one in the Marshall Islands, three in Kiribati, three in the Solomon Islands and one in Vanuatu. There are now over 750 observers in the region, where women probably only make up about two per cent of these positions.

Working on fishing vessels and with observers is not always easy for women; however, Eunice Borero, the MIMRA Electronic Reporting Officer, is tasked with the implementation of new Electronic Reporting (ER) tools used for collecting fisheries data on tuna fishing vessels. This includes observers using handheld tablets to file their daily reports, which are transmitted to MIMRA via satellite. This new system not only gets information to MIMRA on a timely basis, but it also helps with data accuracy through automated calculations and validation processes. The tablets have an SOS feature that can be used by observers when their safety is threatened.

Fishing vessels are now also using tablet applications to submit their catch log-sheets to MIMRA. In Papua New Guinea, the National Fisheries Authority provided the impetus for the implementation of electronic reporting tools (for both observers and vessels). Fisheries data collection systems are thereby evolving in the region. Nine Pacific Island countries and territories are currently at various stages of implementing new electronic reporting tools for observers and vessels, from design to full implementation.

Eunice provides training and coordination for fisheries observers and fishing vessel captains using these new tools. She also manages staff and is getting involved in the trials of Electronic Monitoring Systems (EMSs). EMSs are video camera and GPS systems placed on-board fishing vessels for collecting information on their activities. This information is later analysed by office observers when the vessels return to port.

Over the last two years, Eunice has attended and delivered key regional training and workshop sessions held in New Caledonia, the Federated States of Micronesia, Australia, Fiji and in the Republic of the Marshall Islands (RMI). She has built strong industry contacts and possesses a good understanding of national and regional fisheries data collection standards and how ER and EMSs can be tools for meeting these standards.

She is Filipino, and moved to RMI at the age of 19, as her mother lives in Majuro. She had finished two years of IT studies at a postgraduate level and worked in other RMI Government agencies as an administrator and trainer before starting at MIMRA. When her current position was advertised, she thought it was a 'boy's' job and that she would never get hired – but MIMRA offered it to her as she was the best suited candidate.

At the start, she found the job hard. Most people working in fisheries management have come up through this sector as observers, debriefers and trainers. Due to their regulatory responsibilities, engaging with vessel captains can be difficult for all fisheries staff. Eunice has sometimes faced prejudice or downright dismissal when on board some vessels. For example, once a captain asked her 'if she had even been to school'.

She has also experienced some observers being averse to the idea of receiving training from a younger person and a woman. So in her training sessions, Eunice begins

[1] PIRFO: The Pacific Islands Regional Fisheries Observer programme has provided training and certification to almost 600 observers since 2007.

Eunice Borero (front right) training fisheries observers at MIMRA in Majuro on the use of a tablet-based application for collecting data (image: Malo Hosken).

by emphasising the importance of professionalism and cooperation. Eunice learns from observers about the fishing operations, as much as observers learn from her about ER and EMS developments. The common objective is for MIMRA to implement these new tools, which are not 'plug in and play' ready.

Eunice commented on the importance of the support she has had from both the Pacific Community (SPC) and MIMRA. MIMRA is a proud 'equal employment opportunities employer' and has a policy manual with guidelines to make sure they get the best qualified person for every job.

For the observers employed by MIMRA, a key supportive factor is that the observer coordinator, Bernard Fiubala, takes a lot of care when selecting the vessels on which women are placed on. Women fisheries observers always have a cabin to themselves and are only placed on ships where there is an understanding captain. Bernard's own background as an observer allows him to effectively place observers on fishing vessels.

Employment opportunities in fisheries are growing; there are a lot of women working across various fisheries sectors in the region – e.g. at a recent regional meeting on Fisheries Trade Policy there were nine men and 13 women. At the tuna processing plant in Majuro, there are more women than men – employment varies depending on season – up to 300. EMSs could also present opportunities for women working as office observers.

MIMRA is increasing the number of fisheries observers to 100; thereby, encouraging and supporting women as well as men to work in MIMRA is essential.

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Logging the biodiversity and significance of sharks and rays in the Pacific

Sharks and rays are important to Pacific peoples. They are caught in coastal fisheries and in some places are used as meat and even for products made from their skin. For many more coastal fishers, shark fins are valuable products that provide important cash income. For the industrial tuna fisheries, sharks are important parts of fishery operations, either in terms of supplementary income as byproducts, or in the need to manage bycatch. Sharks and rays are also important as living resources to dive tourism, such as the famous bull shark dive at Shark Reef in Fiji, stingrays and sharks in Bora Bora and Moorea in French Polynesia, Palau's famous shark dives, or shark diving at Osprey Reef in the Coral Sea. And sharks also have value that goes beyond money or food. For some Pacific peoples, sharks are important parts of their culture and identity, and may have spiritual qualities.

However, scientific knowledge about sharks in the Pacific is still quite limited. While research has been done on some species (mainly species that interact with tuna fisheries), we know very little about most of the other sharks and rays in our Pacific waters. For example, then University of Papua New Guinea (UPNG) has a specimen of *Gogolia filewoodi*, the Gogol River shark, in its fish collection. There are only two known specimens of this species in the world, and everything we know about the species comes from those two specimens. More recently, scientists have found that *Neotrygon kuhlii* (Müller and Henle, 1841), the commonly seen banded maskray is actually a complex of *four* different species with three new species being described (Last et al. 2016). In November 2014, sharks thought to have been 'lost' from Papua New Guinea were rediscovered by researchers surveying catches in a village (White et al. 2015). Of course, the fishers knew these sharks, but with so few surveys being done, they had been unrecorded. Then in 2015, a National Geographic expedition found sharks swimming in the hot acidic waters of the Kavachi underwater volcano (Phillips et al. 2016). Later in 2015, we received a photograph of a sawfish rostrum taken in the Solomon Islands in the 1960s. After checking with experts, this photo extended this species' range to the Solomon Islands. The more we look, the more we find.

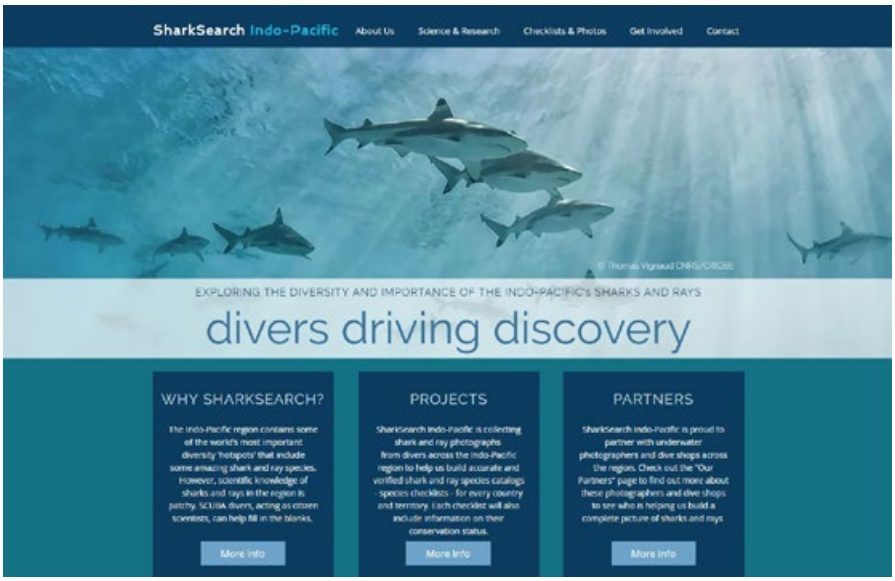
Gogolia filewoodi paratype specimen at UPNG (image: Andrew Chin).

A new project on sharks and rays in the Pacific

It is in this spirit of this discovery that a new project will be launched in March 2017. Shark Search Indo-Pacific (SSIP) is an independent project that aims to provide an accurate and scientifically verified checklist of the shark and ray diversity of every country and territory in the Western and Central Pacific by 2022. Each checklist will contain the up-to-date species names, data sources for each country, conservation information such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Convention on the Conservation of Migratory Species of Wild Animals (CMS) and the Western and Central Pacific Fisheries Commission (WCPFC) conservation information, as well as the IUCN Red List category. The checklist will also include basic life history information for each species, and an assessment of relative productivity. Each checklist will be accompanied by a brief synthesis report of the status and pressures on sharks and rays in each country.

While the checklists will be compiled through a desktop study, **Citizen Scientists** – underwater photographers and fishers from across the Pacific – are also being encouraged to get involved. Divers are being asked to check the Shark Search Indo-Pacific website (www.sharksearch-indopacific.org) to see if they have photos of sharks and rays that have not been listed for a specific country (there is a separate page for every country and territory in the Pacific). If a diver has photos of species that aren't already listed, they should send them to the project team. These photos are essential for verifying the presence of species in a country or location, especially for sharks and rays that don't turn up in fisheries catch records. Maybe one day these photos could be used to produce a field guide to the sharks and rays of the Pacific.

Once each checklist is completed and verified, the checklist and the synthesis report is placed on the SSIP website so that it is freely accessible to anyone who needs this information. For checklists and synthesis reports that are published as scientific papers, these will be classed as open access to make sure people can freely download the information.



The SharkSearch Indo-Pacific website hompage (www.sharksearch-indopacific.org).

The SSIP checklist process

It is crucial that each checklist is scientifically accurate and robust, so a lot of attention is paid to quality checking each product. Each checklist project begins by gathering together a group of In-country Partners who will help make sure that the checklist contains the best information, and helps to inform people and agencies that may need the information about the checklist project. The In-country Partners would also help to review the draft checklist and synthesis to ensure they are correct. The checklist process also involves taxonomic experts who make sure that species are identified correctly and that taxonomic information is up-to-date. The taxonomists also check international museum databases to see if any sharks and rays have been collected from that country in previous years. This is a big job and most of the research is done by graduate students who use the checklist projects as a part of their Master's degree. Each student is assigned a specific country and, under supervision, will be responsible for putting the checklist together. In this way, a very big task is divided among many hands, and the students get experience in carrying out applied literature research and learn about Pacific fisheries and conservation and management tools such as WCPFC Conservation Management Measures, CITES and CMS.

The first checklist – Solomon Islands – has been completed and has been submitted as a scientific paper. The SSIP team hopes that this will be the first of many more checklists for the Pacific.

Looking forward

SSIP is starting off as a small, voluntary, student driven project. However, the long-term vision is that SSIP will provide the basic information that countries need to document their shark and ray resources, in order to meet reporting obligations under the Convention on Biological Diversity, or to help develop National Plans of Action under the FAO guidelines. Each checklist and synthesis will also provide a snapshot of the main trends and issues affecting shark and ray resources, and provide a starting point that the project team and In-country Partners can use to plan future projects. SSIP focuses on collaboration and by working together, the project hopes to, piece-by-piece, build a more complete picture of the diversity, significance and status of sharks and rays across the Pacific.

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2016: Sharks in a post-truth world

Shelley Clarke[1]

Year's end is always a time for retrospection, and particularly in a year as eventful as 2016. So this holiday season, while gathered in front of the hearth, my thoughts inevitably turned to what happened last year in politics and the politics of shark conservation – and why. Would the bitter wind currently causing the fire to flicker and pop blow harmlessly over, or would it sweep away all but the most firmly anchored objects in its path?

Caveat Carcharhinus: a vulnerable oceanic whitetip shark (*Cacharhinus longimanus*) peers suspiciously ahead (image: Jean-Marie Reverdel, Flickr).

For those of you who might have missed it, the Oxford Dictionary named 'post-truth' as word-of-the-year for 2016. Although the term was coined long ago, Brexit and the US presidential election are given credit for the spike in its usage of around 2000% last year.[2] Given the two countries' referendum results, whether it's just a phrase or a phenomenon, post-truth situations in which 'objective facts are less influential in shaping public opinion than appeals to emotion and personal belief' are likely to be with us for a while.

Does this sound familiar? As I mulled over the 2016 milestones in sharks – with the benefit of a glass of mulled holiday cheer and some retrospective news programmes – I took little comfort from the parallel trends. But firstly, here are some confessions from me. I have to admit that I still cling to the rather old-fashioned view that science is supposed to be about truth, or at least the best we can discern it given uncertainty. I also believe that science-based shark management and conservation policy is critical while acknowledging, often painfully, that science is but one of many elements of national and international decision-making. Finally, I need to disclose that I've never understood how public policy is supposed to apply the 'precautionary principle'. What is considered precautionary varies wildly between stakeholders, and while the term is often mentioned in decision-making, it is rarely defined or explained. So, if you'll pardon the expression, when does it trump science?

Of course, for the most economically valuable fish stocks we are making progress in defining and eventually quantifying what the margins of precaution should be through reference points and harvest control rules, but these tools

[1] Technical Coordinator - Sharks and Bycatch ABNJ (Common Oceans) Tuna Project Western and Central Pacific Fisheries Commission

[2] https://www.theguardian.com/books/2016/nov/15/post-truth-named-word-of-the-year-by-oxford-dictionaries

are likely years away for sharks. As a result, we find ourselves in a post-truth zone where we have more shark data than ever before but we seem to be relying on it less and less to shape policy. Instead, shark policy, like other current international issues, is being shaped by the following synergistic post-truth forces:

✓ **Too much noise, not enough signal**. I get it. Even as someone focused on shark issues, there is a continuous and often overwhelming surge of information that makes it challenging to interpret the latest developments. No wonder then that the general public finds it difficult to know whether sharks are really 'going extinct' or whether such reports are distortions constructed from biased or incomplete data reviews. I'm sure I'm in the same boat when asked about global warming: how many papers have I actually read and analysed on the subject? How then do I form an opinion? As in politics, the temptation to just adopt the assertions of those with a similar world view is strong.

✓ **Not everything you need to know fits into 140 characters**. Society today has a short attention span and an unquenched desire to be entertained. Although people want to know whether or not sharks are in dire straits, in most cases they want a 'yes' or 'no' answer, not 'it depends'. The reality is, though, that it does depend on things like the species' life history, its population structure, the behaviour of the fishery, the strength of the regulatory scheme… oops, I've exceeded the Twitter limit already! I understand that scientists need to inform people concisely and without boring them, but I also hope that we can be met halfway. I was scolded in a meeting last year for using my inability to understand something as a reason for not agreeing with it. But it turned out no one but the author understood it either. So, a plea to both sides. To the audience: sometimes the situation *is* complex and will require more than a minute to explain; and to the presenter: be patient, it is your job to inform, not to baffle.

✓ **Expertise is so passé**. Back in the old days, facts used to be the domain of professional societies and forums. Now, according to the New York Times '*the experts and agencies involved in producing facts have multiplied, and many are now for hire. If you really want to find an expert willing to endorse a fact, and have sufficient money or political clout behind you, you probably can*'.[3] I'm not arguing for a return to an elitist past – as a relatively newly-minted female fisheries scientist I've undoubtedly benefitted from the changing of the old guard – but in this era of PR machines wouldn't it be nice if the analysis drove the message rather than the other way around? Or is it true that, as the Brexit campaigner Michael Gove claimed, people 'have had enough of experts'[4] such that it's not a question of which expert analysis to believe, but rather whether any expert analysis is necessary at all?

✓ **If you're not with us, you're against us.** With more and more people seeking information that reinforces their existing views, there is a growing tendency to distrust anyone who disagrees. No one, not even those I deify, holds a monopoly on the truth, which is why, especially in science, open debate must be protected and encouraged. But with the transition to campaign (read: media)-driven shark conservation initiatives, questioning the veracity of the details can be taken as subversion. As the line between science and advocacy blurs, and as scientific advice continues to take a back seat to politics in fisheries management discussions, the value of sticking to the facts is an open question for some. But scientists are the fact-checkers of the shark conservation world, and fact-checking is, thanks to the US election, more popular than ever.[5]

This last point led me to wonder, as the ice began to clink in my glass and I watched the cat get an early start on dismantling the Christmas tree, whether the value of fact-checking amounts to anything more than entertainment. After all, given that the revelations about liberties taken with the facts during the US presidential campaign didn't seem to affect the outcome, do the journalists who broke those stories feel that their work didn't matter? David Fahrenthold of the *Washington Post* who fact-checked some of the biggest stories of the campaign was asked just that recently. He answered: 'It *did* matter. I did my job. The voters did theirs. Now my job goes on… and now I know how to do it.' I think I'll take that as my toast to 2016 and resolution for the new year ahead![6]

[3] http://www.nytimes.com/2016/08/24/opinion/campaign-stops/the-age-of-post-truth-politics.html?_r=0
[4] https://www.ft.com/content/3be49734-29cb-11e6-83e4-abc22d5d108c
[5] https://www.americanpressinstitute.org/fact-checking-project/finally-fact-checking-is-the-new-black/
[6] The views expressed in this article are those of the author and are not necessarily shared by the Western and Central Pacific Fisheries Commission.

Illegal fishing in the central and South Pacific[1]

Francisco Blaha[2]

There has been a lot of information in the news on the so-called 'blue boats' entering domestic waters, since they have been found in Palau, Federated States of Micronesia, Papua New Guinea and as far south as Australia and New Caledonia. Blue boats have been spotted, arrested and rerouted towards Noumea by the French Navy already twice in early 2017. It is true that most of these boats come from Vietnam, but this is only part of the story.

A typical 'blue boat' filled with plastic drums used to store salted marine products (image: French Armed Forces in New Caledonia).

Most of the boats apprehended have Vietnamese citizens on board and many come from Vietnamese ports, but Mr Vu Duyen Hai, the head of the Vietnamese delegation to the Western and Central Pacific Fisheries Commission, doubts Vietnam's responsibility.

'Some other countries have informed us that Vietnamese boats also come to other countries like Palau or Micronesia to poach but Vietnam is not so sure that these are Vietnamese vessels.'[3]

He accepted that some fishing vessels stray outside Vietnam's 200-mile exclusive economic zone (EEZ), but he said this is because they 'follow the fish' and most do not have equipment to find out if they have mistakenly entered into other countries' EEZs.

He also said that the Vietnamese government has tried to address the issue, checking local fishing vessels but 'sometimes, fishing vessels go out, switch off their communication equipment and authorities cannot locate them. This has become a problem and now they are also against this and it has very heavy penalties including removal of licenses for ever.'[3]

And that is perhaps the most telling issue: such fishers clearly leave Vietnam on very long fishing trips, intending to fish illegally, and the risk of losing a fishing licence appears not to deter them.

They make it all the way to other countries in the knowledge that even if coming back may not be an option, it remains good business.

The Federated States of Micronesia authorities assessed that the price of purchasing one of the small boats, which can accommodate 10 to 13 crew members, is about 300 million Vietnamese Dong (approximately USD 12,000). The small

[1] Adapted from Francisco Blaha's blog : http://www.franciscoblaha.info/blog/

[2] Independent Fisheries Consultant, franciscoblaha@mac.com

[3] Source : https://www.facebook.com/groups/VanuatuNews.vu/permalink/1226168907477229/

boats carry 25,000 litres of fuel when they leave the port in Vietnam. They return to port when the fuel gets down to around 10,000–15,000 litres of fuel.

The large 'blue boats', which can carry 16 to 17 crew members, cost around 600 million Dong (approximately USD 24,000). These bigger boats carry approximately 35,000 litres of fuel and return to port when the fuel gets down to 15,000 litres.

The price for diesel fuel in Vietnam has only changed negligibly in the last few months. On 5 September 2016, the price per litre was USD 0.50. At that price, it costs about USD 12,500 to fuel an extended journey on one of the bigger boats. The journeys are intended to last two to three months, and the crew bring enough food for themselves for that period of time.

The other obvious option is to assume that there must be a logistic arrangement between these boats and a fleet of carriers, where these carriers pick up the catch and provide fuel, which allows the boats to stay at sea for such extended periods and reach destinations as far as New Caledonia. If the boats have a fleet of carriers accompanying the foray, radios and GPSs are required on every boat.

In any case, the vessels are very basic, so their cost is not a disincentive if they are seized. Add to this the massive over-capacity in fishing fleet size and subsidies that the Vietnamese government provides for building boats,[4] and the present scenario of substantial illegal migratory fishing is not surprising.

The previous and ongoing Vietnamese fisheries subsidies policies on fuel and vessel renewal, upgrading, infrastructure, etc., offset the loss of a boat if it is captured.

Open fisheries access – which is in a form of lack of management – has led to overfishing and fleet over-capacity. Over-exploited resources and over-capacity, in turn, lead to boats that are ready to head off to further and more productive shores, even if fishing there is illegal.

Official figures put the Vietnamese offshore fleet at approximately 20,000 vessels, and almost all of them are made of wood. Most vessels are equipped with second-hand truck engines. Among these, 6675 vessels are fitted with engines of 90 hp or above, but this is an unconfirmed estimate.

The boats are cheap to buy and operate, and 'allegedly' they are not registered anywhere. If countries catch them, it is up to those countries to decide what to do with them.

Countries that catch boats entering and fishing illegally in their waters have generally confiscated and burned them. They have even blown them up in spectacular fashion. Sinking, burning or blowing up a blue boat may provide spectacular images to the media and the rest of the world, but it does little to prevent large numbers of blue boats from continuing to illegally fish the world's oceans. The blue boats keep returning because losing a boat is simply not enough of a deterrent.

In any case, there are allegedly two agencies involved in monitoring, control and surveillance (MCS) in Vietnam's sea area:[5] Fisheries Inspection and the Vietnam Marine Police. The Vietnam Marine Police is the coast guard of Vietnam; it provides protection and assistance to local fishers when necessary (hence, it is not really a monitoring, control and surveillance function). Fisheries inspection falls under the management of the Directorate of Fisheries. It currently has 92 patrol boats, with only eight boats with engines between 500 to 600 hp that allow them to check vessels leaving the EEZ, which is not a sufficient number to cover the EEZ effectively.

For countries where the poaching takes place, there is a huge drain on local finances when these boats are caught, and a huge drain on the locals' livelihoods when they are not.

The illegal fishers forage the reefs effectively, poaching within the 12-mile zone, taking fish that the coastal populations use, without any form of control or management, which directly affects the livelihoods of Pacific Islanders in remote atolls. Inspections of cargo holds of the seized boats have shown beche-de-mer (sea cucumbers) and reef fish to be the main catch. Because of its very high value on Asian markets, beche-de-mer is probably poachers' main target – it is the catch that makes these ventures financially worthwhile.

Operationally, these illegal fishers are very difficult to catch, as they do not have vessel monitoring system (VMS) transponders, they are small vessels, and these are primarily made of wood, which makes them hard to detect on radar. Furthermore, most island countries do not have aeroplanes or the budget for the planes to go out and look for poachers, and the planes have limited range. The Forum Fisheries Agency (FFA), whose mandate is almost entirely focused on oceanic tunas, is analysing the use of a number of different forms of satellite surveillance technology, which, while they are very expensive, may be justified if they provide useful intelligence and data to FFA member countries about this illegal fishing activity. They have convened a working group with the most affected countries in order to figure out how to proceed.

[4] See: http://unep.ch/etb/areas/fisheries country projects/vietnam/final summary report vietnam.pdf
[5] See: https://www.wcpfc.int/system/files/PLI-VNM-03-%5BConsultancy-report-(Y3)-Vietnam-Tuna-Fishery-Profile-Nov2012%5D.pdf

Diplomatically, once a boat is caught and the crew arrested, the problem continues (or as an affected friend told me: 'This is when the real problem just starts!'). The vessels need to be secured somewhere (good wharf space is a scarce commodity in the Pacific), or stay anchored, with all the responsibilities that this entitles. Furthermore, there are usually no papers to be found: for example, there is usually no vessel or crew identification.

The crews generally do not speak English (or do not reveal it if they do), Vietnam has no diplomatic representation in any Pacific Island states (apart from in New Zealand and Australia), crews do not generally have visas, tickets or money to return home (and there are no direct flights), and flights back home probably require transits through the US or Australia (that are notoriously strict with visas). Therefore, crews and vessels are a burden and essentially are stranded, until someone, somewhere, does something (normally at the cost of the arresting country or the International Organisation for Migration).

As with other arrested vessels, in some cases the boats are scuppered inside an operational port, which becomes an even worse problem, since they block part of the port and become a pollution threat.

Some countries take swift action, either sinking them during pursuit (PNG recently), or burning them for discouragement purposes (Palau) and for media appeal. But the effectiveness of these measures in discouraging boats is limited.

The reality is that media campaigns are only likely to be effective for those people who have access to media. My experience of working in Vietnam is that a lot of these fishers come from very poor backgrounds and do not have access to media, so the messages conveyed through media rarely gets to them.

Unfortunately, there are no easy solutions. Ultimately, the issue is the flag state responsibility, so Vietnam is responsible for its boats that fish illegally in other waters. Ideally and according to established international rules, trade sanctions should be applied. Vietnam is a huge exporter of fisheries and aquaculture products; a tariff structure tied to flag state performance in controlling its illegal fleets (and compliance checks) should be put in place: If a country does not control its fleets, then its products should be subjected to higher tariffs until this issue is solved. Add to this a European Union 'yellow card' – which uses trade controls to incentivise countries to effectively combat illegal fishing – and perhaps Vietnam will take more action to address the various contributing factors originating within its jurisdiction.

French Navy seizing drums of salted sea cucumbers illegally caught in New Caledonia waters (image: French Armed Forces in New Caledonia – FANC).

A new chapter in aquaculture for Fiji

***Pacific Ocean Culture Pte Ltd 'pond to plate' story** – Pacific Ocean Culture Pte Ltd (POCPL)[1] is an integrated aquaculture company operating within the Central Region of Fiji that focuses on food security. POCPL's philosophy is to understand and manage the product from its source to the table, thus ensuring a positive impact on both the future of seafood and the quality of the food we eat.*

POCPL established its marine hatchery in 2015 and has been undergoing discussions and research with academics and community stakeholders regarding the current depleted state of their *qoliqoli* areas and how to work together to improve the status of these ecosystems, for the future of Fiji and its communities. Work in the hatchery has been in response to the needs highlighted in the community.

POCPL's initial focus has been on enhancing the restocking efforts of several species of sea cucumbers; efforts that were internationally recognised when POCPL was finalist of the FISH 2.0 Sustainable Seafood Competition in 2015. In March 2016, POCPL undertook a Memorandum of Understanding with a research academic studying the genetic make-up of sandfish (*Holothuria scabra*) to ensure that restocking programmes are implemented with the most current information regarding their habitat and potential for successful restocking practices. The academic's PhD involves the neutral and adaptive genetic diversity of wild and captive brood stock populations of the species to determine whether any genetic structure is found in the region. Recent technological advances have made it relatively easier to read the actual genetic make-up of an animal through the analysis of its DNA sequences and diversity, rather than relying on proxies and low-resolution measurements such as allozymes, mtDNA and micro satellites to calculate genetic diversity. Comparing the genetic similarities and differences between local groups of sandfish thereby determines how related the local populations are, and consequently how they can be managed or manipulated.

The stocking of sandfish brood stock has been undertaken using samples from Vatulele, Suva Harbour, Raki Raki and Kadavu in Fiji, as well as from Wallis and Futuna.

In 2016, POCPL also successfully launched a breeding programme for the black tiger prawn (*Penaeus monodon*) and the Kuruma prawn (*P. japonicus*). By utilising brood stock supplied by communities, POCPL produce is providing stock back to small-scale farmers for grow-out and ultimately supplying the market with this popular seafood item. Orders of 35,000–50,000 post larvae per farmer are typical. This process involves a direct supply of the juveniles to the farms and advising them on grow-out techniques. The volumes of juveniles produced to date are at around 1,500,000/cycle. In addition, POCPL has selected

Pacific Ocean Culture Pte Ltd hatchery.

two small-scale farms to mentor through this process and is supporting them through the production stages in both farm development and technical capability. Biosecurity limitations on importation highlight the need to grow and produce this product locally in order to capture this great market opportunity. This income generation stream, which is fuelled by market prices of FJD 40–65/kg, will improve both the livelihood and capability of the community farmers.

With plans to expand into the production of other marine species, the POCPL marine hatchery is set to provide aquaculture products for restocking *qoliqoli* and marine park areas, as well as contributing to the commercial production of certified products. POCPL is also currently monitoring Vatulele as the sample area to trial the project. In a world of depleting fish stocks and nutritional food security issues, POCPL aims to produce a premium organically farmed product and promotes 'Fiji Made' products both domestically and internationally.

Pacific Ocean Culture's 'pond to plate' story creates long-term employment for people in a wide range of skill levels, which is a key ingredient for Fiji's success as well as ensuring the consumer receives the highest standards on their dinner plate now and into the future.

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Evaluating the impacts of efforts to improve postharvest processing of sea cucumber in Fiji

Sailasa Tagica[1]

Sea cucumber fisheries are an important source of income for coastal communities in the Pacific. Sea cucumbers are a delicacy that is particularly sought after in South East Asia (Ram et al. 2014). Because of their medicinal properties they are considered 'high value for money'. Sale prices of beche-de-mer (dried sea cucumber) in the Pacific Islands usually range from USD 3–85 per kg, depending on the species, product size and quality of processing when sold by fishers to an exporter or processor (Kinch et al. 2008; Purcell et al. 2016a), while the sale price for raw sea cucumber is much lower. Poor processing of beche-de-mer results in spoilage of product, poor product quality for export and diminished sale prices for fishers in Fiji (Ram et al. 2014). A project funded by the Australian Centre for International Agricultural Research (ACIAR) to evaluate the impacts of efforts to improve the postharvest processing of sea cucumber was carried out in Fiji, Tonga and Kiribati. This paper describes the training that took place in Fiji.

Despite a history of over 200 years of fishing and trade, most village fishers in Fiji had no previous training or information on how to process sea cucumber in order to gain optimum economic returns (Purcell et al. 2016). In Fiji, sea cucumbers are an important export earner and a source of income generation for coastal communities involved in this trade (Ram et al. 2014; Purcell et al. in press).

In Fiji, the project on 'improving postharvest processing' began in Fiji in June 2013, with the support of the Ministry of Fisheries. In 2014, the project conducted baseline socio-economic surveys of fishers in eight locations across Fiji. Thirty-four villages from Bua, Cakaudrove, Taveuni, Ra, Kadavu, Vanua Balavu, the Yasawa group of islands and the Southern Lau Group were surveyed. A structured questionnaire was developed that focused on present sea cucumber fishing practices, and the income and livelihoods of sea cucumber fishers. The survey also considered the fishers' 'current methods of postharvest processing'.

Processing methods used by fishers were studied and described in an article published in issue 36 of the SPC *Beche-de-mer Information Bulletin* (Purcell et al. 2016a). At the same time, a comparison of fishing methods among locations was made, and the influence of gender and socio-economic factors on the different sea cucumber fisheries were examined (Purcell et al. 2016b).

After the socioeconomic surveys were completed, training workshops on postharvest processing for village fishers were conducted. The trainings demonstrated the best practice methods of collection, handling, storage and processing of sea cucumbers. The training emphasised the importance of proper handling and storage, such as gutting, cooking, salting, smoking and drying, which have an impact on the quality of the sea cucumbers.

A technical manual[2] designed to be used by (i-Taukei) communities, and a studio-made DVD[3] were produced by the project and provided to the fishers as part of the training. Both information sources explained and demonstrated all of the steps involved in processing different groups of sea cucumber species. More than 2000 training manuals were distributed to fishers in Fiji.

A fisher gutting a white teatfish during the training (image: Sailasa Tagica).

[1] Partners in Community Development Fiji, 8 Dennison Rd, Suva Fiji. Email:tagicasailasa@gmail.com
[2] http://aciar.gov.au/publication/cop026
[3] https://www.youtube.com/watch?v=9Wd18O1Rdgo&t=8s

Village fishers with their manuals after a workshop (image: Sailasa Tagica).

Conducting a follow-up survey (image: Sailasa Tagica).

A total of 353 fishers were trained during full-time workshops held in 24 villages in Fiji, and shorter training sessions were conducted in another five villages. Each location was revisited a year after the workshops. A follow-up socio-economic survey was delivered in each location to gauge the impacts of the project interventions. A key issue that was frequently raised by fishers during the follow-up surveys was that buyers were dictating the prices of sea cucumbers, whether dry or raw. Many fishers have requested the government's intervention through the Ministry of Fisheries to standardise and regulate the prices of each sea cucumber species. Some fishers, who have been harvesting sea cucumbers for many years reported a decline in sea cucumber stocks over time. The project baseline data found that the majority of fishers believed that the main reason for declining stocks in the sea cucumber fisheries is the increase in the number of fishers (Purcell et al. 2016b). It seems that coastal communities now tend to focus on sea cucumber as their main source of income since sea cucumber fishing is the fastest way to earn money when compared with agriculture or other fisheries.

Since the implementation of this project, we have seen positive changes in the way fishers are processing their sea cucumber. Fishers who have been following the methods taught during the workshops have reported higher returns from their sales. Several of the fishers interviewed are abiding by the recommendation to only harvest the larger sea cucumber, to enable the replenishment of stock. Hopefully, along with future management reforms planned by the Ministry of Fisheries, continued efforts to implement improved processing methods will contribute to a more sustainable sea cucumber fishery in Fiji.

The project videos and manual can be viewed and downloaded at:

- http://scu.edu.au/environment-science-engineering/index.php/125
- www.youtube.com/watch?v=9Wd18O1Rdgo&t=8s
- http://aciar.gov.au/publication/cop026

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Purcell S.W., Ngaluafe P., Foale S., Cocks N., Cullis B.R., Lalavanua W. In press. Multiple factors affect socio-economics and wellbeing of artisanal sea cucumber fishers. PLoS ONE.

Ram R., Chand R.V. and Southgate P.C. 2014. Effects of processing methods on the value of beche-de-mer from the Fiji Islands. Journal of Marine Science Research and Development 4(3). 7 p. doi:10.4172/2155-9910.1000152.

The history of SPC's involvement in fisheries development in the Pacific

Part 2: The 21st century

Lindsay Chapman[1]

Preamble

This is the second part of an article related to the Pacific Community's (SPC) involvement in fisheries development in the Pacific[2]*, focusing on the coastal fisheries sector. The first article described the first SPC fisheries-related activities in the early 1950s, which were followed by numerous projects that eventually led to the establishment of the now renowned Coastal and Oceanic Fisheries Programmes.*

More changes to the structure and focus of the Coastal Fisheries Programme evolved in the early 2000s in line with the changing needs of the Pacific Island countries and territories (PICTs). The Capture Section became the Fisheries Development Section in 2000 and then the Nearshore Fisheries Development section in 2005, while it was amalgamating with the Training Section. An Aquaculture section was established in 2002 for the first time, while the Fisheries Information Section remained the same. The biggest changes, though, were with Coastal Fisheries Science and Management, which split into separate science and management activities, respectively, from 2000 to 2009 (this included focusing on community-based management, which integrated women-in-fisheries-related activities, therefore replacing the Women's Fisheries Development Project). In 2009, they came back together as the Coastal Fisheries Science and Management Section as a result of specific funding for projects, while certain changes and structural issues were also factors.

The Marine Resources Division, which includes the Coastal Fisheries Programme, changed its name to the Fisheries, Aquaculture and Marine Ecosystems (FAME) Division in 2009, to better reflect the actual work undertaken by the division. In 2009, at the 6th Heads of Fisheries meeting in Noumea, the first Strategic Plan (2010–2013)[3] for the FAME Division was developed with input from the members, PICTs and donors. The second Strategic Plan (2013–2016)[4] evolved from the first, and at the next Heads of Fisheries meeting, a 'living document' was presented for discussion along with annual work plans that had been developed for agreement at this meeting. At the 9th Heads of Fisheries meeting in 2015, a review of this Strategic Plan was undertaken; however, given the corporate changes underway within SPC, such divisions would, in future, have 'Business Plans' under the one SPC Corporate Strategic Plan. It is envisioned that the first FAME Business Plan will go to the 10th Heads of Fisheries meeting that is scheduled for March 2017 for endorsement, along with the proposed work plans for the programmes for 2017–2018. All of these documents can be found on the SPC FAME website[5].

Nearshore Fisheries Development Section (NFDS)

During the early 2000s, the main focus remained on providing technical assistance with the developing of domestic tuna longline operations in many countries. Assistance was provided in fishing methodology, handling and preservation of the catch to meet export standards, as well as some fishing trials on new boat designs, such as the Samoan 'Super Alia', along with several vessels in Nauru and a vessel in Papua New Guinea (PNG). A series of studies were also undertaken in collaboration with the Forum Fisheries Agency (FFA) to assess the development options and constraints, including training needs and infrastructure requirements, within the tuna fishing industry and support services in 10 countries, with a focus on domestic development of longlining and small-scale fishing around fishing aggregating devices (FADs). In support of domestic tuna longlining development in PICTs, the NFDS produced a manual *Horizontal longline fishing methods and techniques: a manual for fishermen*[6] in 2003.

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[2] The first part of the article is available from: http://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/FishNews/150/FishNews150_52_Chapman.pdf
[3] http://www.spc.int/fame/doc/corporate_docs/FAME_StrategicPlan.pdf
[4] http://www.spc.int/DigitalLibrary/Doc/FAME/Corporate/FAME_Strategic_Plan_2013_2016.pdf
[5] http://www.spc.int/fame/
[6] http://www.spc.int/DigitalLibrary/Doc/FAME/Manuals/Beverly_03_HLL.pdf

To reduce fish aggregating device cost, the feasibility of setting mid- to shallow water FADs from small crafts was assessed – Solomon Islands, 2011 (image: William Sokimi).

FADs and FAD fishing skills continued to be a focal area for assistance, with regular requests for assistance. Research continued on FADs, and a study was undertaken in Niue, and in Rarotonga and Aitutaki in the Cook Islands, to trial different mooring designs for suitability, aiming for a minimum two-year lifespan for moored FADs. Additionally, a data collection system was implemented so a cost benefit analysis could be undertaken on the effectiveness of the FADs and the catch taken from around them, as opposed to other trolling on free schools or around the reef. Good results were obtained and presented in Fisheries Newsletters 112[7] and 113[8] in 2005. In regard to the FAD mooring designs trialled during this project, a publication *Manual on fish aggregating devices: low-cost moorings and programme management*[9], was produced in 2005.

There were two major small-scale tuna fishery development projects, the 'Development of tuna fisheries in the Pacific ACP[10] countries (DevFish – July 2005 to December 2009)' and the 'Development of tuna fisheries in the Pacific ACP countries Phase II (DevFish 2 – November 2010 to March 2016)'. Both projects were a collaboration, where the Forum Fisheries Agency (FFA) acted as the lead agency looking after the industrial tuna fishery, while SPC's focus was on small-scale operations. They also had the same objectives: to foster the expansion of domestic tuna fishing operations (catching and processing), encourage the participation of the private sector in tuna fishery development and management planning and policies through stronger fishing associations, and provide technical assistance in support of fishing associations and small-scale fishing operations. These projects were very successful and increased input to the development of tuna fisheries management plans and policies by the private sector at the national and regional levels.

From the late 2000s onward, assistance to domestic tuna longlining activities slowed; however, the assistance on FADs and FAD fishing, including sea safety, continued. The NFDS also started looking at other alternative fishing activities, such as fishing for small pelagic fish, sports-fishing and fishing for the large diamond-back squid. Diamond-back squid fishing trials were undertaken in New Caledonia, Cook Islands, Fiji and French Polynesia, with good catches, although now the issue will be finding suitable markets and developing management arrangements to avoid overfishing before the fishery becomes commercial. Fishing for small pelagic species by using an Indonesian 'bagan' fishing method (use of a lift net at night with light attraction) was undertaken in the Marshall Islands, Kavieng in PNG and Tarawa in Kiribati, with mixed results, but there is a growing regional interest for this fishing method that targets a short-lived, fast-growing resource.

[7] http://www.spc.int/coastfish/en/publications/bulletins/fisheries-newsletter/255-spc-fisheries-newsletter-112.html
[8] http://www.spc.int/coastfish/en/publications/bulletins/fisheries-newsletter/254-spc-fisheries-newsletter-113.html
[9] http://www.spc.int/DigitalLibrary/Doc/FAME/Manuals/Chapman_05_FAD_New.pdf
[10] African, Caribbean and Pacific Group of States (ACP). The Pacific ACP countries are : Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Solomon Islands, Samoa, Tonga, Tuvalu and Vanuatu

Good results were obtained for the sports-fishing trials, which have been undertaken in Niue, New Caledonia, Kavieng in PNG, Kiribati, Palau and Aitutaki in the Cook Islands. The Aitutaki work was most pleasing, as some of the main gillnet operators changed their activities to become fishing guides, which provided them with more income compared with their gillnetting operation. In addition to this, it has relieved fishing pressure on the bonefish resource, one of the main species targeted by sports-fishers. Furthermore, NFDS has continued its sea safety campaign, with the development of sea safety 'grab bags' that are waterproof bags containing a set of specific sea safety equipment including inflatable life jackets, a personal locator beacon (PLB) and a VHF radio. There is growing acceptance of these as fishers become more responsible for their own safety when fishing outside the reef.

NFDS also continued with the operation and organisation of training activities, including the long-running practical fishing module of the Nelson course which is now conducted annually at the Vanuatu Maritime College in Santo and combines practical training in sea safety, financial management and small-scale fishing methods. Other workshops were conducted both nationally and regionally, some specifically for women, such as running a small business or business skills and post-harvest technologies, FAD fishing skills workshops, and small boat operating workshops including sea safety measures. Several regional workshops were also conducted on FAD designs, which bring together researchers and technicians to assess the designs currently used. The most recent workshop was held in 2016.

Fisheries Information Section

The Fisheries Information Section produces the 'SPC Fisheries Newsletter', which has been instrumental in gathering and sharing fisheries information in the region since its inception in 1970. In 2000 a new format for the Fisheries Newsletter was launched, although the main categories of information remained similar and covers the activities undertaken by SPC fisheries staff, news from around the region, research results and other highlights of importance to the region. Issues 92 (January to March 2000) to 150 (May to August 2016) were produced at a rate of three to four issues per year. The Newsletter remains the face of the FAME Division, showcasing what is happening in the region in fisheries.

Getting the information all the way to the targeted audience can be a challenge. Hugh Govan, from the Locally-Managed Marine Area (LMMA) Network, carries samples of SPC's *Guide and information sheets for fishing communities* to Su'u village, Solomon Islands – 2015 (image: J. van der Ploeg, WorldFish).

The Section has also continued to produce the special interest group bulletins, which entails up to 10 topics and two issues per year, although this has dropped back to 5 topics as some were not as relevant anymore. The section has also produced a series of fish posters[11], with the first done in 2002 for Tonga. The posters differ from country to country, covering common reef fish, invertebrates and pelagic species. In support of this, over 400 fish paintings were commissioned to ensure a high-quality product for printing. The fish illustrations have been used for many other publications that are produced to facilitate marine species identification, which is an essential tool for fisheries management, such as the *Marine species identification manual for horizontal longline fishermen*[12] in 2006 and the *Fish species identification manual for deep-bottom snapper fishermen*[13] in 2008.

The Fisheries Information Section responds to specific requests from members for assistance with formatting and laying out different publications, such as fishery management plans, policies, information materials, posters and awareness raising materials.

The Section also does the formatting and layout for the FAME series of 'Policy Briefs'[14] on fisheries topics of importance to the region. A new activity undertaken in collaboration with NFDS was the development of educational materials that can be used in schools by teachers to highlight the importance of fisheries and the need for sustainable management of these resources in their lessons.[15] These include fact sheets on different species and different fisheries produced for the Cook Islands and Vanuatu.

An outstanding service that the Fisheries Information Section has provided for the region is the digitisation of materials and the development of the FAME 'Digital Library'.[16] This commenced in 2005 as a collaboration between the Fisheries Information Section, the SPC Library and the Coastal Fisheries Science and Management Section, where all documents were gathered – manuals, reports, etc. that had been produced by, for or in collaboration with SPC's fisheries programmes over the years – for scanning in order to make the materials searchable. It was a long process that has made all of these documents available to the public through the SPC FAME website. At present, FAME's Digital Library contains over 10,000 documents, and is updated regularly with the annual addition of 350–450 documents.

Aquaculture Section

SPC recruited its first Aquaculture Adviser in 2002, whose first task was the organising of an inaugural SPC aquaculture meeting 'Building capacity for aquaculture in the Pacific', in March 2002. The outcomes of the workshop formed part of the first Aquaculture Action Plan (2002) for implementing the new SPC Regional Aquaculture Programme. The objectives of the workshop were to benchmark the status of aquaculture in the SPC region; advance networking among aquaculturalists in the region and interested parties from outside the region; and select a shortlist of aquaculture commodities that would become the primary focus of SPC's work. Prior to this new initiative, SPC's involvement in aquaculture had been limited to a few small collaborations with other partners, but the time became right for SPC to become more engaged, as many PICTs were seeking assistance in this area.

During the first few years of operation, funding was gained to allow the Aquaculture Programme to expand, with two aquaculture officers – one for fresh-water aquaculture and the other for salt-water mariculture. Immediately, PICTs started to request technical assistance, which covered a range of aspects, from how to construct ponds for tilapia to growing seaweed, and how to grow fresh-water prawns or shrimp. A lot of the early work also was focused on the pearl industry, where French Polynesia and Cook Islands were well established, but other PICTs requested assistance to develop this industry for them, although some were not successful.

The Section moved from strength to strength with many activities promoting aquaculture, for example: a study tour of Fiji aquaculture, which included tilapia farms, fresh-water prawn farms, and the pearl industry in Savusavu; a feasibility study on the potential for farming fresh-water shrimp in PNG; a regional training workshop in tilapia and fresh-water shrimp aquaculture; a review of hatcheries, including new designs for specific commodities; a study tour of mud crab culture in the Philippines; the culture of corals for the aquarium trade; and regional meetings on seaweed and pearls. The section also participated in annual meetings of the Network of Aquaculture Centres Asia-Pacific (NACA), to gain experience from activities in Asia, where aquaculture is a major industry, and to provide other with some Pacific experiences.

[11] http://www.spc.int/coastfish/en/publications/posters/marine-species.html
[12] http://www.spc.int/coastfish/publications/341
[13] http://www.spc.int/coastfish/ publications/339
[14] http://www.spc.int/coastfish/en/publications/brochures/policy-briefs.html
[15] http://www.spc.int/coastfish/en/publications/brochures/kit-for-teachers.html
[16] http://www.spc.int/fame/en/publications/digital-library

Tamaroa, community farmer, releasing hatchery-produced juvenile sea cucumbers (sandfish) in sea pens for further grow-out – Abaiang, Kiribati, 2016 (image: Beero Tioti).

In 2006, the SPC Second Regional Aquaculture Meeting was convened in order to build on the work of the first meeting in 2002. As a result, the second SPC Aquaculture Action Plan 2007[17] was produced as a guide document for aquaculture development in the region, including SPC, and identified the main commodities with potential for cultivation in the region. There was growing interest in seaweed in countries like Fiji and Kiribati, especially in remote locations, as the processed commodity could be stored in a shed for months before marketing. Spat collection of various species that could be grown-out in aquaculture facilities also became an area of interest.

In 2010, the SPC Aquaculture Adviser compiled aquaculture statistics in the publication *A review of aquaculture in the Pacific Islands, 1998–2007: tracking a decade of progress through official and provisional statistics*[18], which clearly showed the main centres of activity for aquaculture, with volumes and values of commodities. French Polynesia's pearl industry was by far the most successful by value, while the prawn/shrimp aquaculture industry in New Caledonia was second value, and first in volume. The production of these two territories represented around 80 per cent in volume and 80–90 per cent in value of all PICTs' aquaculture production.

In more recent years, the production levels of French Polynesia and New Caledonia have declined for different reasons, while in other countries like Fiji, aquaculture production has increased, but with lower-value commodities. A major study was commissioned through SPC in 2012 titled 'Opportunities for the development of the Pacific Islands' mariculture sector'.[19] The findings of the report were that most of the mariculture and aquaculture in the Pacific in the past had been based on research rather than economic viability, with a lot of subsidies through the public sector, and recommended that future aquaculture ventures should be based on economically viable operations through private sector development.

The mariculture review was timely, as SPC had several aquaculture projects underway from 2010 to 2015, including the 'Fisheries and food security' project and the 'Increasing agricultural commodity trade' (IACT) project, which focus on economically viability aquaculture and provide assistance to the private sector. Both projects had

[17] http://www.spc.int/DigitalLibrary/Doc/FAME/Reports/Anon_07_SPC_Aquaculture_Action_Plan.pdf
[18] http://www.spc.int/DigitalLibrary/Doc/FAME/Reports/Ponia_10_AquacultureReview.pdf
[19] http://www.spc.int/DigitalLibrary/Doc/FAME/Reports/HambreyConsulting_12_MaricultureReport.pdf

positive results with encouraging advancements in private sector aquaculture in Fiji, PNG, Palau and Vanuatu. The mariculture production of sandfish, a sea cucumber species, has resulted in community-based grow-out of these in cages in Kiribati, and commercial production in ponds in New Caledonia. This is a high-value species, known as beche-de-mer in the processed form, and marketing trials will soon be undertaken. In late 2016, a new aquaculture project commenced, focussing on technical assistance, mainly to the private sector, for economically viable operations and also to provide support for aquatic biosecurity, for imported and exported marine products.

Coastal Fisheries Science and Management (CFSM) Section

As mentioned above, science and management were undertaken by separate groups in the early 2000s, mainly due to funding streams where management had ongoing funding, while science was on a project to project basis. In 2003, the *Strategic plan for fisheries management and sustainable coastal fisheries in PICTs* was endorsed by the Heads of Fisheries. This document provided the basis for SPC's community-based management activities in PICTs, through training and workshops, and focused on training fisheries officers via hands-on community consultations in order to develop community specific management plans. In 2007 and 2008, this strategic plan was reviewed through a series of consultations with the Heads of Fisheries, and a new guiding document or policy for the region was developed, the *Pacific Islands regional coastal fisheries management policy and strategic actions (2008–2013) – the Apia Policy*[20]. This again had a focus on community-based fisheries management using a holistic or 'ridge-to-reef' approach, which guided the work of the section during many in-country assignments.

Funding for a new coastal fisheries science project came online in late 2001, and the 'Pacific regional oceanic and coastal fisheries development programme – PROCFish/C' commenced in early 2002, covering eight Pacific ACP countries and the three French territories. Two years later the 'Pacific regional coastal fisheries development programme – CoFish' commenced as a complementary project to include the remaining six Pacific ACP countries. Both projects concluded at the end of 2009. These projects surveyed finfish and invertebrate resources, and habitat through underwater visual census methods as well as socio-economic surveys on community and household demographics, and fisher patterns at 63 sites across 17 PICTs. This was a massive undertaking and local fisheries staff members in all PICTs received training in all survey methods undertaken in their country. In many cases, the data obtained from this work provided the first assessment of the resources in these sites, and a baseline for future surveys and assessments, through the specific country reports and regional assessment.[21]

In 2010, the community-based management and science activities were amalgamated into a single section, and the science moved away from the pure assessment focus of the PROCFish/C and CoFish projects, to be more focused on answering management needs. In 2010, the 'Scientific support for the management of coastal and oceanic fisheries in the Pacific region – SciCOFish' project commenced, and ran until the end of 2015. The coastal component of this project was focused on answering management needs of the 14 Pacific ACP countries and Timor-Leste, and the main focus was on commercial invertebrate species – in particular, sea cucumbers (beche-de-mer). With an integrated science and management approach, project staff members trained their national counterparts in the survey methodologies to assess the resource in question, worked with them to undertake some surveys, and then left them to continue survey work with their new skills. Once adequate data was collected, two staff members were brought to Noumea to enter, clean, analyse and interpret the data, and then turn the results into management advice to be implemented back in their countries.

The approach was very successful with 10 Pacific ACPs using the standard monitoring protocols developed by the project, and a manual *Assessing tropical marine invertebrates – a manual for Pacific Island resource managers*[22] was produced in 2014. On the management side, a series of information sheets, brochures, posters and a *Guide and information sheets for fishing communities*[23] were produced with the Fisheries Information Section, so community-based fisheries management practitioners had the basic information needed to make informed decisions about their coastal resources and what they could do to manage them. This information was developed in collaboration with the Locally-Managed Marine Area (LMMA) Network, an NGO working across the Pacific promoting and assisting countries with community-based fisheries management.

There were two other significant science projects undertaken during this period. The development and management of the aquarium trade with several projects during 2002 to 2015, and a scientific monitoring project where pilot study sites set up in five countries around the region. The aquarium trade work covered sustainable harvesting, surveys to assess harvestable stocks and species, the promotion of best practices to minimise mortality at all stages from capture to marketing, and sustainable management

[20] http://www.spc.int/DigitalLibrary/Doc/FAME/Reports/Anon_2008_ApiaPolicy.pdf
[21] http://www.spc.int/coastfish/en/projects/procfish.html
[22] http://www.spc.int/DigitalLibrary/Doc/FAME/Manuals/Assessing_tropical_marine_invertebrates.pdf
[23] http://www.spc.int/coastfish/en/publications/brochures/kit-for-communities.html

The PROCFish project activities included hundreds of dives to assess finfish and invertebrate resources at 63 sites across 17 Pacific Island countries and territories – Yap, Federated States of Micronesia, 2009 (image: Kalo Pakoa).

of these wild capture activities. The scientific monitoring project ran from 2010 to 2014, in order to undertake standard surveys for finfish and invertebrate resources, habitats including photo coral quadrats, collecting water temperature data, and, in the second round of surveys, creel surveys to collect data on actual catches including biological data for age and growth, plus genetic work on particular species. The aim was to try to detect changes in the marine environment that could be directly attributed to climate change, as opposed to other factors such as pollution, siltation, over fishing, etc. Two surveys have been completed at each of the five pilot sites, with reports produced for each survey[24]. More surveys need to be undertaken over time to fulfil the overall aim of this project.

The Coastal Fisheries Programme produced two coastal fisheries status reports; one in in 2008[25] and the other in 2013[26]. These were based on the best scientific data available at the time. Unfortunately, there is insufficient data on coastal fisheries to allow for a comprehensive assessment. The results in both reports indicate that coastal resources in many PICTs are overfished, and that sound adaptive management is needed to maintain catches within sustainable limits. The sea cucumber resource is a key example, with gross overfishing across the region, which has resulted in moratoria being put in place in many countries in order to allow this resource to recover. Yet some people still fish sea cucumber illegally, so management measures seem ineffective and need to be strengthened.

In March 2015, SPC hosted a major workshop about community-based management, which brought together around 100 participants from fisheries departments and conservations departments from all PICTs, researchers, donors, regional organisations, NGOs and community practitioners of community-based management. The aim was to develop a way forward for coastal fisheries management, as the 'Apia Policy' had expired, and a new regional strategy was needed. The result of the workshop was the development of *A New Song for coastal fisheries – pathways to change: the Noumea Strategy*[27], as the guiding strategy for SPC and PICTs. The 'New Song' was endorsed by the Heads of Fisheries and the Ministerial Forum Fisheries Committee meeting in 2015.

In a parallel process, FFA and SPC have produced *A regional roadmap for sustainable Pacific fisheries*[28] in consultation with PICTs in 2015. This was a follow-up to the 'Future of fisheries study' undertaken in 2010. The roadmap better defines what is achievable over the next 10 years, with clear goals for both oceanic and coastal fisheries. Both sectors will provide annual 'report cards' to the Forum Leaders, with coastal fisheries 'report cards' produced in 2015 and 2016.[29]

[24] http://www.spc.int/coastfish/en/projects/climate-change.html
[25] http://www.spc.int/DigitalLibrary/Doc/FAME/Reports/Anon_08_FisheriesStatusReport.pdf
[26] http://www.spc.int/DigitalLibrary/Doc/FAME/Reports/Anon_13_Status_Report.pdf
[27] http://www.spc.int/DigitalLibrary/Doc/FAME/Reports/Anon_2015_New_song_for_coastal_fisheries.pdf
[28] http://www.spc.int/coastfish/en/publications/467
[29] http://www.spc.int/coastfish/index.php?option=com_content&Itemid=30&id=467

In late 2016, new funding allowed the CFSM Section to expand its areas of expertise into coastal fisheries and aquaculture legislation; monitoring, control, surveillance and enforcement (MCS&E), and policies and management plans. Legislation and MCS&E are new areas that focus on strengthening national and sub-national governance structures, and, where practical, in collaboration with partners, such as FFA and the New Zealand Ministry of Primary Industries. The CFSM Section is also continuing to strengthen scientific support to PICTs, and has just published an *Identification guide to the common coastal food fishes of the Pacific Islands region*[30] in support of more accurate data collection, mainly through fisher interviews, and market and creel surveys.

Concluding remarks

The development of coastal fisheries over the last 70 years has been one of evolution, taking on new technologies, in boats, outboard motors, fishing methods and equipment, and SPC has provided assistance over the decades. This evolution has been at different rates among PICTs, as each strives to meet its aspirations in support of economic development, food security and small-scale livelihoods. Even though concerns have been expressed in regard to overfishing in some countries or locations since the 1960s, the drive toward further development has continued, including the use of rural fishing centres where fish are caught and transported to the main urban centres for marketing.

When looking at the state of coastal fisheries in PICTs in 2016, it appears that the national focus continues to be on development, and many governments feel there is still scope to further develop coastal fisheries for economic development. Unfortunately, this is not the case, and there is a desperate need for PICT governments to move away from development aspirations in coastal fisheries, and focus more on sustainable management to preserve the remaining reef and lagoon fish, and invertebrate stocks so that they will continue to be productive in the future. Development should only be focused on pelagic species outside the reef or new stocks, such as diamond-back squid or small pelagic species, but only if management arrangements are put in place first to control development within sustainable limits. Aquaculture will continue to expand in some countries, and it will help to fill the growing demand for seafood products, but it cannot produce the amount needed over the next decade to meet the demands of a growing population.

A New Song for coastal fisheries – pathways to change: the Noumea Strategy and the *Regional roadmap for sustainable Pacific Fisheries* provide a direction for what is needed for PICTs to sustainably manage their coastal resources for future generations. SPC is committed to assisting the implementation of the 'New Song' and 'Regional Roadmap', as they were developed by PICTs for PICTs in 2015. They set a path of change that is needed if coastal resources are to be available to future generations of Pacific Islanders, so that they can enjoy the same level of fish consumption per capita as today and so that long-term food security can be achieved on a country by country basis.

In 2015, SPC commissioned the *Fisheries in the economies of Pacific Island countries and territories*[31] study, which was the third in a series of studies to assess progress in the fishing industry. This report has provided a new baseline of the value of fisheries to PICTs, both for measuring achievements and areas of improvement. It documents change in management of the Pacific tuna fishery, food security concerns for coastal fisheries in the face of growing populations, and the flow-on effects to PICTs' economies. The lack of up-to-date coastal fisheries data was an issue and the final result was a small increase in catch in the coastal fisheries sector, but a large increase in fishing pressure, which is a clear indication of overfishing, which needs to be managed.

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The author would like to acknowledge the input provided by SPC fisheries staff, past and present, the fisheries officers of the Pacific Island countries and territories and all others who provided written materials, which are hosted in the SPC Fisheries Digital Library[32], where most of the information in the 'story' has come from. Some of these writings date back to the early trip report of the first SPC Fisheries Officer in the mid-1950s, and a few general documents prior to this are from the late 1940s. Additional information was gleaned from the SPC publication *Meeting House of the Pacific – the story of SPC: 1947–2007*[33], many of the 150 issues of SPC's *Fisheries Newsletter*[34], and other regional reports from organisations, such as FAO and UNDP.

[30] http://www.spc.int/coastfish/en/publications/465
[31] http://www.spc.int/Coastfish/en/component/content/article/462-benefish-study-2016.html
[32] http://www.spc.int/fame/en/fame-digital-library
[33] http://www.spc.int/en/featured-publications.html
[34] http://www.spc.int/coastfish/en/publications/bulletins/fisheries-newsletter.html

A short history of the Skipjack Survey and Assessment Programme (SSAP) [Part 2]

Paul Judd[1]

Preamble

This is the second part of an article related to the Pacific Community's (SPC) Skipjack Survey and Assessment Programme (SSAP) [2]*, which ran from September 1977 to September 1981 and led to the establishment of one the most well-known and highly regarded programmes of SPC: the Oceanic Fisheries Programme.*

Obtaining the funding

From the very beginning of his formal search for funding Dr Kearney was, as detailed in Part 1 of this article, required to approach potential donors and ensure that that they had a clear understanding that the project would be totally separate from SPC's core budget. He would, therefore, have to demonstrate that this project was fundamentally different from the other SPC-proposed extra-budgetary projects, for which these potential donors continued to deny support.

In the early months of his fund-raising efforts Dr Kearney travelled to New York for meetings with Bill Ripley of the United Nations Development Programme (UNDP) (10 and 11 November 1975) and Dr John Pinot, Executive Officer of the Rockefeller Foundation together with the Foundation's Program Committee (14 November). The purpose of this latter meeting was to specifically seek a possible extension of the Rockefeller Foundation's initial seed-funding for the Skipjack Project; it was already clearly apparent that six months was not going to be adequate to raise the more than a million dollars a year that was necessary to fund the Skipjack Programme.

Following Dr Kearney's presentation to that meeting with the Rockefeller Foundation, Dr Pinot informed him that there remained a very high risk that he would not be able to raise the money necessary for the initiation of the full project. However, the Foundation remained extremely supportive of the concept and they regarded risk as something that needed to be managed, not avoided. To Dr Kearney's delight they agreed to extra funding, but on the condition that he accept and adhere to some advice.

As best Dr Kearney can remember 40+ years later, Dr Pinot stated:

> Raising money involves more than just having a good idea; you must convince donors personally that it is in their interests to support you and that idea. It is almost impossible to do this over the telephone. If you think it is truly important to talk to an individual in a key position, do not telephone them, *get on a plane and go meet with them in person.* To back up this advice the travel budget of three thousand five hundred dollars that you've asked for is being increased to fifteen thousand dollars. Spend it wisely. We trust you to do so but don't skimp on travel for a project like this. You're trying to raise a lot of money from at least six different governments and other possible sources; you are going to have to go and see a large number of people who are influential, some almost certainly more than once. If you don't spend the entire travel budget you can always give the remainder back to us.

In keeping with this advice, and the associated generous travel budget, Dr Kearney spent eight months of the next year away from home: travelling around the world meeting with key representatives of potential donors, and supporters of the project who might influence donor decisions.

Dr Kearney personally conducted all of the negotiations with the potential donor governments, with no official help from the SPC hierarchy. This unusual situation, coupled with the extremely strong support from the Pacific

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[2] The first part of the article is available from: http://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/FishNews/150/FishNews150_61_Judd.pdf

Island nations for the project, and subsequently its obvious success, contributed significantly to the high degree of donor solidarity that was displayed – once the project was up and running – towards both the project and Dr Kearney himself as Programme Co-ordinator.

As the search for funding gained momentum, the likely donors agreed that in order to meet the requirement of independence from the SPC core budget that it was not just the budget that needed to be independent from the SPC; the expenditure and accounting processes for the project would best be established as an entity that was totally separate from the rest of SPC's accounts. They committed to the principle that the project would be set up with Dr Kearney as the sole signatory and single authority for committing expenditure. As history shows, the donors maintained their commitment to this principle for the whole of the SSAP, and subsequently the Tuna Billfish and Assessment Programme (TBAP). Both remained totally separate from SPC's accounts until the end of 1986.

The independence of this management arrangement also made it easier for Japan to contribute as an equal. In addition, there was considerable support among both the potential donors and the Pacific Island nations for maintaining independence for the project, in the event that it would be beneficial to move it to a 'Regional Fisheries Organisation'; the creation of which was beginning to be formally discussed at the time under the umbrella of the Law of The Sea[3] negotiations.

It took almost a year to convince all of the likely donor governments that the scientific design of the project was indeed sound, and that the technical and logistical difficulties of working across a huge area of ocean and in many relatively remote areas for extended periods could be overcome. But once this was achieved Dr Kearney was given many indications that none of the six countries he was targeting – Australia, France, Japan, New Zealand, the United Kingdom and the United States of America, listed in alphabetical order – wanted to be left out if the project actually became a reality. But, in the absence of certainty that the others would commit, none was keen to 'stick their neck out'. Getting the first one to actually sign up was always going to be critical and difficult. According to Dr Kearney, New Zealand was the most enthusiastic of the potential donors. The NZ Director of Fisheries, Duncan Waugh, was particularly unwavering in stressing the urgency of the project; and he had strong support from within the NZ Ministry of Foreign Affairs. At that time the New Zealanders were the most aware of the tremendous, relative potential of tuna fisheries to the region, and the pivotal role fisheries would play in regional cooperation. The openness of New Zealand's enthusiasm was critically influential in maintaining momentum for achieving the necessary commitments. The Japanese were also openly keen to be involved in any major fisheries initiative in the region; they were after all the major fishing nation and furthermore, they knew changes to fishing rights and the associated political influence were coming, as major changes to the Law of the Sea were looming.

France was also very keen to have the project take form, and badly wanted it to do so within the SPC, but for very different reasons.

To quote Dr Kearney:

> The French of course at this stage were extremely supportive for political reasons, including that SPC was based in a French Territory and it was losing support; it quite clearly needed new impetus. Furthermore, as a result of opposition to French nuclear testing at Mururoa Atoll there was growing support from other Island States, even those who supported the SPC concept, to move the headquarters to a non-French country or territory. These tensions were important at the time for while they facilitated obtaining French support for the Programme they made it even more difficult to get other donors enthusiastic to fund a major new initiative based at the SPC in New Caledonia.

Alternative sponsor organisations and/or locations for the Programme were frequently raised, but Dr Kearney remained firm in his commitment to SPC. His defence relied heavily on the scientific benefit to the research of highly migratory tuna species and the provision of a full coverage of the research area afforded by the all-inclusive membership of SPC.

Sometime in late 1976 the seed-funding from International Center for Living Aquatic Resources Management (ICLARM) and the Rockefeller Foundation expired. Dr Kearney was forced to concentrate on finding funding to pay his own salary at SPC in order to be able to continue the quest for full funding for the project. SPC still could not help. He was able to obtain small amounts from various sources for extensions of his contract that were on several occasions as short as one week: clearly the lack of job security was less than comforting. He found raising small amounts of money to keep himself employed so that he could raise large amounts rather

[3] The United Nations Convention on the Law of the Sea (UNCLOS) is the international agreement that resulted from the third United Nations Conference on the Law of the Sea (UNCLOS III), which took place between 1973 and 1982. The Law of the Sea Convention defines the rights and responsibilities of nations with respect to their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources (source: Wikipedia).

irksome, and even harmful to the bigger cause. As he stated 'it is one thing to approach donors to fund a major project that will benefit all Pacific Island states and benefit science generally; it is another to ask them to give you money to put in your own pocket'.

In May 1977 New Zealand confirmed its leadership by being the first donor to actually sign a commitment to funding for the project. Within three weeks the catalytic nature of this action was endorsed when four of the other five donors also signed. The remaining one gave an extremely strong verbal re-affirmation that it would not be left out, but apologised because final approval would still take a few weeks. Work could finally commence on the project. By 1 June 1977 a revised, detailed budget, together with a timetable for implementation of the Programme, had been prepared. Duty statements were being finalised, and indicative quotes had been obtained for a suitable vessel to charter for the tagging cruises.

New Zealand's Prime Minister (from 1975 to 1984), Robert Muldoon, being presented with an SPC-SSAP t-shirt by SPC's Secretary-General (from 1979 to 1982), Vivian Young (image: SPC archives).

The commencement of research activities

The Japanese Fisheries Agency proposed the charter of the *Hatsutori Maru* No 1; a commercial vessel of 192 GRT owned by Hokuku Marine Products Co. Ltd that had proven its appropriateness for working in the survey area (it had spent two years in Papua New Guinea, and was working in Fiji at the time). It was a relatively old vessel, but as a purpose-built pole and line boat it was more than adequate for the task. Plus, its choice greatly reduced the tension for Dr Kearney in relation to vessel selection, insurance and management (the dominant item in the Programme's budget), as it came with the expressed endorsement of one of the donor governments, Japan. Dr Kearney went to Fiji in mid-June 1977 to inspect it, and then to Japan for a week to negotiate the charter agreement, on his own, with the owners. The terms and conditions were agreed on during that week in Japan and the final agreement was signed at SPC on 23 August 1977, and then by Hokuku Marine Products Co. Ltd on 1 September 1977.

However, work still remained to outfit the boat to meet the requirements of the project. In August 1977 three people joined the project as staff members: Carol Moulin was assigned as secretary to the project by SPC, with her salary paid from the SPC regular budget; Tony Lewis was appointed for three months, and Robert (Bob) Gillett was the first 'permanent' staff member hired by the project from its own budget. No sooner had Tony Lewis joined the Programme than he departed for Japan (on 30 August) to organise the purchase of the majority of the necessary scientific and research equipment prior to the vessel's departure for Papua New Guinea (PNG), where the first tagging cruise would begin. He also provided critical oversight of the modifications to the vessel that had been negotiated in the charter agreement. These changes included modification of bait tanks and the scientists' cabin (a proxy for a laboratory), including extra room to extend the bunks (which needed to be long enough to accommodate scientists who were tall), and a myriad of other details that were anticipated, and quite a few that were not. This was all part of the vessel's conversion to a research platform, and its preparation for departure on a ten-month continuous period at sea.

Jean-Pierre (J-P) Hallier – who had been working in the New Hebrides (Vanuatu) – was hired in mid-September 1977. The initial tagging cruise for the Skipjack Programme – which included training for staff members; most of whom were new to tuna research, including tagging – took place in PNG waters. This cruise was under the direction of Dr Kearney. Tony Lewis also played a major role in helping to train other staff members and establishing the protocols, techniques and processes, largely transferred from the earlier PNG research project, that were the basis of what were subsequently confirmed to be very robust data capture procedures. Other SPC staff on-board this first cruise included both Bob Gillett and Jean-Pierre Hallier.

The *Hatsutori Maru* commenced fishing on 6 October 1977. In the first week, only 11 skipjack were tagged. It was a most inauspicious beginning, and totally unexpected, given that these were very well-known waters for both Dr Kearney and Tony Lewis, in which they had already tagged thousands of fish. Catch returns from PNG-based commercial tuna boats subsequently confirmed that this was an extremely poor month for skipjack

fishing throughout PNG, but this did little to ease the considerable apprehension at the time of the senior staff members, particularly Dr Kearney: the basic design of the Programme required successful tagging across a huge region comprising the individual waters of more than 20 countries or territories, most of which had had no previous skipjack or baitfish surveys. The limited information that was available strongly suggested that the skipjack and baitfish fishing in PNG would be better than most, if not all (a fundamental reason for PNG's selection as the site for the first cruise). If good quantities of skipjack could not be tagged in PNG then the chances in the more remote areas were not good: the whole Programme could be in serious trouble. However, by the time the boat left PNG waters some three weeks later a total of 918 fish had been tagged, and even more importantly, catch rates were increasing quickly. Optimism was returning.

During the months that followed, very successful survey and tagging operations took place in the Solomon Islands, Vanuatu (still called the New Hebrides at that time), New Caledonia, Fiji, Tonga, Wallis and Futuna, American Samoa and Western Samoa (now Samoa), Tuvalu, and Kiribati (still the Gilbert Islands at that time). In mid-July 1978 the boat moved west to what was still the 'Trust Territory of the Pacific Islands' – an area that now takes in Federated States of Micronesia (FSM), the Marshall Islands, Northern Marianas and Palau. Then on 15 August 1978 the *Hatsutori Maru* returned to Japan for a complete refit prior to the commencement of the second main charter period, which was less than two months later, in October.

During the first year of tagging operations the SPC staff members who were involved in helping with the tagging operations on board the boat expanded considerably, with Bob Gillett and Jean-Pierre Hallier functioning as alternating cruise leaders. They were assisted at various times by a considerable number of full-time and part-time scientific staff members, including Christopher Thomas, Lionel Haeffner, Richard Kinney, Desmond Whyman, Charlie Ellway, Jim Ianelli and Pierre Kleiber (the first Senior Fisheries Analyst for the project).

During the first ten months of the project a total of 50,291 fish had been tagged – half of the original goal for the whole three years of the Programme. Therefore, despite a slow beginning and less than ideal initial geographic distribution of tag releases the project was off to a very good start indeed.

During the second year of the project (October 1978 to August 1979) the SSAP staff members continued tagging operations in the following areas: the 'Trust Territory of the Pacific Islands', Kiribati, Tokelau, the Cook

The crew of the *Hatsutori Maru* No 1 – Cairns, Australia, May 1979 (image: SPC archives).

A tagging cruise on the *Hatsutori Maru* could involve days of hard work in perfect weather, as here in the Cook Islands, where the crew fished for live milkfish to be used as baitfish...

... and very rough days out in the open ocean (images: Charlie Ellway and Bob Gillett).

Islands, French Polynesia, New Zealand, eastern Australia, and Papua New Guinea. Additional staff members who assisted with the tagging operations during the second year included Alexander 'Sandy' Argue (hired as a second Senior Analyst), and Lewis (Sam) Bledsoe. While in NZ waters in February 1979 a TV crew from Television One in NZ joined the boat for a few days, to film an episode that was screened on 'Country Calendar'.

During the third year of the project (October 1979 to August 1980) the Programme staff members tagged in the following areas: The Trust Territory of the Pacific Islands

(now FSM, the Marshall Islands and Palau), Kiribati, the Cook Islands, French Polynesia, Pitcairn Islands, American Samoa, Western Samoa (now Samoa), Niue, Tonga, New Zealand, Norfolk Island, New Caledonia, Fiji, Wallis and Futuna, the Solomon Islands, Tuvalu, Kiribati and Nauru. While in the waters of French Polynesia two scientists from the Inter-American Tropical Tuna Commission (IATTC) joined the boat for nearly two months – Dr William (Bill) Bayliff and Terry Foreman. The Director of IATTC, Dr Jim Joseph, also spent six days on board in mid-January – accompanied by Dr Kearney. However, the same SPC scientists who had already proven their worth in years one and two continued to share the workload of the cruises in year three, assisted at various times by Fishery Officers from the many countries in whose waters the boat was fishing.

The last day of actual tagging took place on 20 August 1980, after which the *Hatsutori Maru* No 5 (which had replaced the slightly smaller *Hatsutori Maru* No 1 for the later cruises) headed north to Japan, having very successfully completed its mission. The total number of tuna tagged, which was 160,276, had exceeded the Programme's goals by more than fifty per cent. Every country and territory in the SPC region had been covered in the survey cruises. Even the most optimistic participants in, and observers of, the Programme were extremely pleased.

The long-awaited arrival of the computer in March 1979, under the supervision of Sam Bledsoe (in front on the right) (image: Sandy Argue).

SPC's first computer

Once tagging had begun the necessity to computerise the data being collected was quickly confirmed. During his time in PNG with the Department of Agriculture, Stock and Fisheries (DSAF) Dr Kearney has been provided with excellent service by the government computer centre. He assumed, therefore, that it would be perfectly feasible to use the New Caledonian government computer for the needs of the Skipjack Programme.

The IBM 370/125 Computer in question belonged to the local government's SMAI (Service des Méthodes Administratives et de l'Informatique – the Service for Administrative Methods and Computerisation), which, at the time, was situated behind the radio and TV station (RFO) at Mt Coffyn. While this computer was available, at a cost, it was known that the Skipjack Programme would need its own specialist programmes and programmer to facilitate the necessary analyses. Dr Kearney sought advice on who would be appropriate for this task from the same agencies he had successfully consulted in the formative days of the PNG tuna research programme, CSIRO and the IATTC. Dr Jim Joseph, the Director and Dr Bill Bayliff, a senior scientist with the IATTC, both of whom were strong advocates for the Programme, proposed an IT expert from San Diego, Al Collins.

As detailed in the 1977 annual report for the Programme:

> A consultant, Mr G.A. Collins, was employed from 23 November 1977 to 5 January 1978 to assist with the determination of processing procedures appropriate for the data collected and the computer facilities available, and to write or modify the necessary programme to a format acceptable on the IBM 370/125 Computer in Noumea. By kind favour of the Inter-American Tropical Tuna Commission a library of population dynamics and statistical programmes suitable for tuna, and general fisheries research purposes (see Appendix 3) was made available to the South Pacific Commission. These programmes were all converted, where necessary, and incorporated into the Skipjack Programme's library of programmes for immediate use in Noumea.

When Dr Pierre Kleiber was hired in late May 1978 as the Senior Fisheries Scientist the cooperative arrangement with the local computer centre was working, and a database was slowly being generated. However, Pierre very quickly determined that this arrangement was too cumbersome; if the Skipjack Programme was to become the centre of scientific excellence in tuna research that was necessary to meet its accepted objectives, it must have its own computer. He managed to convince Bob Kearney

Veronica Van Kouwen, Research Assistant, entering data, May 1979 (image: SPC).

of this. Al Collins was one of two consultants hired to examine options. There were not many at that time, but they included a Hewlett Packard HP-1000 mainframe computer.

Not only did the donor governments need to be convinced of the need for considerable unbudgeted expenditure, but the actual buying of a computer proved extremely difficult. Computer companies were reluctant to allow their products to be used in a place where they could not guarantee servicing, and New Caledonia was considered at that time to be 'remote'. Several possible suppliers in the USA and Australia simply refused to sell. It required Drs Kearney and Kleiber to travel to Melbourne to personally convince Hewlett Packard (Australia) to sell them one. As part of the contract of sale they had to agree to air-condition the dust-free room in which it would be located, and to install an appropriately buffered and isolated power supply.

To quote Dr Kearney:

> Fortunately, the donors were completely behind me; we had convinced them of the quality of our science and the need to keep it at the highest international standard. But the computer would require considerable 'mothering', and it did cost a hundred thousand dollars, which was a huge amount of money in those days… I signed a cheque for sixty thousand dollars for a forty-megabyte hard drive – megabyte!

That first hard drive was bigger than a washing machine, and almost as noisy!

The computer eventually arrived in March 1979 and was installed at SPC. It generated a lot of interest in Noumea. The first person hired to run the computer was Sam Bledsoe, who came from the University of Washington in Seattle. During the six months that Sam worked for the Programme the computer had one major breakdown; Sam was able to diagnose the cause as a failure in the main circuit board. Sam was sent off to Sydney to bring back the necessary replacement board. This was only possible because of a wonderful demonstration of donor solidarity for the Programme: Sam's US passport had expired the week before and he had not yet obtained a replacement. With support from the highest levels of both the French and the Australian authorities Sam was able to fly to Sydney that day, pick up a board that had been couriered up from Melbourne, and hand-carry it back the very next day – all without a valid passport!

Having a computer at SPC made a huge difference to the treatment of the tagging and related tuna catch data that were being accumulated.

Dr Kearney said:

> Pierre Kleiber and Sandy Argue did a fantastic job with the data capture and manipulation, and determination of its real value, its limitations and how best to use it. You know, we had some big conceptual challenges. The biggest reservation I had had with the project right from the start related to a fundamental principle of fisheries resource dynamics and assessment. If we were going to get a good estimate of the population of skipjack in all of the Western Pacific, we really had to have the tags sufficiently uniformly and evenly distributed across the whole area of what we thought was the distribution of the skipjack population we were trying to assess. And I knew that getting uniform distribution was going to be the bugbear.
>
> When we went out to places like parts of French Polynesia, or Pitcairn and other small islands where there was no bait, or not enough bait, even if there was plenty of skipjack it was going to be extremely difficult to tag enough skipjack to meet our requirements for sufficiently uniform distribution of tag releases. Pierre's wonderful programming and analyses enabled all of us to see graphically the progress we were making in addressing this problem. One of his outputs was to overlay the map of the SPC region with circles drawn in each area we tagged: the diameter of the circles was proportional to the number of releases. It made it immediately obvious where the problems remained.

The Programme's annual report for 1979 stated the following:

> The installation of the Programme's computer in April 1979 not only facilitated data processing but also, because of its printing and graphics capabilities, made it possible to generate results in a format more suitable for publication and distribution. Much of 1979 was spent entering the data accumulated during 1977, 1978 and 1979, but towards the end of the year, in-depth analysis of the results had commenced.

The annual report for 1980 stated that:

> During 1980 there were very few modifications to fishing or sampling procedures, but major changes were made in data collection and processing procedures. New techniques for storing, sorting and accessing tagging, sightings, biological and baitfish data were implemented… A major achievement in the Programme's methods of computer analysis involved development of software for graphical display of Programme results in formats suitable for inclusion in reports and for direct distribution to the Fisheries Officers throughout the region… Programme staff also devised intricate security systems for preventing the accidental, or deliberate, corruption of data files held on the Programme's computer. This system included the automatic daily creation of magnetic tape copies of the contents of all computer files to prevent the loss of valuable Programme data due to any accidental causes. A system of storage of these copies at a location outside the Commission [NB: the Australian Consulate-General] prevents the loss of data in the event of a fire or other serious damage to the computer system.

The efficiency of the computer systems put in place by the SSAP staff was summed up by Dr John Sibert. He was recruited to the programme as a Senior Scientist in August 1982, from the Pacific Biological Station of the Department of Fisheries and Oceans (DFO) – one of the premier fishery research laboratories in Canada.

To quote Dr Sibert:

> We (at DFO) had just gotten ourselves a brand new VAX computer, model something or other. We'd finally gotten rid of all our punch cards and… I was now giving up this development to go down to Noumea! I expected some sort of diesel computer; maybe it would be powered by coconut oil? I had no idea… And what I found was actually the way that Pierre and everybody else had set up that HP1000 it was easier to use than the VAX, and no slower. I was astonished. I immediately set to work on stuff that I wouldn't have dreamed of doing any other place.

The Programme's outputs and some of its outcomes

Over the two years following the research cruises, as tag returns continued to be accumulated and analysed, the Programme's performance against its original goals was assessed. The three primary objectives of the Skipjack Programme had been established to: (a) provide a better understanding of the migrations and stock structure of tuna as a basis for determining the interactions between current and potential new fisheries; (b) provide survey information on the distribution and abundance of skipjack and baitfish in each country and territory; and (c) provide improved knowledge of key population parameters (growth, mortality, genetic structure, reproduction, etc.) as a basis for assessment of the magnitude and status of total stocks, including those in the waters of individual coastal states, and the impacts of fishing in them.

The concluding summary of the Skipjack Programme (July 1983) was able to confirm that all of these rather grand objectives for the Programme had been met. Furthermore, collectively the results enabled an assessment of the total skipjack stocks of the whole SPC region and greatly facilitated an estimation of resources beyond these boundaries; objectives that were considered aspirational at the time the Programme commenced. From an administrative perspective it is significant that all research schedules, including the production of preliminary and final reports for each of the countries and territories of the SPC, were met and total expenditure, including for the originally unbudgeted computer, was safely within the budget approved at the commencement of the Programme. The subsequent creation and funding of the Tuna and Billfish Assessment Programme, coupled with the ongoing success of SPC's Oceanic Fisheries Programme, provide testimony to the quality of the scientific and administrative foundations established by the Skipjack Programme.

When the search for funding for the Skipjack Programme commenced in 1975 extremely little was known of the tuna resources in the SPC region, countries had not declared their Exclusive Economic Zones (EEZs), and no regional arrangements were in place for the research and management of offshore and shared resources. There is no doubt that the Programme catalysed developments to much effect in all of these areas, to the considerable benefit of the member countries and territories of the SPC.

The first ever attempt to map out the future EEZs of SPC member countries and territories was done by hand, with a compass, by Bob Gillett in the late-1970s'. This map is still in the OFP offices today.

It also initiated fundamental changes as to how major projects were funded at SPC. In 1975, SPC's Secretary General and Executive publicly expressed their deep concern over the funding for the Commission, and therefore for its future. Pressure from emerging regional institutions was diminishing the perception of the relevance of the Commission. By 1980, extra-budgetary funding was accepted to have a vital role in the Commission's future, and total funding had greatly increased: the Commission was emerging again as the primary driver of regional cooperation. There can be little doubt that the Skipjack Survey and Assessment Programme was a primary catalyst for these developments.

In conclusion

An extremely relevant, independent summary of the initial impact of the Programme was provided by the Rockefeller Foundation, when in late 1980, in reviewing the use of the seed money that they had provided in 1975, it made the following evaluation:

> This grant can serve as the epitome of how a seed grant should work. It provided one year's support in 1975 which enabled the South Pacific Commission, in collaboration with ICLARM, to hire Dr Robert Kearney, to design and initiate an assessment program for improved management of skipjack tuna, one of the South Pacific's largest food resources.

By 1979, the Skipjack Survey and Assessment Programme had grown under Robert Kearney as Coordinator, to have an annual budget of over $1,100,000 with six developed countries providing a majority of the support. It is expected to continue operations at approximately this same level.

The project has generated considerable information concerning skipjack tuna and its population distribution – nine reports published in 1979 alone. This has been of direct value in expanding exploitation and improving management of the resource. It has also saved the expenditure of funds and effort that would have been expended in trying to extend the fishery in portions of the South Pacific where the concentrations of fish are not sufficient.

The Program is allowing the island countries of the South Pacific to move towards maximum economic yield from skipjack tuna, while simultaneously ensuring that the resource is not depleted. In short, a small RF grant provided the start-up funding for a highly successful and much larger research program which in turn is making a significant contribution to the more effective management of an important component of the South Pacific's food resources.

> It might be noted that had this grant been evaluated shortly following its termination in May 1976, few if any of the above comments concerning its success could have been made. Seed grants need time to grow. [Rockefeller Foundation, September 29, 1980]

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The *Hatsutori Maru* No 1 with the SPC flag flying as it leaves Brisbane on 25 April 1979, heading north (image: Charlie Ellway).

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